

TENDER DOCUMENT

RM of Rockwood

Wastewater Trash Removal Building

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Stony Mountain Institution Wastewater Trash Removal Building – Draft Commissioning Forms

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CIVIL

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DIVISION 1

GENERAL

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SECTION 1 General

1.1 DEFINITIONS

- .1 Abandon: The removal from service, dismantling, and disposal of item in a manner acceptable to the Departmental Representative if disposal is on the Departmental Representative's property. Material from abandoning to become the property of the Contractor unless specifically indicated otherwise, Contractor remains responsible for disposal.
- .2 Approved: To give limited, conditional or qualified permission to use material, equipment or methods. Any approval is only for review of the general conformance with the design concept of the project and with general compliance with the information given in the contract documents and does not relieve the Contractor from compliance with all requirements of the Contract.
- .3 Borrow Material: Material obtained from areas outside of immediate construction area and required for construction of embankments or for other portions of work.
- .4 Dike/Embankment: The natural material derived from usable excavation and placed above original ground or stripped surface.
- .5 Furnish or Provide: To supply, install and connect up all works as required to construct or make the system complete with all related accessories necessary or required for safe and regular operation or as indicated in the documents.
- .6 Indicated or Noted or Shown or Detailed: As indicated or shown on the plans or drawings.
- .7 Install: To erect, mount and connect up complete with all related accessories necessary or required for safe and regular operation.
- .8 Most recent version: Where sections of this specification make reference to the "most recent version" of a particular standard or code, they shall mean the most recent version available at the time of the bid close.
- .9 Similar or Equal: To possess the same performance qualities and characteristics, and fulfill the utilitarian function without any decrease in quality, durability or longevity. There is no implication that items must be identical in all aspects if above conditions are satisfied.
- .10 Singular or Masculine: Whenever the singular or masculine is used herein, it shall be construed as if the plural or the feminine or the neuter, as the case may be, had been used, where the context or the party or parties hereto so require, and this agreement shall be construed as if the grammatical and terminological changes thereby rendered necessary had been made
- .11 Standard of Acceptance: That item named and specified meets specification in all respects regarding performance, quality of material and workmanship and is acceptable to the Departmental Representative. Material proposed shall meet same standards.
- .12 Sub base: That layer of granular material between the sub-grade and base course commonly referred to as "C" Base.
- .13 Sub-grade Elevation: Elevation immediately below roadway structure.
- .14 Subsoil: That material immediately underlying the topsoil.
- .15 Suitable material: Material that is suitable to use in the work to construct dikes/embankments.
- .16 Supply: To purchase, procure, acquire, deliver complete with all related accessories necessary or required.

- .17 Waste: Material unsuitable for embankment or material surplus to requirements to be disposed of as waste outside limits of work.

1.2 DESCRIPTION OF WORK

- .1 The Work, as shown on plans or drawings or as specified including but not limited to:
 - .1 Supply and installation of all products, materials, structures, renovations, accessories and services necessary for and incidental to the completion of all work shown on the Plans or drawings and specified within the specifications.
 - .2 The work generally includes:
 - .1 Wastewater Trash Removal Building, consisting of:
 - .1 The wastewater will pass through a grinder and fine screen housed in a block wall building. The building will be equipped with a genset to provide standby power.
 - .2 The existing wastewater sewer will be directed to the new building.
 - .3 Six months after successful commissioning of the Wastewater Trash Collection Building, the existing trash screen chamber and associated gravity sewer piping will be removed.
 - .3 The Contractor is responsible for all work whether clearly indicated or referred unless otherwise specified.

SECTION 2 Examination of Work and Site

2.1 SUBSURFACE CONDITIONS AND SOILS INVESTIGATIONS

- .1 The following soil investigation report has been used by the Departmental Representative in Design and preparation of Contract Documents:
 - .1 A geotechnical investigation titled Geotechnical Report – SMI Sewer Trash Removal System – Stony Mountain Penitentiary, Manitoba was completed by Wood Environment & Infrastructure Solutions in August of 2018. The report is listed in Appendix A. The following disclaimer from the report applies:
 - .1 As to report from others: The report by others is for the Contractor's review, consideration and interpretation. The Departmental Representative have not reviewed the report as to its contents, accuracy or reliability hence will not accept any responsibility for content and will not accept any claims advanced related to any information contained in the report.
 - .2 The geotechnical report(s) and information provided and any statements therein including closure or liability statements are made in the context of the report(s)' purpose being primarily to assist in the design of the project and as such is written for the use of the Departmental Representative. Geotechnical information provided to the Contractor is for informational purposes only. The Departmental Representative is not accepting any responsibility for any claims or extras as a result of the Contractor's interpretation.
 - .3 The Contractor shall not rely upon or make any claim against Departmental Representative with respect to the completeness of such information, reports and drawings, including, but not limited to:

- .1 Any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed to complete the work, and safety precautions and programs incident thereto or;
- .2 Other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings or;
- .3 Any interpretation of or conclusion drawn from any "technical data or calculations" or any such other data, interpretations, opinions, or information.
- .4 It is the Contractor's obligation, prior to bidding, to satisfy himself about the nature of the site and the subsurface conditions and the related risk including determination relating to subsurface conditions. To assess the site and subsurface conditions the Contractor shall complete his own investigations, interpretations or judgments of soils and conditions furthermore the Contractor is solely responsible for all assumptions, deductions, or conclusions which he may make from his examination of this information. Prior to bidding, the Contractor may conduct subsurface investigations, provided written approval from the Departmental Representative is received in advance of site works, and provided the site is restored to original condition following the works. The Contractor shall pay all costs for onsite review and examination associated with assessing risk for the purposes of preparing bid.
- .5 The Departmental Representative will not be completing test holes during the tendering period. Where the Contractor suggests a substantial difference between the information relating to soil and/or sub-surface conditions at the work site and those contained in the Plans and Specifications or other documents supplied to the Contractor, promptly notify the Departmental Representative in writing within 10 days after first observation of the condition. Notice shall include (a) a sufficient description of the facts and circumstances of the occurrence to enable the Departmental Representative's assessment (b) provide clear methods and procedures to be utilized to track and justify a possible extra work claim. If the Contractor fails to give a notice referred to within the times stipulated, and with the information stipulated, an extra payment shall not be considered in respect of the occurrence.

2.2 EXISTING WORKS

- .1 Although the Plans may show the location of existing surface and underground works and services, the Departmental Representative does not assume responsibility for discrepancies between the Plans and the actual locations of the works and services. Make all requests directly to each utility for the location of their existing works prior to the start of construction in the area. If there are any conflicts with the proposed work the Contractor shall notify the Departmental Representative and provide sufficient time if necessary for the Departmental Representative to revise the plans accordingly. If any underground structure is discovered during the course of construction that is in conflict with the proposed work and this underground structure was not identified completely by the respective utility and if the required works are substantial the Departmental Representative shall determine whether the work performed is to be considered extra work. The Contractor shall repair at his own expense any and all damage to such facilities resulting from his operations.
- .2 Prior to the commencement of construction, inspect the site and examine all available records and contact all relevant utilities as necessary to determine the location of all existing surface and underground works. Locations of underground structures if shown

are based on the best information available. No guarantee is given that all existing locations are exact.

- .3 Be responsible for and take all necessary precautions to preserve and protect all public utilities (i.e. telephone lines and cables, hydro lines and cables, Teraspan lines, gas lines, sewer mains and services, water mains and services, etc.) existing drains, culverts, tile drains, and surface drains or parts thereof which may be affected by his operations and which, in the opinion of the Departmental Representative, may be continued in use without change. Prior to construction, contact each respective utility company to verify the regulations for construction near the utility and comply accordingly.
- .4 Make all requests directly to each utility for the location of their existing works prior to the start of construction in the area. If there are any conflicts with the proposed work the Contractor shall notify the Departmental Representative and provide sufficient time if necessary for the Departmental Representative to revise the plans accordingly. If any underground structure is discovered during the course of construction that is in conflict with the proposed work and this underground structure was not identified completely by the respective utility and if the required works are substantial the Departmental Representative shall determine whether the work performed is to be considered extra work. The Contractor shall repair at his own expense any and all damage to such facilities resulting from his operations.

SECTION 3 Documents

3.1 DOCUMENTS

- .1 The Contractor will be provided with 10 sets of plans (11 x 17) and specifications upon contract award. Three full size (22 x 34) set of plans will also be provided.
- .2 Be responsible for reproduction costs of any additional requested sets.
- .3 Maintain at job site, one copy each of following:
 - .1 Contract plans or drawings.
 - .2 Specifications.
 - .3 Addendums and amendments.
 - .4 Reviewed shop plans or drawings, product data and samples.
 - .5 Change orders.
 - .6 Other modifications to Contract.
 - .7 Copy of approved work schedule.
 - .8 Manufacturer's installation and application instructions.
- .4 All Drawings, Specifications, models, and other information furnished by the Departmental Representative shall be used only with respect to the Work, shall not be used on other work, shall not be copied or revised in any manner, and shall be returned to the Departmental Representative, on request, at the completion of the Work. Any models furnished by the Contractor or the Departmental Representative are the property of the Departmental Representative.

3.2 DRAWINGS, PLANS, SPECIFICATIONS AND CONSTRUCTION DETAILS

- .1 The design documents (i.e. plans, specifications and other related details) are prepared solely for the use by parties with whom the Departmental Representative has entered into

a contract. No representations of any kind are made to any party with whom the Departmental Representative has not entered into a contract.

- .2 The construction details, plans and drawing(s) as stated in the front end Table of Contents are to be read in conjunction with this specification. All materials and equipment including quantities shown on the plans and drawings may not be specifically listed or shown in the specifications. Provide all materials and equipment as required if it is shown singularly only on the plans or only included in the specifications.
- .3 All construction details, plans and drawings are intended to complement and form part of this specification and accompanying contract. All lettering on plans or drawings shall be considered as part of the specifications and contract.
- .4 Information if shown on the plans or provided in the specifications related to past works in the area is based on record plans or drawings and specifications, which have been, in part, prepared by Others. While this information is believed to be reliable, the Departmental Representative cannot assure its accuracy or for any errors or omissions which may have been incorporated as a result. The Contractor is hereby advised to obtain independent verification of accuracy of all record information provided before applying it for any purpose.

3.3 CONTRACT DOCUMENTS

- .1 The Contract Documents shall be signed in duplicate by the Departmental Representative and the Contractor and one executed copy delivered to each of the Contractor and the Departmental Representative.
- .2 Changes made by the Contractor to any portion of the contract documents prior to signature are not legally binding unless accepted in writing by both parties signing the contract namely both the Departmental Representative and the Contractor.
- .3 The Work shown and described in various portions of the Contract Documents are intended to be read together and complement each other and what is required by any one shall be as binding as if required by all, together providing the information required for a complete facility.
- .4 The intention of the Contract Documents is to include all products, labour and services necessary to perform the Work in accordance with these documents, including all minor products, labour and services not shown or specified, but which are reasonably necessary for performance and completion of the Work.
- .5 Words which have well known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings.

3.4 DOCUMENT REVIEW

- .1 If, at any time, the Contractor finds errors, inconsistencies, or omissions in the Contract Documents or has any doubt as to the meaning or intent of any part thereof, including laying out of the Work, the Contractor shall immediately notify the Departmental Representative, and request instructions, a Supplemental Instruction, Change Order, or Change Directive, as the case may require, and the Contractor shall not proceed with the work affected until the Contractor has received such instructions, a Supplemental Instruction, Change Order or Change Directive. The Departmental Representative will not be responsible for the consequences of any action of the Contractor based on oral instructions.
- .2 Unless specifically approved by the Departmental Representative, neither the giving of any orders by the Departmental Representative nor the carrying out of such orders by the

Contractor shall entitle the Contractor to any extra payment, project extension, nor relieve the Contractor of their responsibilities under the Contract without an express written order.

- .3 Notwithstanding the foregoing, errors, inconsistencies, discrepancies and/or omissions shall not include lack of reference on the Drawings or in the Specifications to labour and/or Products that are required or normally recognized within respective trade practices as being necessary for the complete execution of the Work. The Contractor shall not use subsequent information requests, issued during execution of the Work to establish a claim for change and/or changes in the work.

3.5 RECORD DOCUMENTS

- .1 Prior to commencement of any Work, record and photograph existing conditions which will be changed as a result of this Contract. Include photos to show conditions of adjacent roadways, buildings, foundation walls, etc.
- .2 The Contractor shall keep one record copy of all Specifications, Drawings, Addenda, Operating and Maintenance Manuals, Shop Drawings, Change Orders, Field Test Reports, Work Schedule and samples at the Place of Work in good order and shall record thereon all changes made during the construction of the Work as they occur. These record copies shall be made available to the Departmental Representative during construction and shall be delivered to the Departmental Representative upon completion of the Work.
- .3 Departmental Representative will provide two sets of white prints for record drawing purposes.
- .4 Maintain project record drawings and record accurately deviations from Contract documents.
- .5 Record changes in red. Mark on one set of prints and at completion of project and prior to final inspection, neatly transfer notations to second set and submit both sets to Departmental Representative.
- .6 Record following information:
 - .1 Depths of various elements of foundation in relation to survey datum.
 - .2 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvement.
 - .3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
 - .4 Field changes of dimension and detail.
 - .5 Actual location of all mechanical and electrical works.
 - .6 Changes made by Change Order or Field Order.

3.6 CONTRACT TIME

- .1 Contract Time
 - .1 No bonus will be allowed by the Departmental Representative for completion of the Work in less time than specified in the Agreement.
 - .2 If the Contract Time is based on Working Days, the Departmental Representative shall prepare a statement at the end of each day, beginning on the date stated in the Agreement for the commencement of the Work, showing the number of hours

charged to each main work item and signifying whether or not said hours constitute a Working Day.

- .3 If the Contractor does not agree with the Departmental Representative's statement, he shall within three (3) days present in writing his reasons for disagreement. Failing receipt of such communication, the Departmental Representatives statement shall be considered binding.

.2 Schedule

- .1 The Contractor shall, within 5 working days of Contract award, prepare and submit for the Departmental Representative's review, a Schedule of activities of the Work to show dates of commencement and completion or number of Working Days for completion of various phases or parts of the Work in relation to the Contract Time stated in the Contract. The Schedule shall provide sufficient detail to the satisfaction of the Departmental Representative. After acceptance, the Schedule shall not be changed without the consent of the Departmental Representative.
- .2 Schedule work to minimize interruptions to existing services. Schedule to identify any possible interruptions of existing services.
- .3 The Departmental Representative reserves the right to withhold payment from the Contractor if such Schedule is not submitted prior to or with the first application for payment, or a revised Schedule is not submitted prior to the next subsequent application for payment after an extension of time has been granted.
- .4 The Contractor shall comply with the Schedule. The Contractor shall bear all costs necessary to meet the Schedule. If the progress of the Work falls behind the most recent schedule or is delayed for any reason other than one for which extra time is provided for, the Contractor shall immediately engage additional labour and equipment and work such additional hours as the Departmental Representative may direct to bring the Work back on schedule at the Contractor's expense.

.3 Delays

- .1 If in the opinion of the Departmental Representative the Contractor is delayed in the performance of the Work by a Stop Work Order issued by any court, other public authority, or the Departmental Representative, providing that such order was not issued as a result of any act or fault of the Contractor or any one employed by him directly or indirectly, then the Contract Time shall be extended by an amount to be determined by the Departmental Representative.
- .2 If in the opinion of the Departmental Representative the Contractor is delayed in the performance of the Work by labour disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized Contractors' Association, of which the Contractor or a Subcontractor is a member), fire, unusual delay by common carriers, unavoidable casualties or; without limit to any of the foregoing, by any cause beyond the Contractor's control, then the Contract Time shall be extended by an amount to be determined by the Departmental Representative.

SECTION 4 Codes, Standards, and Regulatory Approvals

4.1 CODES AND STANDARDS

- .1 Perform Work and obtain permits in accordance with the latest version of the National Codes of Canada and any other applicable provincial or local codes and standards. In any case of conflict or discrepancy the more stringent requirements shall apply.
- .2 Obtain permits and complete Work to meet or exceed the requirements of standards, codes and other documents referred to in this specification.
- .3 Where the specifications contained herein are more stringent than the applicable code or standard utilize the most stringent.
- .4 Equipment and materials to carry CSA, ULC or cUL approval and conform with applicable standards, no exceptions or alternatives.
- .5 When requested by Departmental Representative, submit proof that materials or workmanship, or both, meet or exceed requirements of referenced codes or standards.
- .6 All materials and products in contact with potable water to be NSF/ANSI Standard 61 certified.
- .7 Where a standard or code of any type is referred to anywhere in the document, the standard or code utilized for all work shall be the most recent whether or not the most recent is specifically shown or listed.

4.2 PERMITS, FEES, AND INSPECTION

- .1 Obtain all permits, licenses and certificates, and pay all fees required for the performance of the Work which are in force at the final date for receipt of bids by the Departmental Representative (but this shall not include the obtaining of permanent easement or rights of servitude). Give all required notices and comply with all laws, ordinances, rules, local by-laws, regulations, codes and orders of all authorities having jurisdiction relating to the Work, to the preservation of the public health and construction safety which are or become in force during the performance of the Work. A partial listing is:
 - .1 Building Permit with the South Interlake Planning District.
 - .2 Manitoba Hydro inspection.
 - .3 Provide written certification that all electrical items included in the scope of Work are included in the submission to Manitoba Hydro.
 - .4 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of the Work.
 - .5 Provide copies of all submissions to the Departmental Representative. Authorize and request Manitoba Hydro to provide copies of all inspection reports, written comments and Acceptance Certificate directly to the Departmental Representative.
 - .6 Notify Departmental Representative in writing of changes required by Electrical Inspection Department prior to making changes.
 - .7 Furnish to Departmental Representative the Manitoba Hydro Inspection Department Acceptance Certificate on completion of the Work. Certify that there are no outstanding issues in other correspondence that is not shown on the Acceptance Certificate.

SECTION 5 Departmental Representative

5.1 DEPARTMENTAL REPRESENTATIVE'S FUNCTION, ROLE AND LIABILITY

- .1 The Departmental Representative will:
 - .1 Provide engineering services in accordance with the Contract Documents.
 - .2 Provide administration of the Contract in accordance with the Contract Documents.
 - .3 Visit the Project site at intervals to be familiarized with the progress and quality of the Work and to determine in general if the Work is proceeding in accordance with the design concept for the Project.
 - .4 Be the initial interpreter of the requirements of the Contract Documents and the judge of the acceptability of the Work.
 - .5 Respond in writing within a reasonable time where claims, disputes and other matters in question relating to the performance of the Work or the interpretation of the Contract Documents which are to be referred initially to the Departmental Representative in writing for a decision.
 - .6 Have authority to reject work which does not conform to the requirements of the Contract Documents.
 - .7 Verify whether the Contractor has implemented and is maintaining adequate quality control procedures during the construction of the Work.
- .2 The Departmental Representative will not:
 - .1 Warranty (expressed or implied) or guarantee the design or the Contractor's work.
 - .2 Owe or imply any contractual duty to the Contractor under this contract.
 - .3 Relieve the Contractor of any of his obligations to perform sound and reliable Work as a result of inspections of the works by the Departmental Representative.
 - .4 Be responsible for the Contractor's:
 - .1 Construction means, materials, methods, techniques, sequences or procedures.
 - .2 Failure to perform the Work in accordance with the Contract Documents.
 - .3 Compliance with the applicable Construction Safety Legislation, other regulations or good construction practice.
 - .4 Acts or omissions.
 - .5 Make exhaustive or continuous onsite inspections to neither check the quality nor quantity of the Work, nor be responsible to observe or discover defects or deficiencies in the Work.
- .3 The Departmental Representative and every agent and employee of the Departmental Representative shall have the benefit of all provisions in the Contract Documents limiting the Departmental Representative's duty, responsibility or liability.

5.2 MEETINGS

- .1 Upon award of contract, the Departmental Representative may request a meeting to discuss and resolve administrative procedures and responsibilities. The Contractor shall organize and advise all sub contractors accordingly.
- .2 Departmental Representative will schedule project meetings and assume responsibility for setting times.

- .3 As a minimum, meetings will be monthly until Certificate of Completion is issued.
- .4 Notify all parties concerned, including major sub-contractors to attend, to ensure proper co-ordination of Work.

SECTION 6 Contractor

6.1 CONTRACTOR'S GENERAL RESPONSIBILITY

- .1 Provide all Plant, Material, labour, services and incidentals necessary for the performance of the Work.
- .2 Be responsible for any Work not explicitly set out in the Contract but which may be reasonably implied for the proper completion of the Work.
- .3 Perform, complete and maintain the Work in strict accordance with the Contract. If the Contract or any part of the Contract appears indefinite, unclear or contradictory, the Contractor shall refer the matter to the Departmental Representative in writing for interpretation or clarification. The Contractor shall be responsible for conveying the interpretation or clarifications of the Contract, as given by the Departmental Representative, to the Subcontractors.
- .4 Except as otherwise provided in the Contract, be solely responsible for construction means, methods, techniques, sequences and procedures, and for coordinating the various parts of the Work so as to ensure its proper progress and completion in a sound and workmanlike manner, in all respects in strict conformity with the Contract.
- .5 Have complete control over the methods of performing the Work and shall direct and supervise the Work so as to ensure conformance with the Contract.
- .6 Arrange and carry on its Work so as not to conflict with Work being carried on or to be carried on for, or at the request of the Departmental Representative by others. If the Contractor finds it difficult to work in harmony with such parties, the Contractor shall notify the Departmental Representative promptly in writing.
- .7 Be responsible for completion of all items of the Work, whether implied or defined explicitly in these Contract Documents, and within the control of the Contractor and/or subcontractors and suppliers, regardless if deficient Work is discovered after warranty period has elapsed

6.2 STANDARD OF CARE

- .1 The Contractor represents, covenants and warrants to the Departmental Representative that:
 - .1 The personnel the Contractor assigns to the Project are appropriately experienced.
 - .2 The Contractor has a sufficient staff of qualified and competent personnel to replace any of its appointed representatives, subject to the Departmental Representatives approval, in the event of death, incapacity, removal or resignation.
 - .3 There are no pending, threatened or anticipated claims, liabilities or contingent liabilities that would have a material effect on the financial ability of the Contractor to perform its Work under the Contract.

6.3 INDEMNITY

- .1 The Contractor covenants to save harmless and effectually indemnify the Departmental Representative and its personnel, and their respective agents and employees, against all actions and proceedings, costs, damages, expenses, claims and demands whatsoever committed by the Contractor, his Subcontractors, employees or agents and by whomsoever brought by reason of the performance of the said Work, and more particularly from:
 - .1 Accidental injury (including death) to any person whether retained by or in the employ of the Contractor or not, arising directly or indirectly by reason of the performance of the Work, or by reason of any trespass on or damage to property.
 - .2 Damage to any property owned in whole or in part by the Departmental Representative or which the Departmental Representative by duty or custom is obliged, directly or indirectly, in any way or to any degree, to construct, repair or maintain.
 - .3 Trespass or damage to private property or properties owned by persons other than the Departmental Representative.
 - .4 Inaccuracies in any information provided to the Departmental Representative by the Contractor.
- .2 The Contractor shall pay to the Departmental Representative the value of all legal fees and disbursements required to defend the Departmental Representative against any such claim, action, proceeding, claim or demand arising out of the Contract notwithstanding that the defense of the said action, proceeding, claim or demand was undertaken on behalf of the Departmental Representative by a salaried employee of the Departmental Representative.
- .3 The Contractor shall pay to the Departmental Representative all costs taxed against the Contractor in any litigation between the Contractor and the Departmental Representative arising out of this Contract.
- .4 If the Contractor fails to make any payment required to be made to the Departmental Representative hereunder, the Departmental Representative shall be entitled to deduct the amount of such payment from any payment required to be made by the Departmental Representative to the Contractor under this Contract or take whatever other remedies against the Contractor that the Departmental Representative may have at law.
- .5 The provision of indemnification shall survive the termination of the Contract, howsoever caused and no payment or partial payment, no issuance of a final certificate of payment and no occupancy in whole or part of the Work shall constitute a waiver or release of any of the provisions of indemnification.

6.4 PROTECTION OF PUBLIC, WORK, PROPERTY AND SURVEY MONUMENTS

- .1 The Contractor shall not advance any claims for delays in the Work due to damages caused by the Contractor.

6.5 LOCATION AND COMMENCEMENT OF CONSTRUCTION

- .1 The location within the limits of any project at which the Contractor commences his construction operations and the sequence of these operations shall be as permitted or directed by the Departmental Representative.

6.6 CONTRACTOR'S USE OF SITE AND WORK HOURS

- .1 Co-operate with the Departmental Representative so as to cause the least inconvenience throughout the area at all times.
- .2 Limit use of the site to the project area as other Contracts are being undertaken in the immediate area.
- .3 Confine apparatus, the storage of products and the operations of workers to limits indicated by laws, ordinances, permits and by directions of the Departmental Representative.
- .4 Enforce all regulations and requirements regarding signs, advertisements, fires and smoking.
- .5 Do not unreasonably encumber site with materials or equipment.
- .6 Do not load or permit to be loaded any part of the Work with a weight, load or force that will endanger its safety.
- .7 Move stored products or equipment which interferes with operations of Departmental Representative or other Contractors.
- .8 Obtain and pay for use of additional storage or work areas needed for operations.
- .9 Maintain roads and access in good condition for efficient execution of Work.
- .10 Assume full responsibility for the protection and safekeeping of products under the contract, stored on the site.
- .11 Carry out work between 0800 to 1600 hours, Monday through Friday inclusive or as arranged with the Departmental Representative. Obtain Departmental Representative's approval for work weeks longer than 5 days/week.

6.7 MAINTENANCE

- .1 Complete works in a manner that shall result in good surface drainage during periods of precipitation.

6.8 CONSTRUCTION EQUIPMENT

- .1 Location of existing works in some areas may restrict the normal operation of heavy machinery. In these areas the Contractor is not relieved of any responsibility from damages caused to property. Take all necessary precautions to prevent damage to existing facilities.
- .2 Use extra caution in operating heavy machinery after periods of rain to minimize any damage to the existing road, street, boulevard or ditches.
- .3 When moving heavy equipment protect roads and all property. Use caution when turning heavy equipment on roads to prevent permanent damage. If permanent damage occurs, repair such damage at no expense to Departmental Representative.

6.9 UNSUITABLE WORKERS

- .1 The Departmental Representative may order the Contractor to remove from the Work any person employed or retained by the Contractor in the performance of the Work who the Departmental Representative determines is negligent, disrespectful, intemperate, disorderly, or is otherwise objectionable.

- .2 Immediately upon receipt of the request, the Contractor shall make arrangements to appoint an acceptable replacement, subject to approval by the Departmental Representative.
- .3 Neither the giving of any orders by the Departmental Representative pursuant to these provisions nor the carrying out of such orders by the Contractor shall entitle the Contractor to any extra payment, project extension, nor relieve the Contractor of their responsibilities under the Contract.

6.10 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 his approval for actual location.
- .4 Submit field plans or drawings to indicate relative position of various services and equipment when required by Departmental Representative.
- .5 Follow manufacturer's literature for roughing-in and hook up of equipment, fixtures and appliances.

SECTION 7 Execution of the Work

7.1 COLD WEATHER

- .1 No payment will be made for frost removal or heating and hoarding.

7.2 REJECTED WORK

- .1 If the Contractor does not promptly remove defective works, the Departmental Representative may have them removed and stored at the expense of the Contractor. In the case of earthwork, rejected work applies to the Work as required to expose and adjust moisture content if required and re-compaction. If the Contractor does not pay the expense of such removal within five (5) days thereafter, the Departmental Representative may, upon ten (10) days written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all costs and expenses that should have been borne by the Contractor.

7.3 CORRECTION AFTER COMPLETION

- .1 Where a defect or omission arises; and when service of the works to consumers is interrupted, the Contractor shall remedy the defect or omission and restore service within 24 hours of being notified of the defect or omission. If there is no interruption of service to consumers, the Contractor shall remedy the defect or omission within seven (7) days of being notified. In the event of non-compliance by the Contractor in respect of the requirements of this clause, the Departmental Representative shall cause the defect or omission to be corrected by others and pay for the same out of any monies of the Contractor which the Departmental Representative may have spent in connection with such Work over and above the monies aforesaid of the Contractor, and shall collect the same as a debt due from the Contractor to the Departmental Representative.

7.4 ORAL ARRANGEMENTS

- .1 In case of misunderstandings, disputes or interpretation of plans and specifications oral arrangements will not be considered. The Contractor must produce written authority from the Departmental Representative in support of Departmental Representative's contentions and do not advance a claim in the absence of such written authority.

7.5 EXISTING TRASH SCREEN OPERATION

- .1 Operation of the existing trash screen will be maintained by the Departmental Representative during construction.

END OF SECTION

Part 1 General

1.1 PROCESS AND PURPOSE OF SHOP DRAWINGS

- .1 The term "shop drawings" means plans, drawings, diagrams, illustrations, schedules, performance charts, brochures and other data, including site erection plans or drawings which are to be provided by the Contractor to illustrate details of a portion of the work.
- .2 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.
- .3 Until submittal is reviewed, work involving relevant product may not proceed.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Where articles or equipment from any division or specification section or plan attach to connect to other articles or equipment under any other division or specification section or plan, be responsible and clearly indicate that all such attachments and connections (including electrical) have been properly coordinated, regardless of the trade, specification section or plan grouping under which the adjacent articles or equipment will be supplied or installed. Notify the Departmental Representative in writing if there are any deviations in the shop drawings from the requirements of the contract documents and any obvious or implied conflicts or errors between the various trades, specification sections and plans.
- .6 The shop drawing review process is for the sole purpose of conformance with the general design concept. The shop drawing review shall not mean that the Departmental Representative approves the detail design inherent in the shop drawing. The responsibility of the shop drawings shall remain with the Contractor submitting the shop drawings. The shop drawing review shall not relieve the Contractor of their responsibility for errors or omissions in the shop drawings or of their responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site for information that pertains solely to fabrication process or to techniques for construction and installation and for co-ordination of the work of all all Divisions and suppliers.

1.2 SHOP DRAWINGS

- .1 Plans or drawings to be originals prepared by Contractor, Supplier or Distributor, which illustrate appropriate portion of work showing fabrication, layout, setting or erection details as specified in appropriate sections.
- .2 Prior to submitting shop drawings for the Departmental Representative's review, the Contractor shall review all shop drawings to confirm they are meeting all requirements of the project and mark and sign his approval on the plans or drawings which shall certify review of submission, verification of field dimensions and compliance with contract documents.
 - .1 **Indicate specification section and item number on all documents submitted.**
For each submission package provide a transmittal letter indicating specifications

sections and item numbers submitted for approval in submission package. Shop drawing submissions not so marked will be returned as incomplete.

- .3 Shop drawings to be certified by manufacturer indicating that all product engineering has been performed ensuring the product will meet the requirements of intended installation.
- .4 Include all electrical wiring diagrams and installation plans or drawings for electrically powered equipment.
- .5 Wherever documents are provided in S.I. units, all performance and dimensional data shall be submitted in S.I. units.
- .6 Submit either blackline print hard copies or digital PDF versions.
- .7 If hard copies, submit three copies, of which two will be retained by Departmental Representative.
- .8 Submissions as a minimum shall be subject to the following criteria:
 - .1 Supplement standard information with additional project specific information.
 - .2 Clearly indicate product or material, complete with model number and make.
 - .3 Show dimensions and clearances required.
 - .4 Show performance characteristics and capacities.
 - .5 Identify weight of the equipment.
 - .6 Show wiring diagrams (where requested) and controls.
 - .7 Provide process flow diagrams, including the functional description of logistics.
 - .8 Include overall specification and item numbers.
 - .9 Details of handling and installation.
- .9 Shop drawings for the following shall be sealed by a Professional Engineer registered to practice in the Province of Manitoba:
 - .1 Components of a building that are load bearing. A partial listing is:
 - .1 Roof trusses or other ceiling members.
 - .2 Concrete reinforcement and mix design.
 - .3 Structural steel/aluminum.
 - .4 Structural connection details.
 - .5 Load bearing members including monorails and anchor bolts.
 - .6 Process Equipment.

1.3 PRODUCT DATA

- .1 Certain specification sections specify that manufacturer's standard schematic plans or drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that the product concerned is clearly identified.
- .2 Submit in sets, not as individual submissions.
- .3 Product data will only be accepted if it conforms to the criterion listed above.

1.4 SAMPLES

- .1 Submit samples in sizes and quantities specified as soon as possible after Contract award to facilitate production of complete colour scheme by the Departmental Representative.
- .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 before proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 CONTRACTOR'S RESPONSIBILITY

- .1 Contractor's responsibilities:
 - .1 Review shop drawings, product data and samples prior to submitting to Departmental Representative.
 - .2 Verify:
 - .1 Field measurements.
 - .2 Field construction criteria.
 - .3 Catalogue numbers and similar data.
 - .4 Conformance with the specification – compare specification numbers and item numbers to all required shop drawings.
 - .5 Coordinate with the various trades and confirm that a project can be built as required by the contract documents. Verify the dimensions of equipment, operating voltages, operating parameters and conditions in connection with other shop drawings and the plans with all affected trades.
 - .3 Co-ordinate each submittal with the requirements of the work of all trades and suppliers and contract documents. The Contractor is responsible to ensure and confirm that applicable trades have reviewed and accepted the submission and made any and all required changes to construct a finished and operating project as required by the contract documents.
 - .4 Clearly identify any variations in the shop drawings from the contract requirements. If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submissions. If the Departmental Representative approves any such variation, the Departmental Representative shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued. In all cases the Contractor is responsible for coordination of any and all changes applicable to all Divisions.

- .5 Responsibility for deviations in submittals from requirements of Contract documents and errors and omissions is not relieved by Departmental Representative's review of submittals, unless Departmental Representative gives written acceptance of specified deviations.
- .6 Notify Departmental Representative, in writing at time of submission, of deviations in submittals from requirements of Contract documents.
- .7 After Departmental Representative's review, distribute copies, maintain one copy on site.

1.6 SUBMISSION REQUIREMENTS

- .1 Allow a 14 working day period for Departmental Representative's review for each individual submission.
- .2 Accompany submissions with transmittal letter which lists shop drawings included for review, complete with specification and item numbers.
- .3 No claims will be allowed that may arise because of delays in submissions, re-submissions and review of shop drawings.
- .4 Obtain final review prior to ordering, fabricating or completing installation work.
- .5 Initial submission – As per Item 1.3.
- .6 After final review produce 6 copies of product data and distribute as follows:
 - .1 Contractor - Operating and Maintenance Manual, three (3) copies.
 - .2 Contractor – File, one (1) copy.
 - .3 Contractor – Site, two (2) copies (provide 1 field set to Departmental Representative).

1.7 DEPARTMENTAL REPRESENTATIVE'S REVIEW

- .1 Departmental Representative's review of the workshop drawings has the sole purpose of verifying compliance with the general concept and the general arrangement of elements described in the contract. This review does not mean approval of the shop drawings, responsibility remains with the Contractor, and shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings, or obligations in respect of the contract documents.
- .2 The review does not include consideration of dimensions to confirm and coordinate on-site by the Contractor or the review of manufacturing processes or techniques of construction and installation or examining the coordination of Work of other Divisions; these examinations are the sole responsibility of the Contractor.
- .3 Departmental Representative's review may result in a request for revisions to shop drawings, product data or samples. Complete revisions ensuring all requests for revision items have been addressed and resubmitted for Departmental Representative's review. If the second submission does not address all revisions requested in the first review the Departmental Representative retains the right to hold the Contractor responsible for Engineering costs of additional reviews at a rate of \$150/hr plus expenses. Such additional costs may be deducted from the overall payments due.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Contraband: an intoxicant, including alcoholic beverages, drugs and narcotics, 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, an explosive or a bomb or a component thereof, currency over any applicable prescribed limit \$25.00, and any item not described that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2 Unauthorized Smoking Items: All smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing or snuffing tobacco, cigarette making machines, matches and lighters.
- .3 Commercial Vehicle: Any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4 CSC: Correctional Service Canada.
- .5 Director: Director or Warden of the Institution as applicable or their representative.
- .6 Construction employees: Persons working for the general Contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .7 Perimeter: Fenced or walled area of the Institution that restrains the movement of the inmates.
- .8 Construction zone: Area on the contract drawings where the Contractor will be allowed to work. This area may or may not be isolated from the security area of the Institution.

1.2 PRELIMINARY PROCEEDINGS

- .1 Prior to the commencement of work, the Contractor shall meet with the Director to:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Discuss the sign in/out protocol to access the construction site.
 - .3 Establish mutually acceptable security procedures in accordance with this instruction and the Institution's particular requirements.
 - .4 Discuss logistics of completing security requirements.
- .2 The Contractor shall:
 - .1 Ensure that all construction employees are aware of the CSC security requirements.
 - .2 Ensure that a copy of the CSC security requirements is always prominently on display at the job site.
 - .3 Co-operate with institutional personnel to ensure that security requirements are observed by all construction employees.

1.3 CONSTRUCTION EMPLOYEES

- .1 Submit to the Director a list of the names of all construction employees to be employed on the construction site.

- .2 The Director 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 Director 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 the Institution and shall be displayed prominently on the construction employees clothing at all time while employees are at the Institution.
- .3 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .4 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
 - .1 Appear to be under the influence of alcohol, drugs or narcotics.
 - .2 Behave in an unusual or disorderly manner.
 - .3 Are in possession of contraband.

1.4 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 secure in the possession of the owner or an employee of the company that owns the vehicle.
- .2 The Director may limit at any time the number and type of vehicles allowed within the Institution.
- .3 Drivers of delivery vehicles for material required by the project must remain with their vehicle the entire time that the vehicle is in the Institution. The director may require that these vehicles be escorted by Institutional staff or Commissionaires while in the Institution.
- .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, these trailer doors will be locked at all times. All windows will be securely locked when left unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter must be locked when not in use.

1.5 PARKING

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

1.6 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 for the Contractor.

1.7 TELEPHONES

- .1 There will be no installation of telephones, facsimile machines and computers with Internet connections permitted within the perimeter of the Institution unless prior approval of the Director is received.

- .2 The Director will ensure that approved telephones, facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.
- .3 Wireless cellular or WIFI two-way radio connection devices are not authorized in the perimeter of the institution. Workers must leave their cell phones with the commissioner in the construction trailer before going to Work.

1.8 WORK HOURS

- .1 Work hours within the Institution are: Monday to Friday from 08:00 to 16:00 hours.
- .2 Work will not be permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waived by the Director.

1.9 OVERTIME WORK

- .1 No overtime work will be allowed without permission of the Director. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such the completion of a concrete pour or work to make the construction safe and secure, the Contractor shall advise the Director as soon as this condition is known and follow the directions given by the Director. Costs to Canada for such events may be attributed to the Contractor. Check with the Institution which may have shorter permission request times.
- .2 When overtime work, weekend statutory holiday work is required and approved by the Director, extra staff members may be posted by the Director or his designate, to maintain the security surveillance. The actual cost of this extra staff may be attributed to the Contractor.

1.10 TOOLS, EQUIPMENT AND MATERIALS

- .1 Maintain on site 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 an up-to-date 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, equipment and materials in an approved secure locations. Location to consist of a fenced secured lockable yard area constructed by the Contractor.
- .5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the Contractor.
- .6 Scaffolding shall be secured and locked when not erected and when erected, shall be secured in a manner agreed upon with the director.
- .7 All missing or lost tools or equipment shall be reported immediately to the Commissioner and Departmental Representative.

- .8 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
 - .1 At the beginning and conclusion of every construction project.
 - .2 Weekly, when the construction project extends longer than a one week period.
 - .3 Some Institutions require the daily removal of tools and equipment such as when working on an occupied range.
 - .4 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. Check with Institution for their exact procedure for controlled items.
 - .5 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.

1.11 KEYS

- .1 Security Hardware Keys:
 - .1 All security hardware shall be in accordance with chapter A-6, Hardware of Technical Criteria Correctional Institutions.
 - .2 The Contractor shall arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO).
 - .3 The SMO will provide a receipt to the Contractor for security hardware keys.
 - .4 The Contractor will provide a copy of the above-mentioned receipt to the Ministerial Representative.
- .2 Other Keys
 - .1 See section A-6 paragraph 4.5 of CSC technical Standard. All builder locks shall be under a master key system. Key cylinders for use by staff shall be 7 pin type or alternates offering equivalent security.
 - .2 The Contractor will issue instructions to his employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.
 - .3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:
 - .1 Prepare an operational keying schedule.
 - .2 Accept the operational keys and cylinders directly from the lock manufacturer.
 - .3 Arrange for removal and return of the construction cores and install the operational core in all locks.
 - .4 Upon putting operational security keys into use, the CSC construction escort shall obtain these keys as they are required from the SMO and open doors as required by the Contractor. The Contractor shall issue instructions to his employees advising them that all security keys shall always remain with the CSC construction escort.

1.12 SECURITY HARDWARE

- .1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.

1.13 PRESCRIPTION DRUGS

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

1.14 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 Director.

1.15 CONTRABAND

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on Institutional property.
- .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.
- .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 removal of persons from the facility. 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 removal from site for the driver of the vehicle.

1.16 SEARCHES

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

1.17 ACCESS TO AND REMOVAL FROM INSTITUTIONAL PROPERTY

- .1 Construction personnel and commercial vehicles will not be admitted to the Institution after normal working hours, unless approved by the Director.

1.18 MOVEMENT OF VEHICLES

- .1 Escorted commercial vehicles will be allowed to enter or leave the Institution through the vehicle access gate during the following hours:
 - .1 0700 to 1700 hours, Monday through Friday inclusive.
- .2 Construction vehicles shall not leave the Institution until an inmate count is completed.
- .3 The Contractor shall advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .4 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or Commissionaires working under the authority of the Director.
- .5 Commercial vehicles will only be allowed access to Institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.
- .6 Vehicles shall be refused access to Institutional property if, in the opinion of the Director, they contain any article which may jeopardize the security of the Institution.
- .7 Private vehicles of construction employees will not be allowed within the security perimeter of medium or maximum security Institutions without the authorization of the Director.
- .8 With prior approval of the Director, a vehicle may be used in the morning and evening to transport a group of employees to the work site. This vehicle will not remain within the Institution the remainder of the day.
- .9 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another fixed object.

1.19 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY

- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Director may prohibit or restrict access to any part of the Institution.
- .3 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 escorted by a member of the CSC security staff or a commissionaire.
- .4 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the officer's lounge or the dining room of the Institution.

1.20 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.

1.21 STOPPAGE OF WORK

- .1 The director may order at any time that the Contractor, his employees, sub-contractors and their employees to not enter or to 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 CSC staff member giving this instruction, the time of the request and obey the order as quickly as possible.
- .2 The Contractor shall advise the Departmental Representative of this interruption of the work within 24 hours.

1.22 CONTACT WITH INMATES

- .1 It is strictly forbidden to take pictures of fences, cameras or other security equipment, to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any construction employee doing any of the above will be removed from the site.
- .2 Cameras are not allowed on CSC property.
- .3 Notwithstanding the above paragraph, if the director approves of the usage of cameras, it is strictly forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this contract.

1.23 COMPLETION OF CONSTRUCTION PROJECT

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

END OF SECTION

Part 1 General

1.1 WORKPLACE SAFETY AND HEALTH

- .1 This is a "construction project" as that term is defined in The Workplace Safety and Health Act (the "WSH Act"). The WSH Act and all related workplace safety and health regulations apply to the project. For purposes of the Contract, the Contractor is the sole "prime contractor" as defined in the WSH Act, and is therefore required, and agrees, to co-ordinate, organize and oversee the performance of all Work at the construction project site and to conduct its own activities in such a way as to ensure, so far as is reasonably practicable, that no person is exposed to risks to his or her safety or health arising out of, or in connection with, activities at the construction project site. In addition, the Contractor as prime contractor is required and agrees to ensure, so far as is reasonably practicable, that every person involved in the Work on the project complies with the WSH Act, and in turn to co-operate with any other person who is exercising its, his or her duty to comply with the WSH Act.
- .2 The WSH Act also requires certain employers to establish written workplace safety and health programs, and that the Contractor, as prime contractor, co-ordinate the programs of such employers. The Contractor, as prime contractor, agrees to co-ordinate the workplace safety and health programs of all employers on the project site.
- .3 The foregoing is not a comprehensive description of the Contractor's duties as prime contractor under the WSH Act. The Contractor, as prime contractor, agrees to comply at all times with the requirements of the WSH Act and to provide the Departmental Representative with any information it may reasonably request regarding the Contractor's compliance with such requirements. The Contractor agrees that any right the Departmental Representatives may have to monitor or inspect the Work is only for the purposes of determining the progress and quality of the Work as a basis for payment to the Contractor, and to assess the Contractor's compliance with the terms and conditions of the Contract.

1.2 SUBMITTALS

- .1 Before the Contractor may start any work on the project site, the Contractor must submit a detailed site safety plan to the Departmental including provision for rescue and emergency. Systems and equipment must conform to Manitoba Labour Guidelines and other recognized safe work standards and practices. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .2 Submit Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative monthly.
- .3 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .4 Submit copies of incident and accident reports.
- .5 Submit WHMIS Safety Data Sheets (SDS) for materials used on site.
- .6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 14 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative.

- .7 Departmental Representative's review of Contractor's Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

1.3 CONSTRUCTION SAFETY

- .1 Be solely responsible for construction safety at the Place of the Work and for compliance with the rules, regulations, and practices required by the most stringent of the applicable construction health and safety legislation i.e. Federal Government, Provincial Government, Worker's Compensation Board, local statutes and National Building Code and shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Work.
- .2 Indemnify and save harmless the Departmental Representative, its agents, trustees, officers, directors, employees, consultants, successors, appointees, and assigns from and against the consequences of any and all safety infractions committed by the Contractor under the occupational health and safety legislation in force at the Place of the Work including the payment of legal fees and disbursements on a full indemnity basis (solicitor and own client basis).
- .3 File any notices or any similar document required pursuant to the Contract or the safety regulations in force at the Place of the Work. This duty of the Contractor will be considered to be included in the Work and no separate payment therefore will be made to the Contractor.
- .4 Unless otherwise provided in the Contract Documents, the Contractor shall develop, maintain and supervise for the duration of the Work a comprehensive safety program that will effectively incorporate and implement all required safety precautions. The program shall, at a minimum, respond fully to the applicable safety regulations and general construction practices for the safety of persons or property, including, without limitation, any general safety rules and regulations of the Departmental Representative and any workers' compensation or occupational health and safety statutes or regulations in force at the Place of the Work.
- .5 Provide a copy of the safety program described above to the Departmental Representative prior to the commencement of the Work, and ensure, as far as it is reasonably practical to do so, that every employer and worker performing work in respect of the Project complies with such program. The detailed site safety plan to include provision for rescue and emergency. Systems and equipment must conform to Provincial Labour Guidelines and other recognized safe work standards and practices in the province where the work is being completed.
- .6 Provide certification in respect to the Construction safety services Certificate of recognition (COR) program.
- .7 Assign a designated person to maintain the application of safety onsite. Arrange regular safety meetings, and supply and maintain, at its own expense, at its office or other well-known place at the job site, safety equipment necessary to protect the workers and general public against accident or injury as prescribed by the authorities having jurisdiction at the Place of the Work, including, without limitation, articles necessary for administering first-aid to any person and an emergency procedure for the immediate removal of any injured person to a hospital or a doctor's care.

- .8 Promptly report in writing to the Departmental Representative all accidents of any sort arising out of or in connection with the performance of the Work, whether on or adjacent to the job site, giving full details and statement of witnesses. If death or serious injuries or damages are caused, the accident shall be promptly reported by the Contractor to the Departmental Representative by telephone or messenger in addition to any reporting required under the applicable safety regulations.

1.4 COMMUNICATIONS AND POSTING

- .1 Make all necessary arrangements to ensure effective communication of safety and health information at the site. Workers must be informed of their rights and obligations pertaining to the site specific safety program. The Contractor must insist on their right to refuse to perform work which they feel may threaten their own health, safety or physical integrity or that of other persons at the site. The Contractor must keep and update a written record of all information transmitted with signatures of all affected workers.
- .2 The following information and documents must be posted in a location readily accessible to all workers:
 - .1 Notice of site opening.
 - .2 Identification of principal Contractor.
 - .3 Company OSH policy.
 - .4 Site-specific safety program.
 - .5 Emergency plan.
 - .6 Data sheets for all hazardous material used at the site.
 - .7 Minutes of site committee meetings.
 - .8 Names of site committee representatives.
 - .9 Names of those with first-aid training.

1.5 WHMIS

- .1 Comply with requirements of Workplace Hazardous materials Information system (WHMIS) regarding use, handling, storage and disposal of hazardous materials; and regarding labeling and provision of material safety data sheets (M.S.D.S.).
- .2 Ensure the M.S.D.S.'s are readily available to the workers who are or may be exposed to the controlled product and to the site health and safety representative.

1.6 TRANSPORTATION OF DANGEROUS GOODS

- .1 The transportation of dangerous goods is to be carried out by certified personnel trained pursuant to the Transportation of Dangerous Goods Regulation and is authorized to serve as or act in the capacity of handler, shipper and transporter.

1.7 OVER LOADING

- .1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.8 FALSEWORK

- .1 Design and construct falsework in accordance with the latest edition of CSA S269.1.

1.9 DRUGS

- .1 Prohibit the use of alcohol and all unauthorized drugs from the site.

1.10 CONFINED ENTRY

- .1 Access to confined entry spaces shall be in accordance to all applicable guidelines. This shall include in general a standby worker outside of confined entry area, safety lifelines connected to approved hoist/retrieval system(s), air quality testing, breathing apparatus, communications system, trained workers and written procedures and formal plan for rescue.
- .2 If Departmental Representative is required to inspect confined entry spaces provide equipment and assistance as required in accordance to all applicable regulations.

1.11 MEETINGS

- .1 Contractor decisional representative must attend any meetings at which site safety and health issues are to be discussed.
- .2 Set up a site safety committee, and convene meetings in accordance with the Construction Safety Code.

1.12 SITE-SPECIFIC CONDITIONS

- .1 At the site, the Contactor must take account of the following specific conditions:
 - .1 Presence of offenders, refer to securities procedures by CSC.

1.13 COVID-19 HEALTH & SAFETY PLANNING

- .1 The Contractor will considered the recommendations of Manitoba's Chief Public Health Officer respecting COVID-19 health and safety measures and incorporate those recommendations into the Contractor's health and safety plan. The Contractor shall provide evidence to the Departmental Representative that these health and safety recommendations are in place.
- .2 Contractor shall review Federal COVID-19 safety guidelines and incorporated those recommendations into the Contractor's health and safety plan.
- .3 Contractor shall regularly review the recommendations of Manitoba's Chief Public Health Officer and update their health and safety plans accordingly.
- .4 As a Prime Contractor, the Contractor shall coordinate and enforce compliance of COVID-19 health and safety plan requirements with all Contractor staff and subcontractors.
- .5 Additional resources are provided by the Manitoba Heavy Construction Association's WORKSAFELY Program found here: <http://mhcaworksafely.ca/covid-19/>

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 REFERENCE STANDARDS

- .1 Canadian Society of Landscape Architects (CSLA) / Canadian Nursery Landscape Association (CNLA)
 - .1 Canadian Landscape Standard [2016], First Edition
 - .2 Canadian Nursery Stock Standard [2017], Ninth Edition
- .2 United States Environmental Protection Agency (EPA), Office of Water
 - .1 EPA-833-R-06-004, Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .3 Submit Environmental Protection Plan (EPP) for review by Departmental Representative before delivering materials to site or commencing construction activities.
- .4 EPP shall include comprehensive overview of known or potential environmental issues to be addressed on site during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction task [s].
- .6 Include in Environmental Protection Plan (EPP):
 - .1 Name [s] of person [s] responsible for ensuring adherence to EPP.
 - .2 Name [s] and qualifications of person [s] responsible for manifesting hazardous waste to be removed from site.
 - .3 Name [s] and qualifications of person [s] responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Submit drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
 - .6 Submit a site-specific Traffic Control Plan (TCP) including measures to reduce erosion of temporary and existing roadbeds by construction traffic, especially during wet weather.
 - .7 TCP to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
 - .8 Submit a Site Work Plan (SWP) showing work areas for proposed activities in each portion of area and identifying areas of limited use or non-use.
 - .9 SWP to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

- .10 Submit a Spill Control Plan (SCP) including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .11 Submit a Wastewater Management Plan (WMP) identifying methods and procedures for management or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

1.2 TRENCHING

- .1 Ensure all machinery has proper mufflers to reduce noise. Do not use machinery generating excessive noise, as determined by the Departmental Representative.
- .2 Control emissions from equipment and plant to meet local emission requirements.
- .3 If shallow ground water is encountered during the trenching process, backfill trench with excavated soil shortly after it is trenched to minimizing any potential risk of pollution.
- .4 The short term impacts of constructing a pipeline is mitigable with standard pipeline construction measures.
 - .1 Standard pipeline construction techniques which require the stripping and replacement of topsoil must be used. The sequence of topsoil handling and trenching operations commonly used on cultivated lands is to mitigate the short term adverse impacts of pipeline construction. Grade topsoil to the side prior to any trenching. Upon completion of backfilling replace topsoil.
 - .2 Standard pipeline construction procedures also include: Consultations with landowners; the replacement of existing fences; and the restoration of right-of-ways to their original topographic profiles.
 - .3 Standard construction mitigative techniques must include replacement of soil in compacted lifts, roaching (mounding) of excavated soils over the trench, and the seeding of the excavated area to prevent erosion.
 - .4 In the path of the pipeline some bush and shrubbery must be removed to install the pipe. In these areas limit of bush removal is to be kept to a minimum and specific local approval must be solicited prior to works being undertaken. Removed bush, shrubbery, etc., shall be hauled to the local waste disposal ground by the Contractor.

1.3 HEALTH AND SAFETY

- .1 To reduce and mitigate impact on health and safety use following mitigating measures:
 - .1 Provincial labor guidelines and regulations will be applied regarding health and safety of operator, employees and the general public.
 - .2 Complete operations during daylight hours.
 - .3 Utilize Flagmen, barricades, where and when necessary.
- .2 Discourage public from being in the vicinity of the construction by means of communications with the Contractor's foreman.

1.4 POLLUTION CONTROL

- .1 Provide methods and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious toxic substances and pollutants from construction operations.

- .2 Intercept, clean up, and dispose of spills or releases that may occur whether on land or water. Materials and equipment for cleanup to be readily accessible on site.
- .3 Promptly report spills and releases potentially causing damage to environment to:
 - .1 Authority having jurisdiction or interest in spill or release including conservation authority, water supply authorities, drainage authority, road authority, and fire department.
 - .2 Owner of pollutant, if known.
 - .3 Person having control over pollutant, if known.
- .4 Take immediate action using available resources to contain and mitigate effects on environment and persons from spill or release.
- .5 Provide spill response materials including, containers, adsorbent, shovels, and personal protective equipment. Make spill response materials available at all times in which hazardous materials or wastes are being handled or transported. Spill response materials: compatible with type of material being handled.
- .6 Seed the disturbed soil along the ditches. Restore the road surface as part of the contract Works. The grass growth to minimize dust and the gravel to minimize mud conditions.
- .7 If conditions are dry and windy causing excessive dusting and blowing of soils towards residents, Contractor to temporarily shut down or utilize water trucks and water or water and calcium chloride to control dust.

1.5 WASTE MATERIAL AND FIRE

- .1 Rubbish and Waste Materials
 - .1 The burning of rubbish is prohibited.
 - .2 Do not bury rubbish and waste materials.
 - .3 Contractor to install a waste container for rubbish and waste at construction site.
 - .4 Remove all rubbish from the work site at the end of the work day or shift or as directed. Rubbish and waste material to be hauled to a landfill site approved by Manitoba Sustainable Development.
 - .5 Store oily waste in approved receptacles to maximize cleanliness and safety.
 - .6 Contractor shall provide a plan for wastewater management, indicating the methods and procedures to be implemented for the management and disposal of wastewater from direct construction activities, such as water used for curing concrete, concrete wastes from washing out concrete trucks, wash water / cleaning, emptying, disinfection, hydrostatic testing of pipelines and rinsing.
- .2 Flammable and Combustible Liquids
 - .1 The handling, storage and use of flammable and combustible liquids are to be governed by the current National Fire Code of Canada.
 - .2 Flammable and combustible liquids such as gasoline, kerosene and naphtha will be kept for ready use in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval.
- .3 Supply fire extinguishers necessary to protect, the work in progress and the Contractor's physical plant on site. When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers, equipped with sufficient fire extinguishers.

1.6 REPORTING FIRES

- .1 Know the emergency phone number for fire response.
- .2 Report immediately all fire incidents to the Fire Department.
- .3 When reporting a fire by telephone, give location of fire, name or number of building and be prepared to verify the location.

1.7 LIMITS OF WORK

- .1 To mitigate and reduce impact on land, flora and wildlife habitat limit the work area to the area that is referred to as the construction zone.
- .2 Limits of construction zone will be as defined by Departmental Representative.

1.8 FUELS AND HAZARDOUS MATERIALS

- .1 Work entailing the use of toxic or hazardous materials, chemicals and/or explosives, otherwise creates a hazard to life, safety or health, to be in accordance with the National Fire Code of Canada and the Dangerous Goods Handling and Transportation Act and Regulations.
- .2 Prevent leaks and spills during fuel handling and mitigate as follows:
 - .1 Confine fuel delivery and storage to one designated area for duration of works.
 - .2 Confine equipment re-fueling, cleaning, washing, and servicing to the designated area with warning signs indicating fueling procedures, contact information in the event of a spill, no smoking, and access restrictions.
 - .3 All dangerous good/hazardous materials shall be stored in a secure manner to prevent unauthorized access.
 - .4 Berm area around above ground storage tanks or store in double wall tanks to contain spillage or leakage. If double-walled tanks are not used, ensure the storage tanks are located over a spill containment liner along the floor and berms.
 - .5 Provide clean up material at the site, as a minimum such material to consist of 25 kg of suitable commercial sorbent, 30 sq m of 6 mil polyethylene and an empty fuel barrel for spill collection and disposal (CPWCC).
 - .6 Re-fueling vehicles to carry spill containment kit and fire suppression equipment.
 - .7 Do not store fuel or refuel or service equipment within 100 m from a waterbody including rivers, streams, lakes and wetlands.
 - .8 Designated areas for fuel storage shall be a minimum distance of 3 m from a property line or building and 15 m from hydroelectric poles and lines.
 - .9 Ensure above ground storage tanks are properly grounded.
 - .10 Barriers are to be installed around fuel storage tanks to prevent collisions.
 - .11 Storage tanks are to be properly labeled with tank contents.
 - .12 Maintain construction equipment to prevent leaks and spills of fuels, lubricants, hydraulic fluids or coolants.
 - .13 Any empty fuel containers or used oil filters are to be placed in suitable storage containers and disposed of at approved facilities.
 - .14 Employees handling and storing fuels to have safety and spill response training.
 - .15 Store fuels and collect and dispose of waste hazardous materials from construction activity and equipment in accordance with Provincial and Federal Environmental requirements.

- .16 An emergency response plan shall be in place which includes information on response to spills of hazardous materials, containment and reporting.
- .17 Clean up any spillage as per applicable Environmental guidelines and dispose of contaminated soils at a licensed disposal facility. Notify the Departmental Representative and related Local, Provincial and Federal Authorities as applicable in the event of spills or leaks of fuels or hazardous materials. Manitoba Sustainable Development 24 hour spills reporting emergency number is (204) 944-4888.

1.9 FLORA PROTECTION

- .1 Protect trees and plants on site and on adjacent properties.

1.10 HERITAGE RESOURCES PROTECTION

- .1 If any archaeological or historical resources are discovered, Works are to temporarily stop and the Departmental Representative informed. The Departmental Representative will contact the appropriate federal and provincial authorities and will provide direction to the Contractor.

1.11 DRAINAGE AND EROSION CONTROL

- .1 Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other Work areas. Prevent erosion and sedimentation.
- .2 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical. Strip vegetation, regrade, or otherwise develop to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and water courses, and repair damage caused by soil erosion and sedimentation as directed by Departmental Representative.
- .3 Install and maintain temporary measures which may include, silt fences, hay or straw bales, sten logs, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other construction required to prevent erosion and migration of silt, mud, sediment, and other debris off site or to other areas of site where damage might result, or that might otherwise be required by Laws and Regulations. Make sediment control measures available during construction. Place temporary measures in ditches to prevent sediments from escaping from ditch terminations.
- .4 Install diversion berms and cross ditches 0.6 m high on disturbed steep approach slopes to divert surface water off the Construction Zone. Ensure berms terminate in natural vegetation off the Construction Zone. Stagger ends of berms as required. All such installations are to be in accordance with DFO guidelines.
- .5 Use construction equipment that will minimize surface disturbance, soil compaction, and loss of topsoil in sensitive areas whenever practicable.
- .6 Salvage and conserve topsoil.
- .7 Backfill immediately after Works installed.
- .8 Backfill subsoil prior to replacing topsoil.
- .9 If soil and debris from site accumulate in low areas, storm sewers, roadways, gutters, ditches, or other areas where in Departmental Representative's determination it is undesirable, remove accumulation and restore area to original condition.

1.12 DEWATERING

- .1 Dewater various parts of Work including, without limitation, excavations, structures, foundations, and work areas.
- .2 Employ construction methods, plant procedures, and precautions that ensure Work, including excavations, are stable, free from disturbance, and dry.
- .3 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .4 De-water excavation in a manner that does not cause erosion of soils or sedimentation of watercourses. Do not pump water directly into the stream. Provide energy dissipation at the outlet of all pumped discharges.
- .5 Dewatering Methods: Includes sheeting and shoring; groundwater control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and other measures necessary to enable Work to be carried out in dry conditions.
- .6 Provide sufficient and appropriate labour, plant, and equipment necessary to keep Work free of water including standby equipment necessary to ensure continuous operation of dewatering system.
- .7 Take precautions necessary to prevent uplift of structure or pipeline and to protect excavations from flooding and damage due to surface runoff.
- .8 Test and analyze water generated from dewatering activities and treat to meet required discharge or disposal criteria.

1.13 CLEAN UP

- .1 Commence clean up of construction at watercourses immediately on completion of construction. Complete clean up as quickly as possible.
- .2 Implement the re-vegetation plan as soon as possible on the completion of construction.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 This Section describes administrative and procedural requirements for reactive activities to verify that completed Work conforms to Contract Documents requirements.
- .2 Provide all equipment required for carrying out inspection and/or testing by the respective Agencies. Review scope to determine what items of work are included as payment and what items are incidental.
- .3 Employment of Inspection/Testing Agencies in no way relieves the Contractor of responsibility to perform the Work in accordance with the Contract Documents.
- .4 Allow the Inspection/Testing Agencies access to all portions of the Work on site and manufacturing or fabrication plants, as may be necessary. Provide facilities for access.

1.2 LABORATORIES/AGENCIES

- .1 The scheduling, type and number of tests by an Independent Accredited Inspection/Testing Agencies for the purpose of inspecting and/or testing portions of the Work will be determined by the Departmental Representative based on his exclusive evaluation of site conditions at the time of construction.
- .2 Employment of Inspection/Testing Agencies in no way relieves the Contractor of responsibility to perform the Work in accordance with the Contract Documents.

1.3 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Departmental Representative are specified under various sections.

1.4 INSPECTION

- .1 The Departmental Representative will conduct periodic inspections and reviews of the Work in progress, to determine if the Work is proceeding in general conformity with the Contract Documents.
- .2 The Departmental Representative will have the authority to inspect, test, measure and reject work which in the Departmental Representative's opinion does not conform to the requirements of the Contract Documents. Such reviews or inspections, or lack thereof, shall not give rise to any claims by the Contractor in connection with construction means, methods, techniques, sequences and procedures, safety precautions and programs or general construction practice; the entire responsibility to complete Work in accordance with the Contract Documents belongs exclusively with the Contractor.
- .3 Allow Departmental Representative and their representatives access to the work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .4 If work is designated (a) in the Contract Documents or (b) by the Departmental Representative's instructions or (c) laws or ordinances of the Place of Work for (i) special tests, (ii) inspections, (iii) measurements or (iv) approvals give timely and reasonable notice of when the Work will be ready for review and inspection.
 - .1 Inspection of Certain Construction Operations of the Work: The Contractor shall ensure that the Departmental Representative is at the Work Site while the

following construction operations of the Work are in progress, unless otherwise authorized by the Departmental Representative. Thus the following construction operations have hereby been designated for (i) special tests, (ii) inspections, (iii) measurements or (iv) approvals.

- .1 Pipe installation.
 - .2 Backfill operations.
 - .3 Placing concrete.
 - .4 Construction involving existing work or Utilities.
 - .5 Work on Building which shall be concealed.
 - .6 Commissioning and training.
- .5 If Contractor covers or permits Work to be covered that has been designated for special tests, inspections, record drawing measurements or approvals before such is made, uncover such Work, have inspections, tests or measurements satisfactorily completed and pay costs for making good such Work.
 - .1 Pipe installation.
 - .2 Backfill operations.
- .6 Departmental Representative may order any part of work to be examined if Work is suspected to be not in accordance with Contract documents. If, upon examination by the Departmental Representative, such work is found to not be in accordance with Contract Documents, correct such Work and pay costs of examination and correction. If such Work is found by the Departmental Representative in accordance with Contract Documents, Departmental Representative shall pay costs of examination and replacement.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit schedule of testing and inspection activities to Departmental Representative, applicable Subcontractors, testing agencies, and other affected parties. Include the following:
 - .1 List each testing and inspection agency
 - .2 Identify types of tests and inspections for each agency, and cross reference to applicable specification Section number-title in Contract Documents
 - .3 Description of test and inspection
 - .4 Identify applicable reference standard
 - .5 Identify test and inspection method
 - .6 Indicate number of each test and inspection required
- .2 Submit one digital copy of each quality assurance inspection and test report to Departmental Representative, except where a technical specification Section indicates otherwise.
- .3 Submit reports for inspection and testing required by Contract Documents or by AHJ and performed by Contractor-retained inspection and testing agencies within [ten] days after inspection or test is completed, except where a technical specification Section indicates a different time period.
- .4 Submit one digital copy of each quality control inspection and test report to Departmental Representative, except where a technical specification Section indicates otherwise.

- .5 Deliver copies of quality control reports to Subcontractor of work being inspected or tested.

1.6 REFERENCES

- .1 Inspection and/or testing will be performed in accordance with the most recent and pertinent standard of the American Society for Testing and Materials (ASTM) and the Canadian Standards Association (CSA).
 - .1 ASTM D698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .2 ASTM D6938-17ae1 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - .3 Concrete to CSA A23.1:19/A23.2:19, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
- .2 Maintain copy of related Standard/code on jobsite during works involving such standards/codes.

1.7 APPOINTMENT AND PAYMENT

- .1 Departmental Representative will and pay for the following services by an independent accredited testing lab.
 - .1 Density testing.
 - .2 Proctors.
 - .3 Concrete testing
 - .4 Additional tests specified elsewhere.
- .2 Where tests or inspections by designated testing laboratory reveal work not in accordance with contract requirements, Contractor shall pay costs for additional tests or inspections as Departmental Representative may require to verify acceptability of corrected work.
- .3 When interim or final inspections and tests on installation, assemblies and equipment fail to receive approval by Departmental Representative, all costs incurred to re-visit the project site for further inspection shall be paid by the Contractor.
- .4 Inspection by Departmental Representative shall include visits to the site as may be required to review execution of the design and to give field guidance for the assistance of the Contractor. At no time shall this inspection service relieve the Contractor of any responsibility for defects from faulty works, materials, errors or omissions.

1.8 CONTRACTOR'S RESPONSIBILITIES

- .1 Furnish labour and equipment to:
 - .1 Provide access to work to be inspected and tested.
 - .2 Facilitate inspections and conduct tests.
 - .3 Make good work disturbed by inspection and test.
 - .4 Provide assistance to Departmental Representative as required.
- .2 Complete initial testing of all granular materials and provide acceptable representative gradation results and densities from a certified lab as approved by Departmental Representative. This includes a standard proctor density for each class of material. Granular materials include:
 - .1 Sand used for bedding and backfill.

- .2 C base.
- .3 A base.
- .3 Notify Departmental Representative sufficiently in advance of scheduling of tests to allow for review of schedule and testing procedures.
- .4 Reporting: Authorize and direct Contractor's testing agency to copy Departmental Representative directly with results of all testing completed.
- .5 Representative Sampling: Be responsible to provide representative samples to testing laboratory. Where existing stockpiles are proposed utilize machinery as required to manipulate pile to provide representative face(s) for sampling.
- .6 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .7 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .8 For cold weather concreting provide a heated enclosure near concrete trucks for purposes of inspectors use to obtain and test concrete samples.

1.9 PROCEDURES

- .1 Notify the Departmental Representative minimum 48 hours (2 working days) in advance of any testing.
- .2 Schedule and submit samples and/or materials required for testing to eliminate delay in the Work.
- .3 Ensure all sample results are promptly reported with copies to the Departmental Representative.
- .4 Provide facilities to allow inspection and/or testing and make available space for storage and curing of the test samples.
- .5 Be responsible to cure concrete cylinders prior to arrival at testing laboratory in Winnipeg as per CSA standards.
- .6 If defects are revealed during inspection and/or testing the Departmental Representative may issue instructions for removal or correcting defective work and irregularities. The Contractor shall notify the Departmental Representative within two (2) working days if such instructions are in error or at variance with the Contract Documents.
- .7 Replace any material rejected by the Departmental Representative that, in whole or in part, does not conform to the Specifications or is found to be defective.

1.10 CONCRETE INSPECTION AND TESTING

- .1 Notify Departmental Representative at least two working days before complete formwork and concrete reinforcement will be ready for inspection.
- .2 Allow 24 hours time for inspection and corrective work, if required, before scheduling concrete placement.
- .3 Provide free access to all portions of work and co-operate with appointed firm.
- .4 Submit proposed concrete mix design sealed by a Professional Engineer registered in Manitoba for each class of concrete a minimum of 7 days prior to commencement of work.

- .5 Provide representative samples of aggregates for testing a minimum of 14 days before first concrete pour and provide access to aggregate stockpiles to the Departmental Representative for sampling for additional testing.
- .6 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.
- .7 Take one test for each individual placing operation which exceeds 7.5 cubic metres or at least one test for each 20 cubic metres of concrete placed on day of operation (approx. every third truck).
 - .1 The independent inspection firm is to remain onsite until all concrete has been placed.
- .8 One test is defined as follows:
 - .1 Slump test, air content test and compressive strength tests at frequency as defined in Item 1.10.7 on:
 - .1 Three lab cured cylinders (one for 7 day break and two for 28 day breaks) for Type GU concrete.
 - .2 Four lab cured cylinders (one for 7 day break, one for 28 day break and two for 56 day breaks) for Type HS concrete.
 - .2 Up to 2 hours of slump and air testing at the discretion of the Departmental Representative. Testing could be as frequent as one test per truck for a maximum of 2 hours of testing by the independent inspection firm.
- .9 Two additional site cured cylinders will be taken during cold weather concreting and be cured on the job site under the same conditions as concrete it represents.
- .10 Additional slump tests may be taken as necessary to verify quality of concrete as directed by Departmental Representative.
- .11 Be responsible for curing of the field cast concrete cylinders prior to delivery to the testing laboratory and to deliver the test cylinders to testing company offices in Winnipeg as directed by the Departmental Representative.
- .12 The method of storage, curing, testing and reporting shall be in accordance with CAN3-23.2.
- .13 Re-test to Departmental Representative's approval any workmanship or materials which do not meet specifications. Repair or replace all work found to be faulty unless an alternative solution is accepted by Departmental Representative.
- .14 Inspection or testing by the Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of Contractor's contractual responsibility.

1.11 EQUIPMENT AND SYSTEMS

- .1 Submit testing, adjusting and balancing reports for mechanical, electrical and building equipment systems.
- .2 Submit Commissioning documentation in accordance with Section 01 91 13.
- .3 Refer to Divisions 22, 23, 26 and 40.

1.12 CONFORMANCE

- .1 If there are questions as to whether any product or system is in conformance with applicable standards, the Departmental Representative reserves the right to have such

products or systems tested to prove or disprove conformance. The cost for any testing that is not specifically outlined, implied or stated as a requirement in the specifications will be borne by the Departmental Representative in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.2 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

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

1.2 ACCESS

- .1 Provide and maintain adequate access to project site by way of main roadway.
- .2 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and repair damage resulting from Contractor's use of roads.
- .3 Clean dirt or mud tracked onto paved or surfaced roadways.
- .4 Maintain access to all existing buildings around the construction activity.
- .5 In the event of roads being temporarily closed to the travelling public, provide, erect and maintain all requisite barriers, fences or other proper protection and keep and maintain such patrollers, lights and danger signals as may be necessary, or as may be required to ensure safety to the public and to the workers.
- .6 During the Contractor's operations, provide and maintain reasonable road access and egress to properties fronting along or in the vicinity of the work under contract, unless other means of road access exists.
- .7 Provide adequate barricades, detour signs, warning signs and flashing lights.
- .8 Ensure that the barricades, flags and warning devices are properly maintained.
- .9 Make every attempt to keep construction works from other properties, if other properties are affected perform all necessary remedial works and clean up on those affected properties.
- .10 Perform the works with care, do not damage obstacles i.e. trees, buildings, poles, fences, etc.

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 MATERIAL STORAGE

- .1 Provide adequate weather storage with raised floors, for storage of materials, tools and equipment which are subject to damage by weather.
- .2 Sheds must be able to withstand pressures due to wind and snow loading.

- .3 Store materials in accordance with Manufacturer's instructions.

1.5 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force, in compliance with the *Onsite Wastewater Management Systems Regulation* No. 83/2003.
- .2 Locate portable toilets within 40 m of construction activity.
- .3 Clean toilets on a regular basis and maintain supply of paper.
- .4 Empty toilets and haul septage to an approved treatment facility for disposal.
- .5 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .6 Toilet indoor temperature should be at least 22°C.

1.6 SITE ENCLOSURES

- .1 Erect temporary site enclosure around proposed wastewater trash removal building project site for the period of construction using new 1.8 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m o/c. See CSC Technical Standard Section SP-6 paragraphs 3.1.
- .2 Provide one lockable truck gate for fenced area. Maintain fence in good repair.
- .3 Erect enclosure to allow access for installation of materials and working inside enclosure.
- .4 Post "Construction Site – No Trespassing" signs around enclosure.

1.7 ENCLOSURE OF STRUCTURE

- .1 Provide temporary weathertight enclosures and protection for exterior opening until exterior doors are installed. Design enclosures to withstand wind pressure. Provide lockable entry as required for moving personnel, equipment and materials.
 - .1 Install doors on a schedule that is during plant commissioning.
- .2 Provide temporary enclosures to secure building from entry of unauthorized personnel during construction period.

1.8 HEATING AND VENTILATING

- .1 Pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment. Use of direct-fired heaters discharging waste products into work areas will not be permitted.
- .2 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.
 - .6 Provide temporary building enclosure for cold weather protection for mixing, delivery, placement, finishing and curing of all concrete in accordance with CSA

- A23.1. Enclosure to be minimum 2.4 m above top of floor to prevent interference with work.
- .3 Maintain minimum temperature of 10°C or higher as soon as building shell is enclosed and maintain until acceptance of structure by Departmental Representative.
 - .1 Maintain ambient temperature and humidity levels as required for comfort of office personnel.
- .4 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.
- .5 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .6 Maintain temporary lighting in temporary enclosure for concrete placement and in building during construction.

1.9 POWER

- .1 Arrange, pay for and maintain temporary electrical power supply in accordance with governing regulations and ordinances.
 - .1 Pay for all hydro charges as applicable until the building is commissioned.
- .2 Install temporary facilities for power such as pole lines and underground cables to approval of local power supply authority.
- .3 Connect to the power supply in accordance with Canadian Electrical Code and provide meter and switching.
- .4 Electrical power and lighting systems existing or installed under this Contract can be used for construction requirements with prior approval of Departmental Representative, provided that guarantees for new systems are not affected thereby. Provide, maintain and pay for all temporary power and light, including connections, disconnections and extensions when using existing or new system.
- .5 No connection to existing facilities for temporary power will be permitted.

1.10 SCAFFOLDING

- .1 Design and construct scaffolding in accordance with CSA S269.2.

- .2 Construct and maintain scaffolding in rigid, secure and safe manner.
- .3 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.11 HOISTING

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

1.12 REMOVAL OF DEBRIS AND TEMPORARY FACILITIES

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Remove temporary facilities from site when directed by Departmental Representative.

1.13 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 MATERIAL SUPPLIED

- .1 Use new material (in current production and not discontinued) unless otherwise specified.
- .2 Notify Departmental Representative in writing if any proposed products have been or are scheduled to be discontinued.
- .3 Within 14 days after contract award, submit to the Departmental Representative a complete list of major products proposed to be used, with:
 - .1 Name and address of manufacturer
 - .2 Trade name, model and catalogue number
 - .3 Performance, descriptive and test data
 - .4 Manufacturer's installation or application instructions
 - .5 Evidence of arrangements to procure.
- .4 Provide material of specified design and quality, performing to published ratings and for which replacement parts are readily available.
- .5 All material supplied under this specification shall be subject to inspection and testing by the Departmental Representative or by the Testing Laboratory designated by the Departmental Representative. All materials shall be approved before any construction is undertaken.
- .6 If any material, in whole or in part, does not conform to the Specification detailed herein or is found to be defective then such material shall be rejected by the Departmental Representative and replaced by the Contractor at the Contractor's expense.
- .7 Use products of one supplier for equipment or material of same type or classification unless otherwise specified.

1.2 MANUFACTURER'S INSTRUCTIONS

- .1 Be responsible for obtaining manufacturer's literature and for correct roughing-in and hooking up of equipment, fixtures and appliances. An example is couplers supplied for joining pipes to meet manufactures recommendations for pipe type being installed.
- .2 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods to be used.
- .3 Notify Departmental Representative in writing of any conflict between the Contract documents and manufacturer's instructions. Departmental Representative will designate which document is to be followed.

1.3 DELIVERY AND STORAGE

- .1 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .2 Prevent any damage, adulteration and soiling of material and equipment during delivery, handling and storage. Immediately remove rejected material and equipment from site.
- .3 Store material and equipment in accordance with manufacturer's instructions.

- .4 Store products in original packaging or grouped into lots; leave intact packaging, label and manufacturer seal. Do not unpack or unlink products before the time of incorporation into the work.
- .5 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction. Use primer or enamel to match original. Do not paint over name plates.

1.4 TRANSPORTATION

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

1.5 CONFORMANCE

- .1 When material or equipment is specified by standard or performance specifications, upon request by Departmental Representative, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.

1.6 MANUFACTURER'S INSTRUCTIONS

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

1.7 QUALITY OF WORK

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

1.8 CO-ORDINATION

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

1.9 LOCATION OF FIXTURES

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

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

1.10 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.

1.11 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.

1.12 PROTECTION OF WORK IN PROGRESS

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

1.13 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 building occupants.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.14 CONSTRUCTION EQUIPMENT AND PLANT

- .1 Upon request, prove to the satisfaction of the Departmental Representative that the construction equipment and plant are adequate to manufacture, transport, place and finish work to the quality and production rates specified. If inadequate, replace or provide additional equipment or plant as directed.
- .2 Maintain construction equipment and plant in good working order.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE POINTS AND SURVEYS

- .1 Location and elevation of bench marks and reference points are shown on Drawings. .
- .2 All data to UTM CSRS NAD 83 coordinates, with geodetic elevation conforming to CGVD2013. Complete survey using GRID projection method in metric units.
- .3 Dimensions for lines and grades of structures, appurtenances, and utilities are indicated on the Drawings, together with other pertinent information required for laying out work. If conditions vary from those indicated, notify Departmental Representative immediately, who will make minor adjustments if required.
- .4 Departmental Representative may perform checks to verify accuracy of Contractor's layout work and that completed work complies with Contract Documents. Provide unrestricted access.
- .5 Any existing survey points or other control markers destroyed without proper authorization will be replaced at the Contractor's expense.
- .6 Departmental Representative will provide .dwg electronic files for the Contractor's use as per the following. Information provided will include plan view layout. Be responsible to import elevation (z). **Be responsible for any and all errors in data in comparisons to printed figures and dimensions shown on the plans.**

1.2 QUALITY CONTROL AND RECORD DATA

- .1 Allow the Departmental Representative unencumbered access to obtain survey records and data for all quality control, general conformance review and record data during and after construction activities that the Departmental Representative, at its sole discretion, determines is required.
- .2 Adjust construction activities as may be required from time to time to allow a reasonable window of time to allow the Departmental Representative to obtain required data and to allow such measurement work to proceed unencumbered. Do not proceed with the next stage of any construction until the Departmental Representative has completed measurements of the previous work.

1.3 CONTRACTOR SURVEYOR

- .1 Provide a qualified surveyor to conduct survey services during construction, with qualifications subject to review and acceptance of the Departmental Representative. Contractor to submit qualifications for review.
- .2 Submittal prior to start of construction: Prior to start of Work, submit name and address of qualified surveyor, intended instrumentation and methods to complete Contractor layout, quality control surveys and proof of qualifications.
- .3 If in the Departmental Representative's sole opinion the Contractor's method of setting lines and grades is insufficient for proper quality control or the site Surveyor is not qualified the Contractor shall alter methods or personnel used as required to ensure proper layout and control of grades and levels is maintained.
- .4 Preserve and leave undisturbed control staking until Departmental Representative has completed checks deemed necessary.

1.4 CONTRACTOR'S RESPONSIBILITY

- .1 Be responsible for establishing all secondary control points and/or lines, all slope stakes, the establishment of line and grades for subgrade and the various granular aggregate layers, layout by line and grade of all structures, culverts, and underground utilities, and perform all other layout and measurement necessary for the proper execution of the Contract
- .2 Before commencing work, accept all liabilities relating to the meaning and correctness of all stakes and marks and no claims shall be entertained on account of any alleged inaccuracies. If any error is suspected in the Plans, Drawings, Specifications, onsite staking or the direction of the Departmental Representative, work shall be discontinued until the errors are rectified, but no claims shall be made on account of any delay occasioned thereby. Assume full responsibility for the alignment, dimensions and elevations of each and every part of the work and their mutual agreement.
- .3 Should the Contractor discover or suspect any errors in any control points, control lines, benchmarks, and data provided by the Departmental Representative, the Contractor shall at once discontinue the affected work until such errors are investigated by the Departmental Representative and, if necessary, rectified.
- .4 On request of the Departmental Representative, submit documentation to verify the accuracy of the layout work.
- .5 Be responsible for/to:
 - .1 Survey and layout as required for all grading, underground services and other work executed under this contract to all lines, elevations, reference points and measurements based on plans, specifications, basic control points and benchmark(s) supplied by Departmental Representative.
 - .2 Provide a dedicated competent survey assistant (rod man) as may be required for use by the Departmental Representative at any time as determined by the Departmental Representative to allow the Departmental Representative to check lines and grades and survey excavations. No compensation shall be paid for required assistance in setting or checking lines and grades or for the loss of time. Survey assistant to be responsible to place all stakes and markers into the ground as directed by the Departmental Representative.
 - .3 Setting up base station suitable for GPS GNSS survey and machine grade control.
 - .4 Install reference control points at key locations as deemed necessary to allow daily checks of all machine grade control equipment. Be responsible for and protect the reference control points from damage. Re-check each reference control point at least weekly.
 - .1 Check every machine with grade control into a known control point on a daily basis. For machines with blades check both the left and right side.
 - .5 In event of discrepancy in data or staking provided by Departmental Representative, request clarification before proceeding with Work.
 - .6 Preserve and leave undisturbed control staking until Departmental Representative has completed checks deemed necessary.
 - .7 Cooperate with Departmental Representative so that checking and measuring may be accomplished with least interference to Contractor's operations.
 - .1 Provide assistance as required in attaining survey points in confined areas and trenches such that Departmental Representative does not enter such confined area or trench.

- .2 Complete staking of all works to have sufficient accuracy and frequency for the Departmental Representative to carry out its quantity measurements and quality assurance program.
- .3 Rectify all errors in position, levels, alignment or dimensions at no cost to the Departmental Representative.
- .4 Supply: Supply stakes, paint, flagging and other materials for Contractor's and Departmental Representative's use as required for laying out work and for quality control and record purposes. Stakes to be wood with minimum dimensions of 20 mm thick x 45 mm wide x 1.2 m long with a pointed end.
- .5 Employ competent person(s) to lay out work that is the Contractor's responsibility.
- .6 Supply Departmental Representative all Survey data utilized upon request of Departmental Representative.
- .7 Give at least two days notice to the Departmental Representative prior to requiring any staking of work and to allow Departmental Representative to complete checks and reviews.
- .8 Maintain a complete, accurate log of control and survey work as it progresses.
- .9 Records and quality control: See heading below.
- .10 The checking of the work by the Departmental Representative will not relieve the Contractor of any responsibility for correctness of the work.

1.5 DEPARTMENTAL REPRESENTATIVE'S RESPONSIBILITY

- .1 Provide plans with dimensions suitable to construct works and to provide .dwg files as indicated.
- .2 Provide locations for placing rebar markers for property corners as indicated.
- .3 Complete quality control inspections and reviews as required

1.6 QUALITY ASSURANCE

- .1 All Work is subject to Departmental Representative's quality assurance inspection and testing, as determined appropriate by the Departmental Representative, at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.
- .2 Quality assurance inspections and tests are for the sole benefit of Departmental Representative and do not
 - .1 Relieve Contractor of responsibility for providing adequate quality control measures or quality assurance inspections and tests that are specified in the Contract Documents and other Sections of this Specification.
 - .2 Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
 - .3 Constitute or imply acceptance; or
 - .4 Affect the continuing rights of the Departmental Representative after acceptance of the completed Work.
- .3 The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

- .4 Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Departmental Representative.
- .5 The responsibility for providing quality assurance disciplines for verifying the work is performed in accordance with the Contract Document rests with the Contractor. The Contractor's Quality Assurance Plan shall apply to the assurance of quality throughout all areas of Contract performance as specified in this Section and Section 01000.

1.7 PROTECTION

- .1 Be responsible for and protect all lines, elevations, reference points and measurements of grading, underground services, utilities, permanent benchmarks, temporary benchmarks, survey monuments, Departmental Representative established control points, other reference points and other work executed under this contract from damage. If the Contractor displaces, loses, or removes markers of any type during their operations, be responsible to reset them or have them reset at the Contractor's expense.

1.8 LASER INSTRUMENTATION

- .1 Sewer main grade control: Use of a laser level for sewer main grade control is mandatory.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .3 Provide adequate ventilation during use of volatile or noxious substances. Use for building ventilation systems is not permitted for this purpose.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Departmental Representative or other Contractors.
- .2 Remove waste materials and debris from site at the end of each working day. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building.
- .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 Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 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 When the Work is Totally Performed, remove surplus products, tools, construction machinery and equipment. Remove waste products and debris other than that caused by the Departmental Representative or other Contractors.
- .4 Remove waste materials from the site at regularly scheduled times or dispose of as directed by the Departmental Representative. Do not burn waste materials on site.

- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Leave the work broom clean before the inspection process commences.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Clean and sweep roofs.
- .15 Sweep and wash clean paved areas.
- .16 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .17 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .3 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .4 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .5 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .6 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .7 Separate Condition: Refers to waste sorted into individual types.
- .8 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.

1.2 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 authorities having jurisdiction.
- .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 recycling facility.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Unless specified otherwise, materials for removal become Contractor's property.

- .2 Protect, stockpile, store and catalogue salvaged items.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to approved local facility.
- .4 Protect structural components not removed for demolition from movement or damage.
- .5 Support affected structures. If safety of building is endangered, cease operations and immediately notify Department having jurisdiction.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Separate and store materials produced during dismantling of structures in designated areas.
- .8 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.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of any waste into waterways, storm, or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .4 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.5 USE OF SITE AND FACILITIES

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

1.6 SCHEDULING

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

Part 2 Products (Not applicable)

Part 3 Execution

3.1 APPLICATION

- .1 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 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 or distribution of salvaged materials to third parties is not permitted.

END OF SECTION

Part 1 General

1.1 CLEAN UP AND FINAL CLEANING OF WORK

- .1 Maintain Work in a tidy condition and free from accumulation of waste and debris.
- .2 Remove all waste materials and debris from the site or dispose of as otherwise directed by the Departmental Representative. Do not burn waste material onsite.
- .3 Perform the following prior to application for Substantial Performance:
 - .1 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, ceilings, walls and floors.
 - .2 Make a thorough inspection of all finishes, fitments and equipment and ensure proper workmanship and operation.
 - .3 Broom clean walks, steps, floors and platforms.
 - .4 Remove all dirt and other disfigurations from interior and exterior surfaces.
 - .5 Clean and remove all debris and surplus materials.
- .4 When work is substantially completed, remove all surplus materials, tools, construction machinery and equipment not required for the performance of the remaining work. Leave the work area clean, swept and washed down suitable for occupancy.
- .5 When completion tasks are done, request final inspection of Work by Departmental Representative, and Contractor.
- .6 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.
- .7 Turn over to Departmental Representative all keys and special tools, properly tag all keys and tools giving names of equipment, hardware, room or item to which they are used.

1.2 REMOVAL OF TEMPORARY FACILITIES

- .1 Prior to application for Substantial Performance, remove all temporary offices and furniture, hoardings, fencing, tree and plant protection and all other items used to aid the performance of work. Restore area to original (pre-construction) state.

1.3 DEPARTMENTAL REPRESENTATIVE'S REVIEW OF DEFICIENCIES

- .1 Prior to application for Substantial Performance, carefully inspect all work and ensure it is complete, all processes and related equipment to be fully operational, construction deficiencies completed and/or corrected, clean up works completed, and the building in proper conditions for occupancy. Notify the Departmental Representative in writing, of satisfactory completion of inspection and request a Departmental Representative's inspection.
- .2 Departmental Representative will complete a review prior to the issuance of the Substantial Performance to evaluate if there are any deficiencies to the works. Be responsible to rectify all deficiencies and notify the Departmental Representative so the next review can be scheduled.
 - .1 Provide a written response to each and every item listed (Departmental Representative will provide a "Word" copy upon request) on a minimum of a

monthly basis or sooner if all items have been addressed. In the written response for each item provide information as applicable in accordance to the following:

- .1 List action contemplated and related sub-contractor(s) completing investigations and works.
 - .2 Describe (a) problems found as applicable to deficiency item and (b) corrective action will be or has been taken for repairs/correction.
 - .3 Date of verification that corrective action has fully addressed the issue or proposed date when corrective action will be completed.
 - .4 Photo and/or video documentation showing the corrected deficiencies.
 - .5 Clear statement that indicates if item has or has not been fully investigated and addressed.
- .3 The deficiency list will be amended if additional deficiencies are found during future inspections during the warranty period. This shall exclude warranty items.
 - .4 When all deficiencies have been addressed and the written response as indicated above has been submitted, request a subsequent inspection.
 - .5 A second review by the Departmental Representative will be completed without holding the Contractor responsible for Engineering costs related to the second review.
 - .6 If a third or any additional reviews after the second review by the Departmental Representative determines that the Contractor has not addressed all deficiencies from the first or subsequent review the Departmental Representative retains the right to hold the Contractor responsible for Engineering fees and disbursements of additional reviews, such additional costs may be deducted from the overall payments due.
 - .7 Training will be considered an integral part of overall works in respect to completion.

1.4 CLEANING AND CLEAN UP

- .1 Upon completion and before final acceptance of work remove and dispose waste, surplus and useless materials, and rubbish to the satisfaction of the Departmental Representative.
- .2 Refer to Section 01 74 00 - Cleaning

1.5 START-UP TESTS

- .1 Test all equipment and circuits installed in the presence of the Departmental Representative and co-operate with the suppliers of equipment to ensure equipment will operate in the manner intended, for turnover to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

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

1.2 OPERATING AND MAINTENANCE MANUALS

- .1 Other specification sections indicate Operating and Maintenance (O&M) information, training and record drawings that are to be provided in hard copy and PDF. Incorporate all O&M data, training information and record drawings as requested into one overall submission. Provide index of entire submission.
- .2 Two weeks prior to substantial performance of project submit to the Departmental Representative final copies of Operations Data and Maintenance manual in English. Substantial performance will not be considered unless operating and maintenance manuals are received to the satisfaction of the Departmental Representative.
 - .1 Provide three final hard copies and three USB versions of final hard copy submitted. The electronic submission is to consist of one searchable PDF file.
 - .2 Provide individual pdf files based on major sections and groupings with appropriate files names and indexes. Include all building and major equipment plan sets provided during construction, revised to record drawings where applicable.
 - .1 Label and index USB's. Provide custom permanent typed labels on each USB that indicate this is Operational and Maintenance Manual for project, location and discipline as applicable. Where available use Owner's "logo" or picture of the site as an overlay. Clearly label each USB. Include the date.
 - .2 Provide a "How to Use this Electronic Document" preface section.
 - .3 Provide a Microsoft Word formatted index of each USB with a "brief" written description of what each file on the USB contains. Ensure index page numbers match actual page numbers of document.

- .4 Orientate all files to be viewed so that text rotation is not required. Edit as required by rotating final copy saved so that when viewed it appears in the correct orientation on the monitor.
- .5 Load all O&M, training and record drawing data on USB's onto a single folder on the PC hard drive and back up drive.
- .3 At least 45 days prior to the anticipated date for substantial performance submit to the Departmental Representative for review one draft copy of the operating and maintenance manuals.
- .4 Submission to be made up as follows:
 - .1 Bind data in vinyl hard covered, 3 ring loose leaf binder for 215 x 280 mm size paper. Do not "overfill" binder, fill binders to a maximum of 85% of it's intended capacity.
 - .1 D-Ring presentation binder, normal non-locking or alternate binders are not acceptable.
 - .2 When multiple binders are used, correlate data into related consistent groupings.
 - .3 Assign a number and letter to each section in the manual. The number is to correspond to the specification numbering system and items shall be provided in the order that they appear in the specifications.
 - .4 Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of project; identify subject matter of contents.
 - .5 Prepare a table of contents for each volume, with each product or system description identified, in three parts as follows:
 - .1 Part 1: Directory, listing names, addresses, and telephone numbers of Departmental Representative, Contractor, Subcontractors, and major equipment suppliers.
 - .2 Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section for each category, identify names, addresses, and telephone numbers of subcontractors and suppliers.
 - .1 Significant design criteria.
 - .2 Operating instructions.
 - .3 List of equipment and parts list for each component.
 - .4 Maintenance instructions for equipment and systems.
 - .5 Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents - where applicable.
 - .3 Part 3: Project documents and certificates, including the following:
 - .1 Shop drawings and product data.
 - .2 Certificates and originals of warranties and bonds.
 - .6 Contents each volume.
 - .1 Table of Contents: Provide a table of contents with title of project; names, addresses, and telephone numbers of

- Departmental Representative, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
 - .2 Listing: For each product or system list names, addresses and telephone numbers of Contractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: Mark each sheet to clearly identify specific products, component parts and data applicable to installation. Delete inapplicable information.
 - .4 Drawings: To supplement product data to illustrate relations of component parts of equipment and systems and to show control and flow diagrams.
 - .5 Warranties: Bind in copy of each as specified.
 - .6 Text as Required: Type text as required to supplement product data, providing logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- .5 Manuals for Equipment and Systems.
- .1 For each item of equipment and each system include description of unit or system, and component parts identifying function, normal operating characteristics, and limiting conditions.
 - .1 Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
 - .2 Operating procedures include:
 - .1 Startup, break-in, and routine normal operating instructions and sequences.
 - .2 Regulation, control, stopping, shut-down, and emergency instructions.
 - .3 Summer, winter, and any special operating instructions.
 - .3 Maintenance Requirements include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .4 Provide servicing and lubrication schedule, and list of lubricants required.
 - .5 Include manufacturer's printed operation and maintenance instructions.
 - .6 Include sequence of operation by controls manufacturer.
 - .7 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .8 Provide control diagrams by controls manufacturer as installed.
 - .9 Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.
 - .10 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - .11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .12 Additional Requirements as specified in individual product specification sections.

- .13 Provide a listing in table of contents for design data, with tabbed dividers and space for insertion of data.
- .14 Enclose typed title sheet, labeled "Operating and Maintenance Manual", project name, date and list of contents, names of contractors, consultants and sub consultants. Organize contents into applicable sections of Work to parallel project specification break-down. Mark each section by labeled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .15 Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- .16 Neatly type list and notes. Use clear drawings, diagrams or manufacturer's literature. Bind in copies of all guarantees.
- .17 Utilize a separate pouch for drawings larger than 210 mm x 431 mm, one pouch per drawing.
- .6 Include following information plus data specified:
 - .1 Maintenance instruction for finished surface and materials.
 - .2 Copy of hardware and paint schedules.
 - .3 Description, operations and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
 - .4 Additional material used in project listed under various sections showing name of manufacturer and source of supply.
 - .5 List of suppliers names and addresses for each piece of equipment.
 - .6 Bind in copies of all guarantees.
 - .7 Refer to Mechanical and Electrical Divisions for specific details of Mechanical and Electrical data.
 - .8 Detailed operating instructions for all mechanical and electrical equipment.
 - .9 Service manuals outlining complete maintenance procedures and safety measures for all equipment.
 - .10 Illustrated parts list for all equipment, with local suppliers' names and addresses. In all cases the closest local distributor or authorized repair depot must be listed regardless of the initial purchase outlet.
 - .11 Complete and detailed lubrication schedules for all equipment and components.
 - .12 Final corrected and reviewed shop drawings for all equipment.
 - .13 Final corrected installation drawings for all equipment and equipment operation curves.
 - .14 Start-up test reports.
 - .15 Listing of maintenance material including stand by equipment.
 - .16 Complete information on the process equipment including manufacturer's literature and instructions on all components, including piping and equipment, control panel, monitoring equipment, motors, blowers, disinfection, filters and service instructions.
 - .17 Complete information on the Heating and Ventilation including manufacturer's literature and instructions on all components, including heaters, ventilation fans and controllers.
 - .18 Complete information on the Maintenance Equipment and spare parts including manufacturer's literature and instructions on all components. Supply a complete

- equipment and spare parts list prominently displayed in a protective plastic covering near the operator's workbench.
- .19 Complete operational, maintenance and troubleshooting information. Include daily and summary log sheets.
- .20 Procedures to be followed in the event of equipment failure.
- .21 Other items of instruction as recommended by manufacturer of each system of item of equipment.
- .22 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- .23 Safety precautions.
- .24 Complete listings of all guarantees, warranties and bonds.
- .7 Organize contents into applicable sections of work to parallel project specification breakdown. Mark each section by colored labeled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .8 Group contents and sections according to equipment function (i.e. distribution pumps, raw water pumps, transfer pumps, fire pumps, etc...) complete with related components (i.e. fire pump controller information together with vertical turbine information).
- .9 Include with each copy of Operating and Maintenance manual, a complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- .10 Update manuals as required to include commissioning data. Commissioning data to include a written copy of all program values entered into all equipment supplied.
- .11 An electronic copy of each PLC program on a CD in a protective case with holes to fit the three-ring binder.
- .12 Do not include unnecessary information, advertising and theoretical data not directly related to equipment being supplied.
- .13 O&M manuals are to contain only that information which applies to the equipment provided. Instructions, drawings, schematics, wiring diagrams, parts lists, and other materials which contain information such as optional accessories, alternate equipment arrangements, other equipment series, or other equipment models which are not being provided under the contract may be included only if the Contractor neatly lines out or crosses out this information. Arrows which identify specific items of equipment or referenced items shall be made of stamp and be of drafting quality; hand-drawn arrows are not acceptable.
- .14 Standard catalogs may be included only if the Contractor neatly lines out or crosses out information such as optional accessories, alternate equipment arrangements, other equipment series, or other equipment models which are not being provided under the contract. Individual catalog sheets, which otherwise meet the requirements of this section, are acceptable.
- .15 Service manuals shall contain complete and detailed operating, maintenance and repair instructions in sufficient detail to allow journeyman mechanics and operators to adjust, operate, maintain and repair all components of the equipment, and to order all parts, without consultation with the manufacturer or their representative.
- .16 Include the milestone dates for draft and final manual submissions in overall schedule.

1.3 AS BUILT PLANS AND DOCUMENTS

- .1 Prior to commencement of any work, record and photograph existing conditions which will be changed as a result of this Contract. Include photos to show conditions of adjacent roadways, buildings, foundation walls, etc.
- .2 The Contractor shall keep one record copy of all Specifications, Drawings, Addenda, Operation and Maintenance Manuals, Shop Drawings, Change Orders, Field Test Reports, Work Schedule and samples at the Place of Work in good order and shall record thereon all changes made during the construction of the Work as they occur. These record copies shall be made available to the Departmental Representative during construction and shall be delivered to the Departmental Representative upon completion of the Work.
- .3 Departmental Representative will provide two sets of white prints and specifications. Record information on prints and in specification.
- .4 Use fine felt tip marking pens, maintaining separate colours for each major system for recording information. Mark on one set of prints and at completion of project and prior to final inspection, neatly transfer notations to second set and submit both sets to Departmental Representative.
- .5 Record information concurrently as construction progress. Do not conceal Work until required information is recorded.
- .6 Contract drawings and shop drawings to be legibly marked for each item of actual construction including:
 - .1 Measured depths of elements of foundation in relation to survey 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, reference 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
 - .8 Location of mechanical and electrical works i.e. conduits, outlets, motors, equipment, lights, etc.
 - .9 Programming values entered into all electronic equipment (factory or field entered).
- .7 Specifications are to be legibly marked for each item of 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.
- .8 Other Documents: maintain manufacturer's certifications, inspection certificates, field test records, required by individual specification sections.

1.4 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.

1.5 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 approval.
- .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 approval before each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Departmental Representatives's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers, or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and commissioned systems such as alarm systems, treatment equipment, HVAC equipment.
 - .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 9 month post-construction warranty inspection.
- .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.

1.6 WARRANTY TAGS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks before date of substantial performance.
- .2 Provide 14 day notice to Departmental Representative on operation and maintenance instruction to be given. Departmental Representative will provide list of personnel to receive instructions. Be responsible to coordinate personnel attendance at agreed-upon times.
- .3 Provide copies of 95% completed operation and maintenance manuals for use in demonstrations and instructions.
- .4 Provide access for the Departmental Representative to deliver and set up any fit up equipment required for training in prior to training.
- .5 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation.
 - .4 Ensure testing, adjusting, and balancing has been performed and equipment and systems are fully operational.
- .6 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of O&M manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.2 WARRANTY

- .1 Do not substitute or delay warranty claims for the sole purpose of combining with a training session.

1.3 AGENDA, SCHEDULE AND PERSONNEL

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
- .3 Prepare agendas and outlines at least two weeks prior to a training seminar including the following:
 - .1 Equipment and systems to be included in training seminar presentations.
 - .2 Name of companies and representatives presenting at training seminars.
 - .3 Outline of each training seminar's content.

- .4 Provide an overview on how system is to operate and a description of applicable design parameters, constraints, operational requirements, servicing, and maintenance of each item of equipment at scheduled times and trouble-shooting methodology.
- .5 Time and date allocated to each system and item of equipment.
- .6 Provide separate agenda for each system.
- .7 Obtain schedule approval by Departmental Representative.
- .4 Demonstration/training: Submit schedule of time and date for of each item of equipment and each system prior to submitting request for Substantial Completion, for Departmental Representative's approval. Schedule to include journal, with proposed dates where applicable for the following, as a minimum:
 - .1 Detailed itemized list of items in respect to process, mechanical, electrical and SCADA training to be completed. Include in detail all major equipment, instruments, etc in groupings that have a common training component.
 - .2 Schedule training in individual blocks of time for each equipment/process/trade to allow the operator(s) to absorb material and ask questions. Do not overlap the various blocks of time for the various trades and equipment.
 - .3 Minimum hours as per specification, specification number and proposed hours for each item listed.
 - .4 Person(s) who will be completing training.
 - .5 Fixed dates for entire training period as required by contract.
 - .6 Journal for entering date that each training session was completed. Keep up to date and re-issue after each date that training is completed.
 - .1 Training attendees shall sign off on all training sessions.

1.4 DEMONSTRATIONS AND INSTRUCTIONS

- .1 Prior to scheduling initial training after commissioning co-ordinate schedule with all attendees and advise and co-ordinate with plant Operator(s)
- .2 Provide instruction during regular work hours.
- .3 Time for instruction:
 - .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).
- .4 After commissioning demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times:
 - .1 Demonstrate service all equipment in accordance with the manufacturer's instructions as required for initial operation of the equipment.
 - .2 Check the controls including the supply voltage, heater overload settings and wiring connections.
 - .3 Perform further tests as directed by the Departmental Representative to confirm that the equipment is in accordance with the intent of the specifications.
- .5 Review contents of O&M manual in detail to explain all aspects of operation and maintenance.
- .6 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

- .7 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.
- .8 Include digital photos on CD and in paper form that demonstrates and describes various aspects and equipment instruction.
- .9 During warranty period and for one additional year after the warranty period provide trips at approximately 3 month intervals to complete instructions to operating staff. Coordinate scheduling with General Contractor and contractors related to all Divisions.
- .10 Additional sections of the specifications may define and describe training and number of days for start up of each type of equipment. Utilize the most stringent.

1.5 TRAINING PERIOD

- .1 There are two specific periods for training.
 - .1 Complete training after commissioning: This is referred to as the initial training and typically includes taping of the training sessions for the purposes of producing a DVD of the training sessions.
 - .1 Initial training must be completed prior to issuance of the Final Certificate of Completion and prior to the takeover of any process operations by the plant Operators.
 - .2 Initial calibrations, system checks, process troubleshooting, performance testing and commissioning is to be completed to prove systems Work as intended prior to start of initial training.
 - .2 Training during warranty period: Provide 4 training sessions. Approximately 3 months, 6 months, 9 months and 12 months after all units are commissioned, complete a one day (7 hours onsite) operator training session with the similar manufacturer's representatives present during start up. The 12 month trip is also to complete the 1 year warranty inspection.

1.6 TRAINING DURATION

- .1 Training completed after commissioning applies to:
 - .1 Process equipment (manufacturer).
 - .1 Minimum 1 day.
 - .2 Control and SCADA systems (manufacturer).
 - .1 Minimum 1 day.
 - .3 Genset & transfer switch (manufacturer).
 - .1 Minimum 4 hours: includes software.
 - .4 Instrumentation and meters (manufacturer).
 - .1 Minimum 1 day including calibrations of all instruments.
 - .5 HVAC systems:
 - .1 Minimum 4 hours.
 - .6 Mechanical Divisions: To provide training on general mechanical systems including, HVAC, and valves. If the mechanical sub is approved by the manufacturer they can complete training of general mechanical items including those listed. Submit approval to Departmental Representative.
 - .1 Minimum 4 hours.
 - .7 Electrical Divisions: To provide training on general electrical systems including level measuring instruments and actuated valves. If the electrical sub is approved

by the manufacturer they can complete training of general electrical items including those listed. Submit approval to Departmental Representative.

- .1 Minimum 4 hours.
- .2 For each training session during warranty period applies to:
 - .1 Process equipment (manufacturer).
 - .1 Minimum 1 day.
 - .2 Genset & transfer switch (manufacturer).
 - .1 Minimum 4 hours: includes software.
 - .3 Instrumentation and meters (manufacturer).
 - .1 Minimum 1 day including calibrations of all water quality instruments.
 - .4 Mechanical Divisions: To provide training on general mechanical systems including, HVAC, and valves. If the mechanical sub is approved by the manufacturer they can complete training of general mechanical items including those listed. Submit approval to Departmental Representative.
 - .1 Minimum 1 day.
 - .5 Electrical Divisions: To provide training on general electrical systems including level measuring instruments and actuated valves. If the electrical sub is approved by the manufacturer they can complete training of general electrical items including those listed. Submit approval to Departmental Representative.
 - .1 Minimum 1 day.

1.7 ARC FLASH CO-ORDINATION

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the arc flash coordination study. Install warning labels. Complete training.
 - .1 See Section 26 05 01 "Short-Circuit Coordination Study Arc Flash Hazard Analysis" for further information.
 - .2 Confirm operators in attendance and training provided.

1.8 AUDIO/VIDEO FOR INSTRUCTIONS BY CONTRACTOR

- .1 Hire and co-ordinate with persons completing videotaping and persons providing the on-tape instruction and training explanations as per the following:
 - .1 Provide a preliminary schedule for placing of major works and all training. Update schedule on a monthly basis. Schedule to list all companies/personnel that are proposed to be onsite for the audio/video instructions.
 - .2 Keep video tape personal fully informed of schedule with as much lead time as possible for placement of all major works including initial start up, setting skids on equipment pads, reservoir piping before chamber is filled with water, etc.
 - .3 Keep video tape personal fully informed of schedule with as much lead time as possible for final commissioning and training for all equipment.
 - .4 As applicable allow training instructions to be tapped and complete training instruction at a "pace" as directed by person completing training taping.
 - .5 The training taping will require the training pace to possibly be 'slower' than typical as time is required for multiple camera set ups and other works related to videotaping.

- .2 Complete video recordings with voice (use a separate microphone to minimize background noise) on DVD(s) that demonstrates and describes the various aspects and all equipment and process instruction.
 - .1 Separate all subjects by a titled graphic, and package all material with a graphic, time index, copyright and disclaimers.
 - .2 Film each component in a separate video and included as a separate "chapter" on the DVD separated by a titled graphic. Video chapters typically shall be 3-5 minutes, if the presentation runs more than 7 minutes and may have comprehension issues, insert a time code, as a subsection of the chapter with a description of what it contains. As a minimum, video "chapters" shall be produced for:
 - .3 Produce as a minimum the video chapters for process equipment including:
 - .1 Process i.e. Grinder and Auger.
 - .2 Control systems.
 - .3 Electrical equipment.
 - .4 Instrumentation.
 - .5 SCADA.
 - .6 Genset.
 - .7 HVAC
 - .4 Wherever possible use support legs for the camera and a wireless microphone for persons speaking and completing explanations and supplemental lighting for any "dark" areas.
 - .5 Produce videos for all equipment that will not be visible during facility operation which shall include items such as all submersible pumps, piping within chambers, etc.
 - .6 Each labeled and indexed DVD shall also include an on-screen "menu" to facilitate video navigation.
 - .7 Edit the live presentation so the presenter looks professional, remove breaks and interruptions so that only the meaningful words, sounds and video is seen and heard.
 - .1 Questions: Repeat and answer all relevant questions. The videographer should intervene and request additional explanation as required based on the videographer being familiar with the subject and the on site staff.
 - .8 Provide a Microsoft Word formatted index of all chapters with a "brief" written description of what each chapter contains.
- .3 Include explanatory and summary voice-overs or script indicating major points of maintenance, troubleshooting and where more information can be obtained. Cross reference to the other material when applicable such as the O&M manuals, commissioning manual, laminate quick reference cards etc.
- .4 Label and index DVD's. Provide custom permanent typed labels on each DVD that indicate this is a Training Video for project, location and discipline as applicable. Where available use Owner's "logo" or picture of the site as an overlay. Clearly label each DVD as to the total number in the set and which volume a particular DVD is (ie. 2 of 5). Include the date.
- .5 Upon completion of DVD taping, produce and submit to the Departmental Representative, a sample video focusing on one piece of equipment for review and

comments regarding suitability. Do not finalize editing until format is approved by the Departmental Representative.

- .6 Format final product for use on:
 - .1 DVD players- Provide 5 copies.
 - .2 PC using Windows media player – Provide 5 copies.

1.9 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Ensure amount of time required for instruction of each item of equipment is as specified in the applicable Section. If no specific time is listed in a Section provide a minimum 2 hours of instruction.

1.10 REPORTING AND DELIVERABLES

- .1 Submit reports within one week after completion of demonstration/training, that provide the date and time(s) of demonstration, instructions provided, list of personnel present, outline with notes and adjustments made as applicable and an overall summary of demonstration/training completed.
- .2 Provide a comprehensive maintenance list for all building equipment and components, to be incorporated in the institutions' existing Computerized Maintenance Management System.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

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

1.2 COMMISSIONING OVERVIEW

- .1 Commissioning to be a line item of Contractor's cost breakdown.
- .2 Commissioning activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Commissioning is conducted in concert with activities performed during stage of project delivery. Commissioning identifies issues in Planning and Design stages which are addressed during Construction and Commissioning 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. Commissioning activities includes transfer of critical knowledge to facility operational personnel.
- .4 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed commissioning documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.
- .5 The Contractor is responsible for the following:
 - .1 Organizing and scheduling pre-commissioning and commissioning
 - .2 Preparation and collection of shop drawings, installation drawings and Operation and Maintenance Manuals. Refer to Section 01 78 00.
 - .3 Supervising all pre-commissioning and commissioning activities.
 - .4 Witnessing and confirming accuracy of reported results.

- .5 Submission of all start-up and commissioning reports.
- .6 Operator training. Refer to Section 01 79 00.
- .6 The Departmental Representative is responsible for the following:
 - .1 Witnessing pre-commissioning, commissioning and training
 - .2 Review of schedule and submitted documentation
 - .3 Final acceptance of commissioning.
- .7 The following components are to be commissioned
 - .1 Building Envelope
 - .1 Exterior Walls/Building Envelope
 - .2 Beam and Slab deflection
 - .3 Doors and related hardware.
 - .2 Vertical/horizontal transportation system
 - .1 Indoor crane.
 - .2 Bucket mounted cart dumper.
 - .3 All electrical systems including:
 - .1 Engine generator.
 - .2 Automatic transfer switches.
 - .3 SCADA.
 - .4 PLC.
 - .5 Lighting.
 - .6 Emergency lighting.
 - .7 Transformer.
 - .8 Security system.
 - .9 Video surveillance.
 - .10 Energy Metering
 - .4 All mechanical systems
 - .1 HVAC fans.
 - .2 Louvers and dampers.
 - .3 Unit heaters.
 - .4 Natural gas furnace.
 - .5 Heat energy recovery equipment.
 - .6 Plumbing.
 - .5 All process systems
 - .1 Valves.
 - .2 Level measurement equipment.
 - .3 Pressure measurement equipment.
 - .4 Air quality and differential pressure measurement equipment.
 - .5 Miscellaneous measurement equipment.
 - .6 Trash grinding equipment.

1.3 REFERENCE STANDARDS

- .1 CSA Z320-11 (R2021), Building Commissioning.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Commissioning, correct deficiencies, re-verify equipment and components within the unfunctional 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.

1.5 PRE-COMMISSIONING REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing to Departmental Representative.
 - .1 Adequacy of provisions for commissioning.
 - .2 Aspects of design and installation pertinent to success of commissioning.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for commissioning.
- .3 Before start of commissioning:
 - .1 Have completed commissioning Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand commissioning requirements and procedures.
 - .4 Have commissioning documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Departmental Representative.
 - .7 Have commissioning schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
 - .11 Operating and maintenance manuals must be submitted and deemed a minimum of 95% complete by Departmental Representative prior to pre-commissioning.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

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

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit no later than 4 weeks after award of Contract:

- .1 Name of Contractor's commissioning agent.
- .2 Draft commissioning documentation.
- .2 Preliminary commissioning schedule.
- .3 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of commissioning.
- .4 Submit proposed commissioning procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of commissioning.
- .5 Provide additional documentation relating to commissioning process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve commissioning documentation.
- .3 Provide completed and approved commissioning documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

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

1.10 COMMISSIONING MEETINGS

- .1 Convene commissioning meetings following project meetings.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to commissioning.
- .3 Continue commissioning meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Departmental Representative to call a separate commissioning scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for commissioning. 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 commissioning meetings to be held until project completion and as required during equipment start-up and functional testing period.

- .6 Meeting will be chaired by Departmental Representative, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent commissioning meetings and as required.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

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

1.13 MANUFACTURER'S INVOLVEMENT

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

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and commissioning.
- .2 Conduct start-up and testing in following distinct phases:

- .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
- .2 Start-up: follow accepted start-up procedures.
- .3 Operational testing: document equipment performance.
- .4 System PV: include repetition of tests after correcting deficiencies.
- .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

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

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

1.17 TEST RESULTS

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

1.18 START OF COMMISSIONING

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

1.19 INSTRUMENTS / EQUIPMENT

- .1 Submit to Departmental Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out commissioning:
 - .1 Under actual operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Commissioning procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.

1.21 WITNESSING COMMISSIONING

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

1.22 AUTHORITIES HAVING JURISDICTION

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

1.23 EXTRAPOLATION OF RESULTS

- .1 Where commissioning of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in

accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.24 EXTENT OF VERIFICATION

- .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 fail to receive Departmental Representative's approval.
 - .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 commissioning 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 commissioning to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting commissioning to Departmental Representative in writing. Stop commissioning until problems are rectified. Proceed with written approval from Departmental Representative.

1.28 COMPLETION OF COMMISSIONING

- .1 Upon completion of commissioning leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in commissioning specifications, complete commissioning prior to issuance of Interim Certificate of Completion.
- .3 Commissioning to be considered complete when contract commissioning 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 commissioning process, provide updated commissioning form for affected item.

1.30 TRAINING

- .1 In accordance with Section 01 79 00.

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 TAB and 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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC - Commissioning Guidelines CP.3 -3rd edition-[03].

1.2 GENERAL

- .2 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 systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Use this Commissioning Plan as master planning document for commissioning:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Commissioning.
 - .2 Communicates responsibilities of team members involved in Commissioning Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Commissioning.
 - .4 Describes process of verification of how built works meet design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Commissioning.
 - .2 General description of elements that make up Commissioning Plan.
 - .3 Process and methodology for successful Commissioning.
- .3 Acronyms:
 - .1 Cx - Commissioning.
 - .2 WHMIS Safety Data Sheets (SDS).
 - .3 PI - Product Information.
 - .4 PV - Performance Verification.
 - .5 TAB - Testing, Adjusting and Balancing.
 - .6 WHMIS - Workplace Hazardous Materials Information System.
- .4 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Commissioning - Commissioning 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% COMMISSIONING PLAN

- .1 A 95% Commissioning Plan is included in the Appendix.
- .2 Commissioning Plan to be 100% completed within 16 weeks of award of contract to take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Commissioning schedule.
 - .5 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Commissioning team's requirements.
- .3 Submit completed Commissioning Plan to Departmental Representative and obtain written approval.

1.4 REFINEMENT OF COMMISSIONING PLAN

- .1 During construction phase, revise, refine and update Commissioning Plan to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
- .2 Revise, refine and update every 6 months during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Commissioning Plan to Departmental Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.5 COMPOSITION, ROLES AND RESPONSIBILITIES OF COMMISSIONING 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 Commissioning 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 Commissioning activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Commissioning 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 Commissioning activities, training, development of Commissioning documentation.
 - .5 Work closely with members of Commissioning Team.
- .3 Departmental Representative is responsible for:
 - .1 Organizing Commissioning.

- .2 Monitoring operations Commissioning activities.
- .3 Witnessing, certifying accuracy of reported results.
- .4 Witnessing and certifying TAB and other tests.
- .5 Ensuring implementation of final Commissioning Plan.
- .6 Performing verification of performance of installed systems and equipment.
- .7 Implementation of Training Plan.
- .4 Construction Team: contractor, subcontractors, suppliers and support disciplines, is responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Commissioning activities.
 - .4 Delivery of training and Commissioning documentation.
 - .5 Assigning one person as point of contact with Consultant and PWGSC Commissioning Manager for administrative and coordination purposes.
- .5 Contractor's Commissioning agent implements specified Commissioning 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 COMMISSIONING PARTICIPANTS

- .1 Employ the following Commissioning 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 Commissioning agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Commissioning specialists on this project.
 - .5 Client: responsible for intrusion and access security systems.
 - .6 Ensure that Commissioning 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 Modify ventilation rates to meet changes in off-gassing.
 - .2 Redistribution of electrical services.
 - .3 Modifications of fire alarm systems.
 - .4 Modifications to voice communications systems.
- .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Commissioning 3 months prior to starting date of Commissioning for review and approval.

1.7 RISK ASSESSMENT

- .1 The performance of the overall system will affect the performance of the lagoon downstream of the Wastewater Trash Removal Building. It is planned, therefore to verify the performance of all systems and equipment before acceptance by the user.
- .2 The SMI lagoon is operated by the RM of Rockwood. The Departmental Representative will update the RM as required with the status of the project.
- .3 The process systems in the Wastewater Trash Removal Building will be new for the existing facility maintenance staff. It is planned, therefore to complete a thorough commissioning and training of all equipment to sure that CSC will be able to successfully operate the system.

1.8 EXTENT OF COMMISSIONING

- .1 Refer to Section 01 91 13 – Commissioning

1.9 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 WHMIS Safety Data Sheets (SDS).
 - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.10 DELIVERABLES RELATING TO THE COMMISSIONING PROCESS

- .1 General:
 - .1 Start-up, testing and Commissioning requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

- .2 Definitions:
 - .1 Commissioning as used in this section includes:
 - .1 Commissioning of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
 - .1 Commissioning Specifications.
 - .2 Startup, pre-Commissioning 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 Commissioning activities and documentation.
 - .8 Description of Commissioning of integrated systems and documentation.
 - .9 Tests of following witnessed by PWGSC Design Quality Review Team:
 - .1 All equipment related to sewage screening.
 - .2 Instrumentation
 - .3 HVAC systems
 - .10 Tests performed by Owner.
 - .11 Training Plans.
 - .12 Commissioning Reports.
 - .13 Prescribed activities during warranty period.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.

1.11 PRE-COMMISSIONING ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Commissioning Plan include the following:
 - .1 Pre-Start-Up inspections: 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 Commissioning 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 certified by Departmental Representative and does not form part of Commissioning specifications.
 - .6 Departmental Representative will monitor some of these inspections and tests.
 - .7 Include completed documentation in Commissioning report.
- .2 Pre-Commissioning activities - ARCHITECTURAL AND STRUCTURAL:
 - .1 Slab and beam deflection test: test after removal of temporary supports and concrete has cured to ensure adequacy for raised floors.

- .2 Exterior walls: conduct thermographic surveys to ensure appropriate level of tightness after exterior envelope has been completed. Permanent HVAC systems are able to provide appropriate negative or positive pressure, a temperature of at 20 degrees C can be maintained between inside and outside and wind speed is less than 10 kph.
- .3 Doors, windows, related hardware:
 - .1 Door and window hardware: confirm fit and operation of all doors and hardware.
- .3 Pre-Commissioning activities - MECHANICAL:
 - .1 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 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.
 - .2 HVAC equipment and 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 TAB on systems. TAB reports to be approved by Departmental Representative.
- .4 Pre-Commissioning activities - LIFE SAFETY SYSTEMS
 - .1 Include equipment and systems identified above.
 - .2 Reports of test results to be witnessed and certified by Departmental Representative before verification.
- .5 Pre-Commissioning activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
 - .2 Backup power generation systems
 - .1 Transfer switches: test by simulating loss of power. Verify availability of power at equipment requiring same.
 - .2 Uninterruptible power systems: test under full and partial load conditions.
 - .3 Lighting systems: includes all lights in hazardous location and emergency lighting systems.
 - .4 Security, surveillance and intrusion alarm systems: to include verification by CSC and Departmental Representative.
 - .5 Low voltage systems: These include clock, communications, low voltage lighting control systems and data communications systems.

1.12 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 Commissioning 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 certify reported results using approved PI and PV forms.
 - .4 Departmental Representative to approve completed PV reports and provide to Departmental Representative.
 - .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 startup and testing.

1.13 COMMISSIONING ACTIVITIES AND RELATED DOCUMENTATION

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

1.14 COMMISSIONING OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Commissioning to be performed by specified Commissioning specialist, using procedures developed by Departmental Representative and approved by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Commissioning specialist to prepare Commissioning Report, to be certified by Departmental Representative and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Identification:
 - .1 In later stages of Commissioning, before hand-over and acceptance Departmental Representative, Contractor, Project Manager, Property Manager and

Commissioning 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, systems.

1.15 INSTALLATION CHECK LISTS (ICL)

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.18 COMMISSIONING SCHEDULES

- .1 Prepare detailed Commissioning Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Commissioning activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
 - .3 Commissioning agents' credentials: 60 days before start of Commissioning.
 - .4 Commissioning procedures: 3 months after award of contract.
 - .5 Commissioning Report format: 3 months after contract award.
 - .6 Discussion of heating/cooling loads for Commissioning: 3 months before start-up.
 - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Commissioning.
 - .8 Notification of intention to start TAB: 21 days before start of TAB.
 - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .10 Notification of intention to start Commissioning: 14 days before start of Commissioning.
 - .11 Notification of intention to start Commissioning of integrated systems: after Commissioning of related systems is completed 14 days before start of integrated system Commissioning.
 - .12 Identification of deferred Commissioning.
 - .13 Implementation of training plans.
 - .14 Commissioning reports: immediately upon successful completion of Commissioning.
 - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.

- .3 6 months in Commissioning schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Commissioning Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Commissioning agent, and Departmental Representative will monitor progress of Commissioning against this schedule.

1.19 COMMISSIONING REPORTS

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

1.20 ACTIVITIES DURING WARRANTY PERIOD

- .1 Commissioning activities must be completed before issuance of Interim Certificate, it is anticipated that certain Commissioning activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems.
 - .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.
 - .3 Full-scale emergency evacuation exercises.

1.21 TESTS TO BE PERFORMED BY OWNER/USER

- .1 None is anticipated on this project.

1.22 FINAL SETTINGS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
- .2 Related Requirements

1.2 INSTALLATION/START-UP CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists 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.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

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

1.4 PERFORMANCE VERIFICATION (PV) FORMS

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

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
 - .1 See Appendix A
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 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 approval prior to use.
 - .1 Additional commissioning forms to be in same format as provided by Departmental Representative.

1.7 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.

1.8 LANGUAGE

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

DIVISION 2

EXISTING CONDITIONS

Part 1 General

1.1 GENERAL

- .1 Demolition work will include the following items:
 - .1 Complete removal of the existing trash screen manhole, wastewater sewer and existing manhole not being reused after the trash removal building is completed.

1.2 PROTECTION

- .1 In all circumstances ensure that demolition work does not adversely affect adjacent water courses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .2 Protect existing items designated to remain and materials designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Departmental Representative.

Part 2 Products (Not Applicable)

Part 3 Execution

3.1 PREPARATION

- .1 Inspect site with Owner's Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 No demolition and removal works are to commence until 6 months after successful commissioning of the wastewater trash removal building.
- .3 Locate and protect utility lines. Preserve in operating condition active utilities traversing site.
- .4 Notify utility companies before starting demolition.

3.2 REMOVAL OPERATIONS

- .1 Completely remove the existing trash screen manhole and associated piping and manholes as indicated on the plans.
- .2 Backfill in accordance with Section 31 23 10.
- .3 Topsoil and seed in accordance with Sections 32 91 21 and 32 92 19.16.
Sealing: Grout pipe ends and walls of manholes that are to remain. Securely plug to form watertight seal.

3.3 DISPOSAL OF MATERIAL

- .1 Dispose of materials not designated for salvage as determined by the Departmental Representative or re-use in work, off-site.
- .2 Trim disposal areas to approval of Departmental Representative.

3.4 RESTORATION

- .1 Restore areas and existing works to match condition of adjacent, undisturbed areas.
- .2 Refer to Section 31 22 00.

3.5 SITE CLEAN-UP

- .1 Upon completion of work, remove debris, trim surfaces and leave work site clean.

END OF SECTION

DIVISION 3

CONCRETE

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Method and Schedule of construction.
 - .2 Materials and arrangement of joints.
 - .3 Design of formwork and supporting framing.
 - .4 Ties, Shores, Liners and locations or temporary embedded parts.
- .2 Design formwork for the loads and lateral pressures outlined in ACI 347R, CSA S269.1 and CSA S269.3 in addition to the applicable loads specified by NBC and its supplements.

1.2 REFERENCES

- .1 ACI 347R-14, Guide to Formwork for Concrete.
- .2 CSA-A23.1:19/A23.2:19, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
- .3 CSA O86:19, Engineering design in wood, Includes Errata 1 (2020), Errata 2 (2021), and Errata 3 (2021).
- .4 CSA O121-17, Douglas Fir Plywood.
- .5 CSA O151-17, Canadian Softwood Plywood.
- .6 CSA S269.1-16 (R2021), Falsework and Formwork.
- .7 CAN/CSA-S269.3-M92 (R2013), Concrete Formwork.

1.3 STORAGE AND HANDLING

- .1 Deliver and store formwork and falsework materials, etc. so as to prevent damage or deterioration prior to use.
- .2 Store plywood off the ground in flat, dry, covered piles, ready for use.
- .3 Store void forms on raised platforms at least 150 mm above ground level and covered with a tarpaulin for protection or in a waterproof structure. Reject void forms that become damaged or damp from any causes.

Part 2 Products

2.1 MATERIALS

- .1 Use Douglas Fir "Concrete Form Grade" plywood for forms conforming to CSA O121.
- .2 Steel or aluminum forms may be used in lieu of plywood at the Contractor's option.
- .3 Form release agent: Colourless mineral oil, free of kerosene, suitable for use in structures storing potable water.

- .4 Form ties: Shall be commercially manufactured type. The portion remaining within the concrete shall leave no metal within 40 mm of the surface after stripping. Form ties for water retaining structures shall be metal ties incorporating a water seal on the tie rods and a plastic spreader cone which shall leave no metal within 40 mm of the surface.
- .5 Falsework materials to CSA 269.1.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Verify lines, levels and column centers before proceeding with formwork and ensure dimensions agree with drawings.
- .2 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/A23.2.
- .3 Obtain Departmental Representative's permission before framing openings not indicated in beams, slabs, walls or structural joints.
- .4 Align form joints and make watertight. Keep form joints to minimum.
- .5 Exposed surfaces: Square - edged, smooth surface panels true in plane, free of holes, surface markings or defects.
- .6 Unexposed Surfaces: Lumber, plywood or other material suitable to retain concrete without leakage or distortion.
- .7 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Ensure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

3.2 KEYWAY

- .1 Form keyway prior to concrete pour. Construction methods that do not have a formed in place keyway prior to a concrete pour will NOT be accepted.

3.3 ERECTION

- .1 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by most recent edition of CSA A23.1.
- .2 Arrange and assemble formwork to permit removal without damage to the concrete.
- .3 Form chases, slots, openings, drips recesses, expansion and control joints as indicated.
- .4 Clean forms as erection proceeds to remove foreign matter. Use compressed air to ensure keyways and other surfaces are free of cuttings, shavings and debris. Clean formwork in accordance with most recent edition of CSA A23.1.
- .5 Apply form release agent prior to placing reinforcing steel however do not treat any surfaces which are to receive coverings which are affected by agent.
- .6 Keep forms moist prior to placing concrete.
- .7 Set screeds with top edge level to required elevations.
- .8 Check and readjust formwork to required lines and levels during placing of concrete.

- .9 Re-use of formwork and falsework subject to requirements of most recent edition of CSA A23.1. If form cannot meet, in the opinion of the Departmental Representative, the tolerances and surface quality as required the form shall be rejected.

3.4 TOLERANCES

- .1 Construct all formwork to maintain the following maximum tolerances:
- .1 Deviation from vertical line - 5 mm in 3 m, 10 mm in 6 m and 20 mm in 12 m or more.
 - .2 Deviation from horizontal line - 5 mm in 3 m.
 - .3 Deviation from flat or sloped surface for walls or floors - 3 mm in 3 m.
 - .4 Deviation of linear building lines from design drawings and position of columns, walls and partitions - 5 mm.
 - .5 Deviation in cross sectional dimensions of columns or beams or in thickness of slabs and walls - 5 mm.
- .2 Camber slabs and beams 5 mm per 3 m of span (unless otherwise shown). Maintain beam depth and slab thickness from cambered surface.

3.5 REMOVAL

- .1 Leave formwork in place for following minimum periods of time after placing concrete or until a strength of 75% of specifications has been demonstrated by both lab and field cured cylinders as being achieved unless otherwise approved by Departmental Representative.

Portion of Structure	Average Daily Temperature in °C		
	>20°C	15-20°C	<15°C
Walls, sides of slab, sides of beams and other parts not supporting weight of concrete	2 days	3 days	4 days
Beams and all other formwork supporting weight of concrete	14 days	17 days	21 days

- .2 Remove formwork by gradual easing without jarring or damaging the concrete faces. If excessive construction loads are anticipated, all work shall be shored to prevent overloading the structure.
- .3 On exposed formed surfaces, chip off unsightly ridges, or other imperfections and rub flush with the general surface.
- .4 Do not repair any honeycomb areas discovered after removal of the forms until inspected by the Departmental Representative and designated as structural or non-structural. Where honeycombing has occurred in non-structural elements, cut out the affected area and fill with mortar. Where honeycombing has occurred in structural elements, if requested by the Departmental Representative, the Contractor shall provide a structural evaluation report including recommendations on the corrective method of treatment. The report is to be prepared and sealed by an independent professional Engineer registered in the Province of Manitoba. The Departmental Representative will review and assess the report and direct the Contractor on the corrective method of treatment to be carried out.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Air Entraining agent.
 - .2 Water Reducing agent.
 - .3 Set Retarders.
 - .4 Plasticizer.
 - .5 Waterstop.
 - .6 Repair grouts/mortars.
 - .7 Expansion Joint Fillers.
 - .8 Void Form materials.
 - .9 Modular Link-Seal closures.
 - .10 Horizontal Reinforcement Spacers.

1.2 STANDARDS

- .1 All reference to standards shall be to the most recent edition of the applicable standard, whether specifically listed or not.

1.3 REFERENCES

- .1 ASTM C39/C39M-21, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- .2 ASTM C135-96 (2015), Standard Test Method for True Specific Gravity of Refractory Materials by Water Immersion.
- .3 ASTM C266-21, Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles.
- .4 ASTM C267-20, Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
- .5 ASTM C494/C494M-19, Standard Specification for Chemical Admixtures for Concrete.
- .6 ASTM C881/C881M-20a, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- .7 ASTM C882/C882M-20, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
- .8 ASTM D624-00 (2020), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
- .9 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
- .10 ASTM D732-17, Standard Test Method for Shear Strength of Plastics by Punch Tool.
- .11 ASTM D1752-18, Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

- .12 ASTM D2240-15 (2021), Standard Test Method for Rubber Property - Durometer Hardness.
- .13 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .14 CAN/CSA A23.1/A23.2-19, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
- .15 CSA A3000-18, Cementitious materials compendium, Includes Update No. 1 and Errata (2021).
- .16 CAN3-A266.4-M78, Guidelines for the Use of Admixtures in Concrete.
- .17 CSA C22.2 No. 211.2-06 (R2016), Rigid PVC (Unplasticized) Conduit, Update No. 1 (2011).
- .18 CRD-C58-92, Standard Test Method for Water Permeability of Concrete.
- .19 NSF/ANSI/CAN 61-2021, Drinking Water System Components – Health Effects.

1.4 APPROVALS

- .1 All materials shall be approved for use in potable water structures and conforming to ANSI/NSF Standard 61.
- .2 All additives shall be approved to be mutually compatible within the mix.

Part 2 Products

2.1 RIGID INSULATION

- .1 See Section 07 21 13

2.2 AIR ENTRAINING AGENT

- .1 Air entraining admixtures shall be completely neutralized rosin solution, and comply with ASTM C260/C260M and CAN3-A266.4.

2.3 WATER REDUCING AGENT

- .1 The admixture shall not contain calcium chloride and shall meet the requirements ASTM C494/C494M as a Type A or Type D admixture and CAN3-A266.4-M78 Type WN.
- .2 Certification of compliance shall be made available on request.
- .3 Shall be delivered as ready to use liquid product and shall require no mixing at the batch plant or job site.

2.4 INITIAL SET RETARDERS

- .1 To ASTM C494/C494M and CAN3-A266.4-M78.
- .2 Accelerating or set retarding admixtures for use during cold and hot weather placing and are subject to the approval of the Departmental Representative.

2.5 WATERSTOP

- .1 For all floor to wall joints use a PVC hollow tube at midpoint, 150 mm wide, 10 mm thick waterstop. Provide shop welded mitered tees, crosses and L's.

- .2 Water stop supplier to shop fabricate all joints other than straight butt joints. Provide hog tie holes or hog tie rings to allow waterstop to be secured to rebar.
 - .1 Tensile strength: To ASTM D412, method A, Die "C".
 - .2 Elongation: To ASTM D412, method A, Die "C", minimum 275%.
 - .3 Tear resistance: To ASTM D624, method A, Die "B".

2.6 REPAIRING/SEALING (> 75 MM THICKNESS)

- .1 Use polymer modified cementitious two component fast-setting, free-flowing repair mortars to fill and repair cavity or void.
 - .1 Density: Min 2,100 kg/m³ to ASTM C135.
 - .2 Compressive strength: 28 day – 50 MPa to ASTM C109/C109M.
 - .3 To be NSF 61 approved if in contact with potable water.

2.7 EXPANSION JOINT FILLERS

- .1 Non-extruding resilient and shall meet the requirements ASTM D1752, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 To be easily compressed with a recovery of not less than 95% of original thickness and a density of not less than 480.kg/m³.
- .3 Thickness to be suited for type and thickness of joint or as stated on drawings.

2.8 HORIZONTAL JOINT FOR CONCRETE

- .1 Single component, self-levelling, premium-grade polyurethane sealant with an accelerated curing capacity.
- .2 Shall meet the requirements of CAN2-19.13-M87.
 - .1 Service range temperature: -40° to 62°C.
 - .2 Shore hardness: 21 day – 50 ± 5 to ASTM D2240.
 - .3 Tensile strength: 2070 kPa to ASTM D412.
 - .4 Elongation at break: 500% to ASTM D412.
 - .5 Adhesion in peel: > 15 pli peel strength and 0% adhesion loss to ASTM C-794.

2.9 REPAIR MORTARS

- .1 For repair around pipes through concrete and snap tie holes use a fast-setting, non-shrink, high-bond-strength, hydraulic cement compound suitable for potable water and cures without moisture retention requirements.
 - .1 Compressive strength: 28 day – 31 MPa to ASTM C109/C109M.
 - .2 Setting time: Initial set: < 4 min, final set: < 10 min to ASTM C266.
 - .3 Tensile Bond Pull-Off: 0.8 MPa to CSA A23.2.
 - .4 To be NSF 61 approved if in contact with potable water.

2.10 GROUTING/BONDING ADHESIVE

- .1 Two component, 100% solids, moisture tolerant structural epoxy adhesive suitable for bonding fresh concrete to existing concrete.
- .2 Shall conform to ASTM C881/C881M, Types I, II and V, Grade-2, Class C.

- .1 Tensile strength: 14 day – 33 MPa to ASTM D638.
- .2 Flexural strength: 14 day – 51 MPa to ASTM D790.
- .3 Shear strength: 14 day – 34.5 MPa to ASTM D732.
- .4 Bond strength: 14 day moist cure (plastic concrete to hardened concrete) – 12.4 MPa to ASTM C882/C882M.

2.11 CONCRETE PLASTICIZER

- .1 Shall meet the requirements ASTM C494/C494M, as a Type A (water reducing) or Type F (high range water reducing) admixture.
- .2 Certification of compliance shall be made available on request.
- .3 Shall be delivered as ready to use liquid product and shall require no mixing at the batch plant or job site.

2.12 CONCRETE ANCHORS

- .1 Concrete anchors size and application to be approved by Departmental Representative.

2.13 VOID FORM MATERIAL

- .1 Use one of the following void form types as frost cushion and void material under structural slabs and grade beams.
 - .1 Type 1: Corrugated paper with uniform cellular interior configuration and moisture resistant exterior.
 - .1 Water-resistant coating for temporary protection from moisture.
 - .2 Constructed without glues or mechanical fasteners.
 - .3 Comes with endcaps to provide extra strength at the very edge of the void form.
 - .4 Minimum 48 kPa (1000 psf) capacity or as required if additional strength is needed.
 - .5 Ensure storage is under dry conditions.
 - .6 Provide protective 9 mm hard board (plywood) covering placed over the void form before reinforcing steel placement to prevent puncture.
 - .7 Cover top of void form with polyethylene, 6 mil minimum, overlapping joints.
 - .8 Extreme wet ground conditions shall require waterproof membrane to protect void form. After forms are stripped, cut sides of protective membrane of void form to allow moisture to penetrate.
 - .9 Void form to be 150 mm thick.
 - .2 Type 2: Rigid closed cell, expanded polystyrene (EPS) void form.
 - .1 Flame Spread Index/ Smoke Developed Index: Less than 25/450 to ASTM E84.
 - .2 Compressive Strength: 27.5 kPa.
 - .3 Fabricate material to support concrete placing, finishing, and weight of the slab.
 - .4 Ensure storage is under dry conditions.
 - .5 Provide protective 9 mm hard board (plywood) covering placed over the void form before reinforcing steel placement to prevent puncture.

- .6 Void form to be 300 mm thick.

2.14 BOLTS, NUTS

- .1 Use 304 or better stainless steel bolts, nuts and washers on all couplers or materials which are to be buried or submerged.
- .2 Provide "proof" to Departmental Representative that materials used for bolts, nuts and washers are stainless steel 304 or better.

2.15 PIPE THROUGH WALL OR SLAB

- .1 Use either one of the following unless otherwise specified on the plans:
 - .1 Where stainless steel piping is indicated on the plans: cast in place a piping with a "no-leak flange" (100 mm larger than pipe OD) for all wall penetrations.
 - .1 Cast "no-leak flange" in place in factory. Ensure "no-leak flange" is centered within wall. Use hydraulic cement for all openings in accordance with manufacturer's instructions. Ensure seal is watertight.
 - .2 Precast into wall a molded non-metallic HDPE sleeve with integral hollow, molded water-stop ring 100 mm larger than the outside diameter of the sleeve itself, as manufactured by the same manufacturer as the modular seals used. Provide end caps.
 - .2 Where modular/mechanical seal and sleeve type connection is shown on the plans: Connections to be completed with modular, mechanical seal, consisting of EPDM rubber links shaped to continuously fill the annular space between the pipe and the wall opening. Modular seals as follows:
 - .1 NSF 61 certified with stainless steel bolts.
 - .2 Size unit as per manufacturer's instructions, provide shop drawings.
 - .3 For new installations: Cast in place a plastic sleeve to form a "round" penetration through the wall sized to match modular seal.
 - .4 For existing concrete: Core round hole sized to match modular seal.
 - .5 Standard of acceptance: PSI-Thunderline Link-Seal Modular Seal S61 c/w Century-Line model CS Sleeve and end caps (for cast in place installations) or approved equal.

2.16 HORIZONTAL REINFORCEMENT SPACERS

- .1 Use horizontal reinforcing spacers for all vertical steel inside walls.
- .2 Shall be precast concrete of a quality equal to or better than the concrete of the member in which the supports are to be used. Plastic or steel supports shall not be used.

Part 3 Execution

3.1 WATERSTOPS

- .1 Install PVC waterstops continuous without displacing reinforcement and according to manufacturer's specifications. Heat seal all joints watertight at intersections and splices.
- .2 Ensure all edges to be welded are straight and clean. Ensure that ribs and bulbs are aligned and continuous across welds.
- .3 Provide PVC waterstops for all construction joints in as shown on plans.

- .4 Place waterstops at center of keyway with bulb at concrete joint. Suspend waterstop from rebar before pouring concrete.
- .5 Vibrate concrete around waterstops to ensure a good bond to the concrete.
- .6 Ensure that waterstops are adequately supported prior to concrete pouring. Fix to formwork or reinforcement at 300 mm o/c with wire ties or hog rings around edge ribs.
- .7 Clean area around waterstops and keyway (ie. vacuumed, washed, compressed air) prior to pouring.
- .8 Do not allow concrete placed over a waterstop to freefall more than 1.5 m.
- .9 Where expanding joint type waterstop are approved by Departmental Representative or shown on the plans:
 - .1 Clean surface. Maintain minimum concrete cover depth as recommended by manufacturer.
 - .2 Ensure product is placed to provide minimum concrete encasement and there is minimum one row of vertical reinforcement steel.
 - .3 Apply water-based latex adhesive specially formulated to adhere waterstop to hardened concrete with a roller or brush. Do not allow adhesive to freeze.
 - .4 Once adhesive has cured and changed color remove release paper and press firmly against adhesive. Preferred application of waterstop to adhesive is within 2 hours of adhesive curing (turning color), do not exceed 6 hours.
 - .5 Tightly butt coil ends together, do not overlap coil ends.

3.2 PIPE PENETRATIONS THROUGH WALLS/TOP SLAB

- .1 Provide a “no-leak flange” for all pipes that extend through a concrete section.
- .2 For modular/mechanical seal and sleeve type connections.
 - .1 Install the exact number of links indicated in sizing charts.
 - .2 Center piping within opening and provide pipe support, do not use modular seal assembly to support piping. Ensure seal assembly is clean and free from dirt.
 - .3 Loosen rear pressure plate so links move freely, slide belt assembly into annular space ensuring all bolt heads are facing the installer.
 - .4 Use a hand socket or wrench only, no power tools. Do not tighten any bolt more than 4 turns at a time. Continue in a clockwise manner, making full oases as required until all sealing elements “bulge” around all pressure plates.
 - .5 Use hydraulic cement to fill the annular space not used by the seals.
 - .6 Check to ensure piping is properly supported during backfill operations, do not use seal assembly to support the weight of the pipe.
- .3 For connecting pipe ends of piping through walls:
 - .1 Use flanges with SS bolts/nuts or mechanical couplings, as shown on the plans, to connect pipe ends.
 - .2 Ensure piping ends and stubs are fully aligned.
- .4 Prior to placing concrete cap all piping placed to prevent entry of foreign material.

3.3 REPAIRING/SEALING > 75 MM THICKNESS

- .1 Restore/repair openings through hardened concrete that require a thickness greater than 75 mm with a polymer-modified cementitious, fast-setting, free-flowing repair mortar.

- .2 Prepare contact surface of the hardened concrete to ensure complete removal of loose and deleterious materials to ensure contact surface is clean and sound.
- .3 Apply continuous bead of extrudable, swelling waterstop along inside (water side) perimeter of opening. Size of bead to be in accordance with manufacturer's recommendations.
- .4 Form opening on both sides suitable for grout application/installation.
- .5 Install grout in accordance to manufacturer's recommendations with head as required to entirely fill opening.
- .6 Strip forms and remove any projections of hardened grout.

3.4 GROUTING

- .1 Grout all pipes through concrete floors or walls with non shrink concrete grout to provide a watertight connection.

3.5 SNAP TIE HOLES

- .1 Grout all snap tie holes with non-shrink hydraulic cement specifically stated on manufacturer's literature to be suitable for filling tie rod holes in accordance with manufacturer's recommendations to provide a watertight connection.
- .2 Clean and prepare areas to receive hydraulic cement in accordance with manufacturer's recommendations to provide a waterproof repair. In general.
 - .1 Mix small amounts due to rapid hardening properties, mix with a trowel for no longer than 30 seconds. Add material to potable water using a measuring device for powder and water. Use water as required to allow the material to be hand formed in a ball.
 - .2 Clean areas and dampen with water.
 - .3 Knead mixture in a ball and force it into the opening by hand or with a trowel to the full depth of the opening. Trowel finish 'smooth'.
- .3 Do not use mixed material beyond rated pot life or flash set, generally within 3 minutes.

3.6 INITIAL SET RETARDERS

- .1 Evaluate use based on site specific circumstances based on traveling time from batch plant to site and air temperature. Use initial set retarders if the batch plant is located a driving time of 80 minutes or more from the site.
- .2 Account for water reducing properties of retarders.
- .3 Obtain manufacturer's recommendations on application rates and submit proposed application rates for approval of Departmental Representative.
- .4 Add air entrainment agent on site based on Manufacturer's recommendations. NOTE: Base slump is determined after the addition of air entrainment.

3.7 SLAB ON VOID FORMS

- .1 Where structural slabs and grade beams are poured on void forms, the construction from grade up shall be as follows:
 - .1 50 mm sand leveling bed.
 - .2 Void form.
 - .3 6 mil polyethylene vapour barrier.

- .4 9 mm plywood (as working surface).

3.8 JOINT SEALERS

- .1 Remove all loose material assuring joining surfaces are clean, dry and structurally sound and concrete has fully cured.
- .2 Use a “gun” to apply sealant filling the joint from the bottom to the top without bridging of the joint. Do not overfill or underfill.
- .3 Immediately after use clean up any spills with xylene.
- .4 Ensure no foot traffic affects surface for minimum of 3 days.

3.9 PLASTIZERS

- .1 Use plastizer in conjunction with a concrete “boom” type pumper truck for placement of concrete for floor, walls and top slab unless Departmental Representative approves otherwise based on site specific circumstances.
- .2 Submit manufacturer’s recommendations of rates a minimum of 48 hours before concrete placement.
- .3 Obtain Departmental Representative’s approval of addition rate.
- .4 Add and mix in accordance with manufacturer’s recommendations.

3.10 BONDING ADHESIVE

- .1 Bonding tie bars and dowels into hardened concrete: As per manufacturer's instructions.

3.11 CONSTRUCTION JOINTS

- .1 For construction joints between hardened concrete and new concrete:
 - .1 After dowels have been installed (including bonding agent) clean the surface of all lattice and foreign matter. Utilize air compressor and high pressure air to ensure surface is clean.
 - .2 Coat hardened concrete with grouting adhesive in accordance with manufacturer's instructions prior to pouring new concrete.
 - .3 Obtain Departmental Representative's approval before placing new concrete.

3.12 TOP SLAB CAST IN PLACE PIPING

- .1 The plans indicate a partial listing of required cast in place piping. This includes water supply piping, drains and electrical conduit.
- .2 Ensure mechanical and electrical sub trades review all shop drawings and required works to provide a complete listing of required cast in place piping.
- .3 Consider dimensions shown for locations of cast in place piping as a guide only. Mechanical and electrical sub trades to confirm required location of all cast in place piping based on their shop drawing review.
- .4 Place piping and conduit so that there is a minimum clearance of 40 mm between all piping and conduit runs.
- .5 Piping to be cast midway in top slab.
 - .1 Maximum pipe OD cast into top slab to be 32 mm.

- .6 During concrete placing ensure there is no movement in piping or conduits, provide personnel to “check” alignment during concrete placing.

3.13 ELECTRICAL CONDUITS

- .1 Cast in place electrical conduits shall be rigid PVC as per CSA C22.2 No. 211.2.
- .2 The plans indicate a partial listing of required cast in place conduit, provide conduits noted or implied. Install electric conduit in the concrete as required by the drawings and specified elsewhere in the specifications.
- .3 Locate terminations, outlet boxes and fixtures with reference to the final floor, wall or ceiling finish and so secured that they will not be displaced by concrete placing.
- .4 Conduits to be cast midway in top slab.
 - .1 Maximum conduit OD cast into top slab to be 32 mm.
- .5 Terminate as shown on the plans. If the plans do not indicate a termination location:
 - .1 Terminate and cap above the floor such that the conduit can be extended at a later date.
- .6 If the plans indicate termination near a building wall place vertical riser such that inside edge of conduit is within 50 mm of finished wall interior edge.
- .7 Place conduit so that there is a minimum clearance of 40 mm between all piping and conduit runs.
 - .1 29 mm OD and smaller conduit: two conduits can be placed side by side.
- .8 Complete all bends with a bending machine or use long sweep elbows.
- .9 Locations shown on plans are approximate only, set final locations to suit equipment use. If additional information of “exact” locations are provided during the construction process, utilize such dimensions in placing the conduit.
- .10 Maintain a minimum of 150 mm horizontal space between all pipes cast mid-slab.
- .11 Provide record drawings of all cast in place conduits.

3.14 CAST IN PLACE WATER PIPING

- .1 Piping to be cast midway in top slab.
 - .1 Maximum pipe OD cast into top slab to be 32 mm.
- .2 Terminate above floor slab. If the plans do not indicate a termination detail:
 - .1 Terminate and cap above the floor such that the pipe can be extended at a later date.
- .3 If the plans indicate termination near a building wall place vertical riser such that inside edge of conduit is within 50 mm of finished wall interior edge.
 - .1 Provide method to “protect” vertical piping above floor during concrete casting and building erection such that possible kinking is mitigated. Use a long sweep 90 degree PVC electrical conduit as a sleeve.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Indicate bar sizes, spacing, location and quantities of reinforcement, mechanical splices, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings. Complete drawings in accordance with ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - .2 Detail placement of reinforcing where special conditions occur.
 - .3 Design and detail lap lengths and bar development lengths to most recent edition of CSA CAN3-A23.3, unless otherwise indicated.
 - .4 Concrete reinforcement shop drawings to be sealed by a Professional Engineer registered to practice in the Province of Manitoba.

1.2 REFERENCE STANDARDS

- .1 MNL-66, ACI Detailing Manual 2020.
- .2 ASTM A775/A775M-19, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
- .3 ASTM A1060/A1060M-16b, Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .4 ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .5 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .6 CSA A23.3-14, Design of Concrete Structures.
- .7 CSA G30.18:21, Carbon Steel Bars for Concrete Reinforcement.
- .8 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels, Includes Update No. 1 (2014)
- .9 RSIC-[2020], Reinforcing Steel Manual of Standard Practice.

1.3 SUBSTITUTES

- .1 Substitution of different size bars or splice location permitted only upon written approval of Departmental Representative.

1.4 EPOXY COATING

- .1 Epoxy coat all reinforcing steel that may be in contact with water including all plastic to hardened concrete areas.

1.5 STORAGE AND HANDLING

- .1 Deliver and store reinforcement at least 150 mm above grade and in a manner as to prevent damage or deterioration prior to use.

- .2 Deliver bars in bundles, clearly identified in relation to bar lists.

Part 2 Products

2.1 MATERIALS

- .1 Reinforcing steel: Billet steel grade 400, deformed bars to CSA G30.18 unless indicated otherwise.
- .2 Cold-drawn annealed steel wire ties: minimum 1.6 mm thick to ASTM A1060/A1060M.
- .3 Epoxy coating of non-prestressed reinforcement: to ASTM A775/A7754.
- .4 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2 Standard Clause 6.6 and shall be plastic chairs of adequate for strength and support of reinforcing construction condition.
- .5 Mechanical splices subject to the approval of Departmental Representative.

2.2 FABRICATION

- .1 Fabricate reinforcing steel to CSA A23.1/A23.2.
- .2 Fabricate within the following tolerances:
 - .1 Sheared length: plus or minus 25 mm.
 - .2 Stirrups, ties and spirals; plus or minus 10 mm.
 - .3 Other bends: plus or minus 25 mm.
 - .4 Depth of truss bars: plus 0, minus 10 mm.

2.3 BENT BARS

- .1 Factory bend bars are required at the following minimum locations. Refer to drawings for all required bent bars.
 - .1 Bend bars at all waterstop locations.
 - .2 Bend bars in base slab, at sumps typically located under access cover.
 - .3 Bend bars under channel drain.
 - .4 Bend bars for hooks, piles and columns as shown on the plans.

Part 3 Execution

3.1 EXAMINATION

- .1 Before starting this work, examine work done by others which affects this work.
- .2 Notify the Departmental Representative of any conditions which would prejudice proper completion of this work.
- .3 Commencement of work implies acceptance of existing conditions.

3.2 INSTALLATION

- .1 Detail, install and protect reinforcing steel in accordance with CSA A23.1/A23.2.
- .2 Welding of reinforcing steel is not permitted.
- .3 Locate mechanical splices as detailed on shop drawings.

- .4 Obtain Departmental Representative's approval of reinforcing steel and position before placing concrete.
- .5 Ensure cover to reinforcement is maintained during concrete pour.
- .6 Place reinforcement accurately to specified tolerances and ensure reinforcement is adequately supported before concrete is placed and secured against displacement during concrete placement operations. The reinforcement shall be supported by bar supports to assure proper concrete cover and spacing within the allowable tolerances before and during placement of concrete.
- .7 Bar supports shall be sufficient in number and strength to carry the weight of reinforcement and prevent displacement by workmen and equipment before and during concrete placement. Side form spacers shall be used for all column and wall construction to secure reinforcement against displacement and maintain cover distance between reinforcement and vertical formwork.
 - .1 Concrete bricks, broken concrete blocks, stones, wood supports and other non fabricated methods are not acceptable for supporting reinforcing steel.
- .8 Tie bars well and securely together, using 1.625 mm wire at a number of locations sufficient to maintain the bars in the required position. Minimum tie spacing of 600 mm on center in either direction.
- .9 Minimum laps for reinforcing bars to be the maximum as per CSA A23.3. As a minimum provide 25 bar diameters or 450 mm minimum at splices unless otherwise noted. Provide corner bars to match longitudinal reinforcing at all intersections.
- .10 Set all wall dowels in forms prior to placing concrete so that each dowel is maintained in its proper location.
- .11 Support slab bottom bars on continuous chairs. Spacing of chair lines not to exceed 500 mm for 10M, 750 mm for 15M, 1,000 mm for 20M and larger bars. Chairs to support steel within 3 mm of its correct height.
- .12 Reinforcement, at the time concrete is placed, shall be free from mud, oil, pitting, rust or other coatings that adversely affect bonding capacity. The Contractor shall remove any dry concrete that has been deposited on the steel during previous placement operations before additional concrete is placed.
- .13 Notwithstanding CSA A23.1/A23.2, the Contractor shall place reinforcing steel to provide proper minimum concrete cover as follows.
 - .1 Suspended Slabs:
 - .1 10M and 15M bars: 40 mm.
 - .2 20M and larger bars: 50 mm.
 - .2 Structural Base Slabs:
 - .1 Top Bars: 50 mm.
 - .2 Bottom Bars: 75 mm.
 - .3 Beams:
 - .1 Principal reinforcement: 65 mm.
 - .2 Stirrups and ties: 50 mm.
 - .4 Walls: 50 mm.
 - .5 Walls and slab faces exposed to sewage: 60 mm.
- .14 Maintain alignment as follows:

- .1 Slabs: ± 6 mm.
- .2 Other structural members: ± 6 mm.
- .3 Rebar Bends and Ends: ± 50 mm.

3.3 TOLERANCES

- .1 Reinforcement must be placed within the following tolerances.
 - .1 For clear concrete protection of reinforcement: ± 12 mm.
 - .2 Where depth of flexural member, thickness of wall or smallest dimension of column is:
 - .1 200 mm or less: ± 8 mm.
 - .2 Larger than 200 mm but less than 600 mm: ± 12 mm.
 - .3 600 mm or larger: ± 20 mm.
 - .4 Lateral spacing of these bars shall be within ± 30 mm of the specified spacing.
 - .3 For longitudinal location of bends and ends of bars: ± 50 mm.
 - .4 For longitudinal location at discontinuous ends of members: ± 20 mm.

3.4 PLACING REINFORCEMENT

- .1 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .2 Place reinforcing steel as indicated on approved placing drawings and in accordance with CSA-A23.1/A23.2.
- .3 Protect epoxy coated portions of bars with covering during transportation and handling.

3.5 FIELD BENDING

- .1 Do not field bend 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 which develop cracks or splits.

3.6 FIELD TOUCH-UP

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

3.7 CLEANING

- .1 Maintain all reinforcing clean and free from oil or other deleterious matter.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Details and listing of proposed area of each pour, sequence of each pour, methods to maintain proposed construction joints and placement of waterstop.
 - .2 If construction joints are proposed that are not specifically noted or shown on the plans provide details in proposal on finishes of all hardened concrete in construction joints, method to ensure integrity of the reinforcing steel in the construction joint if in the presence of water, method to ensure no leakage through the waterstop in the construction joints and other information as outlined by Departmental Representative.
 - .3 Concrete Mix Design see Certificates below.
 - .4 Details of housekeeping pads.

1.2 SAMPLES

- .1 Provide all concrete required for field control tests.
- .2 If requested by Departmental Representative submit samples of the following items for approval at least 2 weeks before placing any concrete:
 - .1 Form ties
 - .2 Rebar chairs, bolsters
 - .3 Anchorage inserts
 - .4 Aggregates (coarse and fine)
 - .5 Reinforcing steel
 - .6 Admixtures.

1.3 WORK INSTALLED BUT SUPPLIED UNDER OTHER SECTIONS

- .1 Access hatch frames, anchors, bolts, hangers, sleeves, pipes, vents and other inserts to be cast into concrete to be supplied under other sections.

1.4 REFERENCE

- .1 Perform cast-in-place concrete work in accordance with the following standards except where specified otherwise.
 - .1 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C494/C494M-19, Standard Specification for Chemical Admixtures for Concrete.
 - .3 CAN/CSA-A23.1/A23.2-19, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
 - .4 CSA A23.3-19, Design of concrete structures.
 - .5 CSA-A3000-18, Cementitious materials compendium, Includes Update No. 1 and Errata (2021).
- .2 Abbreviations and Acronyms:

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
 - .1 Type GU, GUb and GUL - General use cement.
 - .2 Type HS and HSb - High sulphate-resistant cement.

1.5 CERTIFICATES

- .1 Provide certification that plant, equipment and materials to be used in concrete comply with requirements of CSA-A23.1.
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA-A23.1 section 4.3.1.
- .3 Be responsible for the concrete mix proportion. Select constituent materials and mix proportions to provide strength, durability, plasticity and workability in accordance with the requirements for each class of concrete.
- .4 Submit to the Departmental Representative a "stamped by a Manitoba Professional Engineer" mix design certifying the materials including admixtures which will be used in concrete, at least 14 days before first concrete is to be cast.

1.6 WORK CREW

- .1 Provide certification that members of work crew have experience for the required concrete works. Provide listing of crew members and their related experience in the required critical aspects of works that are time dependent such as concrete placing, screeding, floating, floor finishing, etc.
- .2 During times of concrete pouring provide details of number of members of work crew and their duties, ensuring sufficient extra experienced members are available to complete concrete floor finishing works while pouring continues.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
 - .1 Modifications to maximum time limit must be agreed to by the Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by the Departmental Representative.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .3 Waste Management and Disposal:
 - .1 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.
 - .2 Provide an appropriate area on the job site where concrete trucks can be safely washed.
 - .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site.
 - .4 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .5 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid

with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial and National regulations.

1.8 DEFICIENCIES

- .1 Failure to comply with the requirements which control strength will result in the structure being considered potentially deficient.
- .2 A structure will be considered potentially deficient when:
 - .1 Concrete strength is not as specified.
 - .2 Reinforcing steel size, quantity, position, quality or arrangement not as specified or detailed.
 - .3 Improper curing.
 - .4 Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - .5 Mechanical injury from fire, construction overload or premature removal of forms.
 - .6 Poor workmanship including cold joints, honeycombing or poor concrete finishing.
 - .7 Failure to have the Departmental Representative inspect and approve formwork and reinforcement before placing concrete.
 - .8 Concrete which differs from the required dimensions.
 - .9 Improper protection of concrete during initial set from rain, snow, freezing and other adverse weather elements.
- .3 Deficiencies related to workmanship and strength evaluation tests and analysis:
 - .1 The Departmental Representative may order an independent testing firm to evaluate deficiencies in workmanship (i.e. cold joints, honeycombing, exposed reinforcing steel, etc.) or concrete quality (strength, type, etc.) including obtain cores, x-rays, or similar non-destructive tests.
 - .2 The Departmental Representative may order a load test and/or analysis as defined by CAN3-A23.3, if the non-destructive tests are impractical or inconclusive.
 - .3 As directed by the Departmental Representative, reinforce by additional construction or replace at contractor's expense, concrete judged inadequate by structural analysis or results of load tests.
 - .4 Pay the cost evaluation of concrete deficiencies including design, testing (including resident and non resident administration) and/or analysis which is required to demonstrate the adequacy of the structure which does not meet the requirements for strength, long term impacts from poor workmanship (i.e. cold joints, honeycombing, exposed reinforcing steel, etc.), impact of hot weather or freezing conditions during curing, or evaluation required due to concrete which has been placed before formwork and reinforcing have been inspected and approved by the Departmental Representative.
 - .5 Complete all remedial works as determined by the Departmental Representative based on the evaluation.
 - .6 The Departmental Representative may order additional testing at any time even though the required tests indicate that the strength requirements have been met. In this instance, the Departmental Representative will pay for those tests that meet the specified requirements and the Contractor shall pay for those that do not.

Part 2 Products

2.1 MATERIALS

- .1 Cement:
 - .1 Normal Portland Cement – Type GU (formally 10) to CAN/CSA - A3001.
 - .2 Sulfate resistant cement - Type HS (formally 50) to CAN/CSA - A3001.
 - .3 Water, fine aggregates and coarse aggregates to CSA-A23.1 section 4.2 and subsection 5.2.1.
- .2 Curing compound shall be compatible for potable water environment.
- .3 Air entraining admixture: To CSA-A23.1 clause 4.2.4.2.
- .4 Non-shrink Grout: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 50 MPa at 28 days.
- .5 Chemical admixtures to ASTM C494, Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .6 Possolanic mineral admixtures: to CSAA23.1/A23.2. Maximum 25% by total weight of cementing materials (ie. flyash, cement and silica fume).

2.2 CONCRETE MIXTURES

- .1 Provide concrete mixed in accordance with requirements of CSA-A23.1.
- .2 Pay all costs for mix design. Submit design to Departmental Representative for review at least two weeks prior to any concrete delivery to the job site.
- .3 All concrete: compressive strength, cement type, cement content, water to cement ratio, aggregate size, slump and air content to be as shown below.

Portion of Structure	Min. Comp Strength at 28 Days (MPa)	Min. Comp Strength at 56 Days (MPa)	Cement Type	Min Cement Content (kg/m ³)	Max Water Cement Ratio	Aggregate Size (mm)	Slump Max (mm)	Air Content (%)
Building Floor (Top Slab)	35	--	GU	350	0.40	20	90	Natural
Skin Coat	15	--	GU	-	-	20	120	-
Parking Slabs		32	HS	320	0.50	20	90	5-7
Structural Concrete in Contact with Earth or Fill	--	35	HS	340	0.45	20	90	5-7
Structural Concrete NOT in Contact with Earth or Fill	35	--	GU	340	0.45	20	90	5-7
Concrete Equipment Bases (Housekeeping Pads)	30	--	GU	340	0.45	20	90	Natural

- .4 Calcium Chloride and Admixtures other than water reducing agents and air entrainers are not permitted without written approval from Departmental Representative.
- .5 Slump of all concrete placed may be temporarily increased to a range between 150 mm - 200 mm with the use of a concrete plasticizer.

- .6 Maximum water cement ratio and minimum cement content are intended for durability. More cement may be required to assure that minimum compressive strength is attained. Pay costs of additional cement required to assure the minimum compressive strength is attained.
- .7 All admixtures are subject to the approval of the Departmental Representative. List all proposed admixtures in mix design submission. Do not change or add admixtures to approved design mixes without Departmental Representative's approval.

Part 3 Execution

3.1 SETTING OUT

- .1 Be responsible for vertical and horizontal controls by setting structural corners, locations and elevations from reference points and bench marks provided by Departmental Representative
- .2 Place concrete reinforcing in accordance with Section 03 20 00 Concrete Reinforcing.

3.2 COORDINATION AND INSPECTION

- .1 Coordinate location and supply of all embedded items such as sleeves, hangers, anchor bolts, bearing plates, waterstop, etc. and install same.
- .2 Advise Departmental Representative at least 48 hours in advance of anticipated concrete placement to allow inspection of formwork, reinforcing steel placement and general preparations. Provide all assistance and materials necessary during inspections. One side of a wall (s) and deep beam forms shall be left open until reinforcing steel placement has been inspected and approved for concrete placement.
- .3 Do not place concrete without Departmental Representative's approval following inspection of the work.

3.3 WORKMANSHIP

- .1 Ensure that all forms and reinforcement are clean and ready to receive concrete.
- .2 Ensure all reinforcement, anchors, seats, plates, ports, pipes, and any item to be cast into concrete are in correct location and position before placing concrete.
- .3 Ensure reinforcement and all cast in place inserts are securely placed so that they are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative's review of proposed method for protection of concrete during placement and curing in adverse weather including proposed artificially heated environment for finishing and curing operations.
- .5 Ensure that method of placing has been adequately thought out so that no delays are encountered. Ensure adequate access for trucks, walkways, cranes, buggies, water and vibrators. Ensure that once work has started, it can proceed continuously until completed.
- .6 Maintain accurate records of cast in place concrete items to indicate date, location of pour, quantity, air temperature and test samples taken.

3.4 CONCRETE DELIVERY

- .1 Place concrete in the forms and compact before initial set and within 30 minutes of being removed from the truck. Maximum time between initial batching and compaction in the

forms is 2 hours. Any trucks standing at the site for more than 45 minutes shall have their contents inspected and, may be rejected at no cost to the Departmental Representative.

- .2 Ensure the rate of delivery of concrete during concreting operations provides for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed twenty (20) minutes.
- .3 Provide the Departmental Representative with a delivery ticket for each batch of concrete at the time of delivery. The delivery ticket must contain:
 - .1 Name and location of batch plant
 - .2 Date
 - .3 Amount of concrete in cubic metres
 - .4 Cement content in kg/m^3
 - .5 Type of admixtures added
 - .6 Time of batching
 - .7 Mix number.

3.5 PLACING CONCRETE

- .1 Place concrete in accordance with requirements of CSA A23.1 Section 7 and as indicated on the drawings.
- .2 Pour concrete continuously between pre determined construction and expansion joints shown on the plans. Unless otherwise specified allowed construction joints are:
 - .1 Sewage sump to basement floor slab: Pour sump slab with PVC waterstop for all exterior sump walls. Use PVC waterstop for interior walls.
 - .2 Basement floor slab to walls: Use PVC waterstop for all exterior walls.
 - .3 Walls to top floor slab: Monolithic pour all walls. Walls to top floor slab cold joint.
 - .4 Columns: Monolithic pour.
 - .5 Grade Beams: Monolithic pour.
 - .6 Top floor slab: Monolithic pour.
 - .7 Building curb: Continuous pour monolithic with top slab.
- .3 Pour top slabs and entrance pads over grade beams separate from grade beam pour. Complete backfilling to grade beam prior to pouring roof slabs and entrance pads.
- .4 Pour top slab separately from basement walls.
- .5 Consolidate all concrete by mechanical vibration, applied directly to the concrete. Keep a back-up vibrator on site during all concrete placing operations.
 - .1 Vibrate concrete systematically and at such spacing intervals that the zones of influence overlap and the depth of penetration of the vibrator enters the upper part of the previously placed lift of the fresh concrete.
 - .2 Insert vibrator vertically and withdraw slowly in a vertical direction to facilitate the removal of entrapped air bubbles.
 - .3 Apply vibrator at any one position until the concrete is consolidated but not to the extent that segregation will occur. Do not apply vibration directly or through the reinforcement of section of the degree that the concrete ceases to be plastic under vibration.

- .4 Do not use vibration to make concrete flow in the forms over distances so great as to cause segregation, do not use to transport concrete in the forms.
- .6 Use equipment for conveying concrete such as buckets, trucks, belt conveyors, pumps, etc. of such design, size and condition to ensure a continuous and adequate supply of concrete of the required consistency at the point of deposition.
- .7 When placing operations involve dropping concrete more than 1.5 m, deposit concrete through pipes, troughs or chutes. All chutes, troughs and pipes shall be kept clean and free from coatings of hardening concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear of the structure.
- .8 Place concrete in horizontal layers not exceeding 600 mm thick, at such a rate to ensure satisfactory compaction without voids or honeycombing.
- .9 Floors: use a combination thereof where applicable of truck chutes, pump, troughs, overhead buckets and cranes or wheel barrels.
- .10 Use a concrete pump "boom" truck to pour wall sections and top slab. Provide back up system onsite for use in the event of problems with the pumper truck. Acceptable back-up systems are as follows (either onsite or within 1 hr of site (provide written certification of a equipment and operator on standby):
 - .1 Cranes with overhead buckets.
 - .2 Second pump truck.
 - .3 Trailer mounted concrete pump.
- .11 Do not place concrete in excavations containing water.
- .12 Roughen (before the concrete has set) all construction joints by raking or by equivalent means to create longitudinal striations 3- 5 mm deep. Use bonding agent prior to subsequent pours.
- .13 Do not start concrete placing operations when there is a weather forecast of high probability of rainfall, excessive heat or high winds. If the Departmental Representative postpones pouring due to above, the Departmental Representative 's decision shall be considered final.
- .14 Honeycomb or embedded debris in concrete is not acceptable and shall deem concrete to be defective. Remove and replace defective concrete.
- .15 Progression of concrete placement in casting of horizontal slabs to be parallel to principle steel located in that slab. Maintain "finished" full span throughout duration of casting.
- .16 Boreholes for cast in place piles with 300 mm of water or more:
 - .1 Pump out the water just prior to depositing the concrete from ground surface.
 - .2 Alternatively use tremie method to deposit concrete from the bottom up.
- .17 Vibrate the top 3 m of the concrete pile.

3.6 CONSTRUCTION JOINTS

- .1 Use PVC waterstop for all construction joints in water retaining structures, below grade and where shown on the drawings. Expanding type waterstop may be considered in specific areas only if shown on the plans.
 - .1 Suspend PVC waterstop in exact position prior to concrete placement, construction methods that propose final placement of waterstop occurring during concrete pouring operations will **NOT** be accepted.

- .2 Roughen the surface of hardened concrete.
- .3 Provide construction joints where indicated. If joint locations are not specifically shown apply and obtain approval of supplementary joints desired. Departmental Representative's decision on approval of supplementary joints and related conditions to be final.
- .4 Clean the surface of all hardened concrete prior to placing new concrete.
 - .1 Remove all lattice and foreign matter.
 - .2 Utilize a combination of pressure washer, air compressor and high pressure air to ensure surface is clean.
 - .3 After cleaning and immediately prior to pouring fresh concrete, coat hardened concrete with bonding adhesive in accordance with manufacturer's instructions.
- .5 For sealing openings in existing or hardened concrete floors, walls or top slab.
 - .1 Drill and epoxy set 15M epoxy coated dowels at maximum 250 mm spacing.
 - .1 Depth into hardened concrete as per plans.
 - .2 Set dowels at middle of slab.
 - .3 Ensure hardened concrete is roughened and cleaned of all dust and foreign material (including dowel epoxy bonding agent).
 - .4 Place and secure expanding joint type waterstop – locate under dowels.
 - .5 Coat hardened concrete with bonding adhesive. Mix and apply as per manufacturer's instructions ensuring product is "tacky" when fresh concrete is placed.
- .6 For new construction obtain approval from Departmental Representative for all proposed hardened concrete and new concrete locations:
 - .1 After dowels have been installed, clean the concrete joint surface of all lattice and foreign matter (including dowel epoxy bonding agent).
 - .2 Obtain Departmental Representative's approval before placing new concrete.
- .7 Pour concrete continuously between pre determined construction and expansion joints shown on the plans and listed in 3.5.2.

3.7 KEYWAY

- .1 Form keyways as shown on the plans prior to concrete pour. Construction methods that do not have a formed in place keyway prior to a concrete pour will not be accepted.

3.8 CURING

- .1 Cure all concrete as soon as the concrete has hardened sufficiently to prevent surface damage in accordance with the requirements of CSA A23.1/A23.2 curing type 3 and for a minimum period of 7 days using either "moisture loss prevention" or "supplying supplemental moisture" as described below to prevent excessive loss of moisture:
 - .1 Moisture loss prevention:
 - .1 Leaving formwork in place.
 - .1 Do not "break" or "release" formwork during curing period.
 - .2 Supplying supplemental moisture:
 - .1 Wet cure by ponding.

- .1 Where applicable construct formwork to account for minimum 25 mm depth for flooding. Add appurtenances as required to “hold” water.
 - .2 Curing water shall not be 12°C cooler than concrete temperature when applied.
 - .3 Where applicable use sandbags to block openings in curbs and plug drains as required to maintain minimum 25 mm of water over the concrete.
- .2 Wet cure by water sprinkling.
 - .1 Provide a water spray over 100% of the surface after the surface has sufficient strength to prevent damage.
 - .2 Maintain surface wet at all times, wetting and drying is NOT permitted.
 - .3 Provide method to drain away excess water.
 - .4 Ensure drying does not occur from wind, especially on “upward” side.
- .3 Curing compounds.
 - .1 To be used only for sidewalks and concrete pads not part of a building structure.
 - .2 Apply in two applications in accordance to manufacturer’s specifications with the second being at right angles to the first to ensure uniform coverage.
 - .3 Apply as soon as the concrete is finished and when there is no free water on the surface.
 - .4 Confirm that this curing method is suitable for final surface covering.
- .2 To mitigate plastic shrinkage cracking until final finishing protect the concrete from moisture loss using suitable methods such as wind breaks, fogger sprays and misting.
- .3 Initiate curing methods as soon as the concrete hardens enough to prevent surface damage, this is generally immediately after final finishing. In general the top surface of concrete should not be allowed to dry, curing procedures must be implemented prior to any drying of the top surface.
 - .1 For flooding wait until the poured concrete surface can be flooded with water without damage. Test this every half-hour after pouring by applying a small amount of water to a small section.
- .4 Prevent rapid drying at end of curing period.

3.9 COLD WEATHER REQUIREMENTS

- .1 Conform to the requirements of CSA-A23.1.
- .2 Do not place any concrete in contact with ice, snow or frozen ground.
- .3 Concrete temperature shall be in accordance with CSA when deposited.
- .4 When the air temperature is at or below 5°C or there is a likelihood of it falling to that limit within 24 hours of placing, employ suitable means to maintain temperature of all concrete surfaces above 10°C for 24 hours before pouring and above 10 °C for at least 7 days after pouring.

- .5 Provide heating enclosures that are meet CSAA23.1/A23.2.. Locate heating units to prevent local overheating or drying of the concrete or damage from combustion gases. Vent heat units outside the enclosure.
- .6 Notify Departmental Representative well in advance as to the methods of enclosure and frost protection that is proposed.
- .7 Provide two or more maximum/minimum indicating thermometers in each enclosure. Monitor air temperatures in corners or extremities as directed by Departmental Representative. Provide a third maximum/minimum indicating thermometers for use by Departmental Representative. Provide Departmental Representative with twice daily records of recordings.
- .8 Do not use calcium chloride or other chemicals to prevent freezing unless authorized in writing by Departmental Representative.
- .9 Ensure all necessary equipment and material for the protection of concrete is in good working order and is on hand.
- .10 Repair any concrete damaged by frost, carbonation or flash setting as directed by the Departmental Representative.

3.10 HOT WEATHER REQUIREMENTS

- .1 Conform with requirements of CSA A23.1/A23.2.
- .2 When air temperature is at or above 27°C during the placing period, employ suitable approved means to maintain temperature of the concrete as low as practicable and in any case not more than 27°C.
- .3 When the air temperature is above 27°C use water spray, ponding, and hot curing compounds for initial curing.
- .4 When Departmental Representative determines that conditions are likely to cause plastic shrinkage cracking (low relative humidity with rate of evaporation exceeding 0.7 kg of water per square metre per hour), use an approved moisture retention film and/or other suitable means to prevent plastic shrinkage cracking.

3.11 SKIN COAT

- .1 Complete skin coat in accordance to plans.

3.12 SLABS-ON-GRADE

- .1 Prior to placing concrete, verify that subgrade has been compacted and tested as required and that it is acceptable to the Departmental Representative.
- .2 Form construction joints at any location where casting of slab must be interrupted.
- .3 Provide a broom finish. Finish all edges using an appropriate edging tool.

3.13 CONCRETE SLAB DRAINAGE

- .1 Each horizontal concrete slab shall drain completely without any puddling or ponding. The top slab shall be continuously sloped to the drain(s) in accordance to plans prepared or approved by the Departmental Representative. Should a completed floor provide improper drainage the Departmental Representative may request another pour of the floor at the Contractor's expense. Furthermore should any cracks appear within forty (40) days anywhere in the basement the Departmental Representative may request alterations at the Contractor's expense. Specifically each slab shall drain according to the following:

- .1 Grade the building from the outside edge of the slab (at the perimeter curb) at a minimum drop as specified on the plans. The surface is to be continuously straight and smooth from high point to low point. Concrete thickness at the high end must be greater than at the drains to maintain minimum concrete thickness at the drains as shown on the plans.
 - .1 Tolerance for continuous grading not to exceed plus or minus 3 mm.
 - .2 Provide written proposal to Departmental Representative that outlines method to obtain slope and quality control measures to be taken.
 - .3 Depth of any ponding not to exceed 3 mm.
- .2 Consider equipment pads and their placement in overall floor drainage. Make openings in equipment pads as required to maintain floor drainage.
- .3 Set up string lines across the slab to verify quality control of slab drainage.
- .2 Flood floor(s) to demonstrate that grades are within acceptable tolerances as indicated above. Provide a schedule and program for approval of the Departmental Representative as of flooding the floor to demonstrate grades and potential remedial measures. Consider the timing of the installation of equipment pads and equipment in the schedule and potential remedial measures such as a topping if required. . Be responsible for all grinding and patching of the floor as required to achieve tolerances listed above.

3.14 FLOOR FINISHES

- .1 The top of final surface of all concrete shall be finished by screeding, floating and troweling, as specified by the Departmental Representative. Dusting of wearing surfaces with dry materials to absorb moisture or to stiffen the mix shall not be permitted. The floor slabs shall be struck off true to required level or slopes shown.
- .2 Mechanical float and steel trowel slabs and in accordance with CSA A23.1 Section 7.5 to produce a hard, smooth, dense troweled surface free from blemishes; finishing tolerance classification: flat (subject to grading as shown on the plans).
- .3 Provide a "workmanlike and neat" finish of surface in a good manner and as required to provide a tight and compact appearance uniform in color and texture.
- .4 Ensure top of building floor area adjacent to curbs and walls is smooth, straight and free of imperfections that would interfere with a "neat" fit at the floor of the base material being used between the concrete floor and inside wall bottom of liner panel Z trim. Provide grout as may be required for ensuring neat finish of base material to the floor.
- .5 Should any cracks appear within forty (40) days anywhere in the , due to improper finish or curing, the Departmental Representative may request alterations/repairs at the Contractor's expense.

3.15 ENTRANCE APRON FINISHING

- .1 Following completion of floating operations, but prior to initial set of the concrete, the edges of all concrete slabs shall be carefully finished with an appropriate edging tool. The entire surface of any slab shall be given a broom finish following edging.
- .2 Joints:
 - .1 Joints shall be constructed where required in accordance with the details shown on the Drawings or as directed by the Departmental Representative. The joints shall be vertical and shall not deviate more than 15 mm from the horizontal alignment shown on the Drawings.

- .2 Expansion joints shall be constructed only where new concrete is being placed up against existing non-pavement structures, or where directed by the Departmental Representative. A 15 mm thick fibre joint filler shall be installed in expansion joints. The fibre joint filler shall extend from the base of the concrete slab up to the concrete surface but no higher.
- .3 Joints shall be saw-cut by approved methods to the dimensions shown on the Drawings as soon as the concrete is sufficiently hard so that it will not be ravelled or damaged. The time at which all saw-cutting is to be undertaken shall be determined by the Contractor. The Contractor shall be wholly responsible for all concrete defects arising from this operations and shall further correct or replace all such defective concrete as may be required in the opinion of the Departmental Representative. The costs of all corrective measures shall be borne entirely by the Contractor and rejected concrete shall be removed and at the expense of the Contractor clear of the site of the work.
- .4 During saw-cutting operations the Contractor shall take necessary measures to protect adjacent properties from the saw-cut residue.

3.16 TOP SLAB CAST IN PLACE PIPING

- .1 The plans indicate a partial listing of required cast in place piping. This includes drains and electrical conduit.
- .2 Locate outlet boxes and fixtures with reference to the final floor, wall or ceiling finish and so secured that they will not be displaced by concrete placing.
- .3 Ensure mechanical and electrical sub trades review all shop drawings and required works to provide a complete listing of required cast in place piping.
- .4 Consider dimensions shown for locations of cast in place piping as a guide only. Mechanical and electrical sub trades to confirm required location of all cast in place piping based on their shop drawing review.

3.17 PATCHING

- .1 Complete patching prior to other waterproofing measures. Any cracking in the concrete walls or floors found either prior to or subsequent to the leakage testing shall be patched on both sides of wall or floor.
- .2 Patching shall consist of chiseling as required and placing non shrink grout.

3.18 BUG HOLES

- .1 Bug holes (blow holes) are defined as small regular or irregular cavities, usually not exceeding 15 mm (0.6 in.) in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and consolidation.
- .2 Patch (grout) all bug holes larger than 15 mm in exposed concrete surfaces using a cement based, polymer modified, quick setting, concrete finishing material stated by the Manufacturer to be suitable for the repair of bug holes.

3.19 GROUTING EQUIPMENT BASES

- .1 Equipment grout is to have compressive strength capable of supporting the equipment. Refer to equipment manufacturer for grouting recommendations.
- .2 Thoroughly clean and saturated with water the concrete surfaces prior to grouting. Grout shall consist of pre blended grout, fine aggregate and water in strict accordance with the

recommendations of the manufacturer. Use the amount of mixing water required to produce a plastic to flowable mix.

- .3 If cavities are present after grouting, re-grout until the bases are supported over their entire area.

3.20 HOUSE KEEPING (EQUIPMENT) PADS

- .1 Provide concrete or corrosion resistant fabricated bases to raise all mechanical and electrical equipment approximately 100 mm above the floor unless otherwise noted on the plans. Coordinate size, height and location of housekeeping pads with mechanical and electrical Divisions. A partial listing is:
 - .1 Genset (co-ordinate with Division 26)
 - .2 Electrical panels (co-ordinate with Division 26).
 - .3 Drum Scrubber (co-ordinate with Division 44).
 - .4 As identified on plans.
- .2 Chamfer edges of housekeeping pad.
- .3 Cast in place 10M L-shaped hooks or drill and epoxy 10M steel into concrete floor at 400 mm on center around the perimeter of the concrete pad and provide 10M steel around perimeter of all pads. Verify location of imbedded services prior to drilling for anchors.
- .4 Provide 10M or wire mesh as reinforcing steel in middle to prevent shrinkage cracking, tie to drilled anchors (400mm on center – bothways).
- .5 Provide openings in the pad as required to maintain water drainage on the floor to the drains.
- .6 Clean the surface of all hardened concrete prior to placing new concrete.
- .7 Level over entire surface plus or minus 2 mm.
- .8 Apply concrete bonding adhesive prior to pouring of pad.

3.21 FLOOR DRAINS/DRAINAGE SUMPS

- .1 Install and construct drains in accordance with plans.
- .2 Ensure floors are sloped to drains and function to the fullest extent possible.
- .3 Test drains by flooding the floor and or plugging the drains in the presence of the Departmental Representative to ensure drains are not obstructed, are watertight and provide full drainage flow.
 - .1 Piping to drain fully without puddles.
- .4 Ensure that cast in galvanized steel grating support frames and floor drains are at the proper elevation to ensure floor drainage.

3.22 BUILDING CURB

- .1 Building perimeter curb to be continuous pour monolithic with building floor.
- .2 Curb is not to be continued under door.

3.23 CLEAN UP

- .1 Remove and dispose of all form and falsework.

- .2 Landscape to fill in any holes made by the form and falsework to original condition or as indicated on the plans. Final ground landscape elevations as per plan.
- .3 Dispose of rubble, waste concrete and garbage at an approved waste disposal grounds.

END OF SECTION

DIVISION 4

MASONRY

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Product Data
 - .1 Submit manufacturer's instructions, product data and MSDS.
 - .2 Submit data indicating proportion or property specifications used for each type of mortar including Portland cement.
 - .3 Submit cured samples of coloured mortar for conformance to colour.
 - .2 Submit confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Departmental Representative of:
 - .1 Aggregate: coarse aggregate and sand.
 - .2 Cement.
 - .3 Lime.
 - .4 Colour pigment samples.
 - .3 Quality Assurance
 - .1 Submit test reports showing compliance with specified performance characteristics and physical properties.
 - .2 Supply any samples required by the Departmental Representative for the purpose of testing to determine the fitness of products incorporated in the work.

1.2 REFERENCES

- .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA A179-14 (R2019), Mortar and Grout for Unit Masonry.
- .3 CAN/CSA A371-14 (R2019), Masonry Construction for Buildings.
- .4 CSA A3000-18, Cementitious Materials Compendium, Includes Update No. 1 and Errata (2021)

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 5° C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32° C prior to, during, and 48 hours after completion of masonry work.

Part 2 Products

2.1 MORTAR MATERIALS

- .1 Aggregate: Conforming to CSA A179.
- .2 Water: Clean, potable, free of injurious amounts of acids, alkali's and organic material which may affect mortar performance or appearance.
- .3 Masonry Cement: To CAN/CSA A3002 and CSA A179, Type S.
- .4 Mortar Cement: To CAN/CSA A3002 and CSA A179, Type S.
- .5 Portland Cement: To CAN/CSA A3000, normal Type GU – General use.
- .6 Hydrated Lime: To CSA A179.

2.2 ADMIXTURES

- .1 No air-entraining admixtures or material containing air-entraining admixtures.
- .2 No antifreeze compounds shall be added to mortar.
- .3 No admixtures containing chlorides shall be added to mortar. Admixtures containing more than 0.1% chloride ions are not permitted.

2.3 MORTAR COLOR

- .1 Use coloring admixture not exceeding 10% of cement content by mass, or integrally colored masonry cement, to produce colored mortar to match approved sample. Admixtures to be approved prior to use. Use in accordance with the specific manufacturer's recommendations. Mortar color sample as selected from manufacturer's standard color range.

2.4 MORTAR MIXES

- .1 Load Bearing Walls and Partitions: to CSA A179, Table 2, Type S, 1/2 part Portland cement: 1 part Masonry cement: 4-1/2 parts dry aggregate by volume, 10 MPa min. compressive strength at 28 days.
- .2 Non-load Bearing Walls and Partitions: to CSA A179, Table 2, Type N, 1 part Masonry cement: 3 parts dry aggregate by volume, 4 MPa min. compressive strength at 28 days.
- .3 Pointing Mortar: CSA A179, Type N using property specification with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
- .4 Parging mortar: Type N to CSA A179.
- .5 Following applies regardless of mortar types and uses specified above:

- .1 Mortar for calcium silicate brick and concrete brick: Type N based on proportion specifications.
- .2 Mortar for stonework: Type N based on proportion specifications.
- .3 Mortar for grouted reinforced masonry: Type S based on proportion specifications.

2.5 MORTAR MIXING

- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
- .2 Mix mortar ingredients in accordance with CSA A179 in quantities needed for immediate use.
- .3 Maintain sand uniformly damp immediately before mixing process.
- .4 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.
- .5 Do not add air entraining admixture to mortar mix.
- .6 Use a batch type mixer in accordance with CSA A179.
- .7 Pointing mortar: Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
- .8 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
- .9 Use mortar within 2 hours after mixing at temperatures of 32° C, or 2-1/2 hours at temperatures under 5° C.

2.6 GROUT MIXES

- .1 Bond Beams: minimum grout mix 10 to 12.5 MPa strength at 28 days or as otherwise indicated on drawings; 200-250 mm slump; mixed in accordance with CAN/CSA A179.
- .2 Lintels: minimum grout mix 10 to 12.5 MPa strength at 28 days or as otherwise indicated on drawings; 200-250 mm slump; mixed in accordance with CAN/CSA A179.
- .3 Grout: minimum compressive strength of 12.5 MPa at 28 days or as otherwise indicated on drawings. Maximum aggregate size and grout slump: CAN/CSA A179.

2.7 GROUT MIXING

- .1 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179.
- .2 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .3 Do not use calcium chloride or chloride based admixtures.

2.8 MASONRY MATERIALS

- .1 Replace cracked, broken or damaged masonry block units with masonry block units that match the existing.

2.9 SOURCES

- .1 Use same manufactured brands and sources of mortar materials for entire project, to ensure uniformity of mix and colouration.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 CONSTRUCTION

- .1 Do masonry mortar and grout work in accordance with CSA A179, except where specified otherwise.
- .2 Apply parging in uniform coating of thickness indicated.

3.3 MORTAR MIXING

- .1 Measure cementitious and aggregate material in dry condition by volume and mix mortar ingredients thoroughly in quantities needed for immediate use.
- .2 Ensure mechanical mixer is clean prior to batching.
- .3 Mortar must be weaker than the units it is binding.
- .4 Mix mortar in mechanical mixer operated until materials are homogeneously blended, but not less than 3 minutes after all materials are in mixer.
- .5 Control batching procedure to ensure proper proportions by measuring materials by volume. Sand measured by shovel count is not permitted.
- .6 Hand mixing permitted providing quantities of materials and water are accurately controlled and that method of mixing is approved by the Departmental Representative.
- .7 Do not retemper partially set mortar. Each batch shall be used up within one half hour of mixing or be discarded.

3.4 INSTALLATION

- .1 Install grout and mortar in accordance with manufacturer's instructions.
- .2 Install grout and mortar to requirements of CAN/CSA A179.
- .3 Remove excess mortar from grout spaces.
- .4 Work grout into masonry cores and cavities to eliminate voids.
- .5 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
- .6 Do not displace reinforcement while placing grout.

3.5 FINAL CLEANING

- .1 After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brush and clean water, spray applied at low pressure.
- .2 Use of metal scrapers or bristles will not be permitted.
- .3 Use of acid or alkali cleaning agents will not be permitted.

3.6 SITE WORK AREA SITE CLEAN UP

- .1 Remove and dispose all debris and garbage associate with the work from site to an approved landfill.
- .2 Dispose of run-off from cleaning operations in a manner that prevents damage to soil, landscaping, etc.
- .3 Repair and restore all damaged areas or surfaces resulting from the work.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All products described above in Item 1.1.1.

1.2 REFERENCES

- .1 ASTM A36/A36M-17, Standard Specification for Carbon Structural Steel.
- .2 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
- .3 ASTM A580/A580M-18, Standard Specification for Stainless Steel Wire.
- .4 ASTM A615/A615M-20, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- .5 ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .6 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .7 ASTM A996/A996M-16, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
- .8 ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .9 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
- .10 ASTM D2240-15 (2021), Standard Test Method for Rubber Property - Durometer Hardness.
- .11 CAN/CSA A179-14 (R2019), Mortar and Grout for Unit Masonry.
- .12 CSA A370-14 (R2018), Connectors for Masonry.
- .13 CAN/CSA A371-14 (R2019), Masonry Construction for Buildings.
- .14 CSA A23.1-14/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .15 CSA G30.18:21, Carbon Steel Bars for Concrete Reinforcement.
- .16 CSA S304-14 (R2019), Design of Masonry Structures, Includes Update No. 1 (2015).
- .17 CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .18 Reinforcing Steel Manual of Standard Practice, [2004].

Part 2 Products

2.1 JOINT SEALANTS

- .1 Silicone sealant: Shall conform to the requirements of ASTM C920.

- .1 Review color charts of above products and provide color chart, building product sample color (metal, brick, etc) and a proposed sealant color for Departmental Representative's review. Allow Departmental Representative to accept or choose alternate color to best match area requiring a sealant.

2.2 CLEANER

- .1 Masonry cleaner shall be as recommended by unit masonry supplier.

2.3 WALL REINFORCING, TIES AND ANCHORS

- .1 Masonry Reinforcing: Truss or ladder type, minimum 5 mm deformed wires galvanized finish to CSA G30.18 sized 50 mm narrower than wall.
- .2 Connectors: To CSA A370 and CSA S304.1.
- .3 Anchor Bolts: Including nuts, washers, studs, ferrules and related items, galvanized steel or bronze as detailed.
- .4 Cavity Wall Ties: To CSA A370 and CSA S304, 1.6 mm thick stainless steel connector plate, c/w 5.8 mm diameter holes for veneer tie wire attachment, 4.76 mm diameter veneer ties with polyethylene insulation supports. Total length of connector plate to suit block width, air space and insulation.
- .5 Anchors: Shall be 3 mm (11 ga) galvanized steel (plate type) or 4 mm diameter (6 ga) galvanized wire (wire type).
- .6 Dovetail Anchors: Shall be as shown on the plans.
- .7 Corrosion protection for wire reinforcement: To CSA S304, galvanized to CSA S304 and CSA A370.

2.4 MASONRY FLASHINGS

- .1 Polyethylene: 0.075 mm polyethylene bonded to asphalt treated creped kraft paper, reinforced with 12.7 x 12.7 mm glass fiberglass scrim.
- .2 Lap adhesive: As recommended by masonry flashing manufacturer.
- .3 Sheet membrane flashing: Self adhering SBS rubberized asphalt compound integrally laminated to cross-laminated polyethylene film, minimum thickness 1.0 mm.
 - .1 Primer: As per manufacturer's recommendation.

2.5 CAVITY WEEP HOLE INSERTS

- .1 Purpose made galvanized steel or polyvinyl chloride.

2.6 SHELF ANGLE SUPPORT

- .1 Provide shelf angle support as per drawings.

2.7 LINTELS

- .1 Refer to plans for lintel schedule and details.

2.8 VERTICAL CONTROL JOINTS

- .1 Provide vertical control joints in accordance with Masonry Council Guidelines. Joint to have copper water stop, sealant backer rod and sealant.

- .2 Provide vertical control joints in the concrete masonry banding spaced at a maximum of 6 m on center.
- .3 Provide an additional ladder joint reinforcing placed @ 400 mm vertically in the exterior of the concrete masonry banding unit.
- .4 Placed at every inside corner.
- .5 Placed 100 mm from one side of every outside corner.

2.9 EXPANSION JOINTS

- .1 Provide vertical expansion joints in accordance with Masonry Council Guidelines. Joint to have copper water stop, sealant backer rod and sealant.

Part 3 Execution

3.1 LINTELS

- .1 Concrete Lintels and Bond Beams.
 - .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.
 - .2 Place and grout reinforcement in accordance with CSA S304.1, CSA A371, and CSA A179.
 - .3 Support and position reinforcing bars in accordance with CSA A371.
 - .4 Install reinforced unit masonry lintels over openings where steel lintels are not scheduled.
 - .5 Construct lintels using grout fill and reinforcing.
 - .1 Maintain minimum 300 mm bearing on each side of opening unless otherwise noted on Drawings.
 - .2 Use reinforcing bars on one-piece lengths only.
 - .3 Cast and cure lintels on plank. Set special channel lintel blocks using specified mortar. Place wood stops at either end of lintel to prevent movement.
 - .4 Place 25 mm of 20 MPa concrete in voids, lay in reinforcing bars and place concrete to level of block sides. Rod and tamp concrete well without disturbing reinforcing. Allow lintels to cure 7 days before moving.
 - .5 Place and consolidate grout without disturbing reinforcing.
 - .6 Allow lintels to reach strength before removing temporary supports.

3.2 INSTALLATION OF ACCESSORIES

- .1 Install continuous control joint fillers in control joints as indicated.
- .2 Lap adhesive: Apply adhesive to flashing lap joints.
- .3 Keep air space in cavity walls free from mortar droppings by placing wood strip on the ties or reinforcement. Strip shall be on line cord and be pulled up level and cleaned of droppings prior to laying next course of ties or reinforcement.
- .4 Install weep hole inserts in mortar joints of exterior face of cavity wall at 600 mm on centre just above all through-wall flashings, shelf angles, beams and at bottom of cavity. Ensure that holes in inserts are not plugged with mortar or debris.

3.3 INSTALLATION OF FLASHINGS

- .1 Build in flashings in masonry in accordance with CSA A371 as follows:
 - .1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.
 - .2 Carry through-wall flashings minimum 150 mm up backing material and turn top edge into joint or anchor top edge continuously. Keep flashing 12 mm from exterior exposed face. Lap joints minimum 150 mm.
 - .3 Lap and completely seal joints with adhesive to manufacturer's instructions. Bond flashing to vertical surfaces over whole area using flashing material manufacturer's recommended adhesive.
 - .4 All flashing installed shall be made to exclude moisture or divert it outside.

3.4 BONDING AND TYING

- .1 Tie masonry veneer to backing in accordance with NBC, CSA S304.1, CSA A371 and as indicated.
- .2 Connect masonry veneer to backing in accordance with CSA A371, with tie spacing beginning within 400 mm of base of wall or support, and within 300 mm of openings and tops of walls and as follows:
 - .1 Shear connectors: 600 mm vertical and 800 mm horizontal spacing maximum. Install shear ties with vertical leg up.
 - .2 Veneer connectors: 600 mm vertical and 600 mm horizontal spacing maximum.

3.5 ANCHORS

- .1 Supply and install metal anchors in accordance with CSA A370 and CSA A371.

3.6 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Product literature indicating unit masonry types, shapes, sizes, textures, (e.g., smooth, split face, ground face, etc.) and colours for review and selection.
 - .2 Details of Building anchoring to foundation.
 - .3 Drawing of wall to curb connection.

1.2 REFERENCES

- .1 ASTM C126-18, Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
- .2 CAN/CSA A82-06 (R2011), Fired Masonry Brick Made From Clay or Shale.
- .3 CAN/CSA A165 Series-14 (R2019) , CSA Standards on Concrete Masonry Units [consists: A165.1, A165.2, A165.3].
- .4 CAN/CSA A371-14 (R2019), Masonry Construction for Buildings.
- .5 CSA S304-14 (R2019), Design of Masonry Structures, Includes Update No. 1 (2015).

1.3 QUALITY ASSURANCE

- .1 Supply any samples required by the Departmental Representative for the purpose of testing to determine the fitness of products incorporated in the work.
- .2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 COLD WEATHER REQUIREMENTS

- .1 When air temperature is less than 5°C, measure temperature of masonry materials prior to use; maintain temperature as close as possible for mortar batches; ensure mortar temperature on mortar boards does not exceed 50°C; use dry masonry units or units which have not been wet or frozen; lay masonry on unfrozen surfaces free from snow or ice; use windbreaks when laying masonry not protected by enclosures when wind exceeds 25 km/h; provide a high-low registering thermometer where directed on site.
- .2 When air temperature will be, over a 24 hour period, less than 5°C but not less than 0°C, perform masonry work as for normal temperature except heat water and sand to produce mortar temperature between 4°C and 50°C. Protect constructed masonry by enclosing within weatherproof membrane for 48 hours.
- .3 When air temperature will be, over a 24 hour period, less than 0°C but not less than -4°C, perform masonry work as for normal temperature except heat water and sand to produce mortar temperature between 4°C and 50°C and maintain temperature of mortar boards above 0°C. Protect constructed masonry by enclosing within weatherproof membrane for 48 hours minimum.
- .4 When air temperature is less than -4°C, provide heated enclosures to maintain air temperature above 2°C on both sides of masonry under construction for minimum of 48

hours after placing mortar. Perform masonry work as for normal temperature except heat water and sand to produce mortar temperature between 4°C and 50°C. Heat concrete block masonry units so that temperature of units at time of laying is greater than 0°C.

1.5 PROTECTION

- .1 Protect work from rapid drying. Cover tops of completed and partially completed walls with waterproof coverings at end of each working day. Drape covers that extends over walls and down sides sufficient to protect walls from wind driven rains. Anchor cover securely in position.
- .2 Protect adjacent finished surfaces from marking or damage due to masonry work.
- .3 Provide temporary bracing of masonry work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

1.6 STORAGE, HANDLING

- .1 Store materials onsite in a manner to prevent damage. Store masonry units off the ground.
- .2 Protect all materials from damage due to weather conditions.
- .3 Handle materials carefully to prevent chipping and breaking.

1.7 COORDINATION

- .1 Coordinate hose bibs, louvre, exhaust fan and intake opening work with Division 22 and 23.
- .2 Coordinate receptacle, junction boxes and lighting work with Division 26.
- .3 Coordinate overhead door and door openings and installed hardware with Division 8.

Part 2 Products

2.1 MATERIALS

- .1 Concrete Blocks: To CSA A165.1, normal weight type H/15/A/M, lightweight type H/15/C/M, modular size.
- .2 Prefaced Concrete Block: to CSA A165.3. Body of unit to CSA A165.1, Type H/15/C/M, modular size.
- .3 Provide blocks in the sizes as shown on the Drawings with all joint, header, corner and other special shaped blocks as required.
- .4 Special shapes: Provide square units for exposed corners.

2.2 VENEER CONCRETE BLOCK MASONRY UNITS

- .1 Notwithstanding visual inspection requirements of CSA Standards, masonry units shall be free of surface indentations, surface cracks due to manufacture, or chipping. Units so delivered shall not be used where exposed to view, but may be used where concealed.
- .2 Exterior dimensions to be 90 mm x 190 mm x 390 mm.
- .3 Colour: As identified on the plans. Provide a colour chart to Departmental Representative prior to ordering materials.

2.3 INTERIOR FACE STANDARD CONCRETE BLOCK MASONRY UNITS

- .1 Notwithstanding visual inspection requirements of CSA Standards, masonry units shall be free of surface indentations, surface cracks due to manufacture, or chipping. Units so delivered shall not be used where exposed to view, but may be used where concealed.
- .2 Exterior dimensions to be 190 mm x 190 mm x 390 mm
- .3 Blocks to be normal weight.

2.4 REINFORCEMENT

- .1 Reinforcement in accordance with Section 04 05 23.

2.5 LINTELS

- .1 Lintels in accordance with Section 04 05 23.

2.6 CONNECTORS

- .1 Connectors in accordance with Section 04 05 23.

2.7 FLASHING

- .1 Flashing: in accordance with Section 04 05 23.

2.8 MORTAR MIXES

- .1 Mortar and mortar mixes in accordance with Section 04 05 12.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Build masonry work true-to-line, plumb, square and level, with vertical joints in proper alignment, within construction tolerances in accordance with CSA A371 and CSA A179.
- .2 Tolerances for exposed masonry work shall be:
 - .1 Variation from mean plane: 3 mm under 2.5 m straight edge.
 - .2 Variation in masonry openings: 6 mm maximum.
 - .3 Variation from plumb: 6 mm in 3 m, 9 mm in 6 m, 12 mm in 12 m or more.
- .3 Assume complete responsibility for dimensions, plumbs and levels of this work and constantly check same with graduated rod.
- .4 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below opening, with minimum cutting.
- .5 Masonry courses to be of uniform height, and both vertical and horizontal joints to be of equal and uniform thickness.
- .6 Lay interior concrete masonry units as follows:
 - .1 Bond: running stretcher
 - .2 Coursing height: 200 mm for one (1) block and one (1) joint
 - .3 Plain block jointing: concave where exposed or where paint or other finish coating is specified.

- .7 Extend non-load-bearing partitions to bottom surface roof construction above. Provide lateral support anchors attached to roof above to requirements of CSA CAN3-S304-M. Fill topmost joint with mortar.
- .8 Construct walls upward in a uniform manner, no one portion being raised more than 1,200 mm above another at any time. Build no more than 1,500 mm of wall measured vertically in any one day.
- .9 Keep cavity airspace and weep holes clean or mortar, clean out promptly if mortar falls into cavity airspace or plugs weep holes.
- .10 Fill tops of low partitions (partitions stopping below ceiling height) with concrete to provide a smooth, flush surface.
- .11 Buttering corners of units, throwing mortar into joints, deep or excessive furrowing of bed joints will not be permitted. Do not shift or tap units after mortar has taken initial set. Where adjustments must be made after mortar has started to set, remove mortar and replace with fresh supply.
- .12 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

3.2 BLOCKWORK

- .1 Lay concrete block in running bond, with thicker end of face shell upward. Coursing to be modular 200 mm for one block and one joint.
- .2 Use specially shaped units where indicated, specified or required. Exposed open cells not permitted.
- .3 Stagger joints: stacked joints not permitted.

3.3 EXPANSION JOINTS

- .1 Construct expansion joints with fillers as required, installed in accordance with manufacturer's recommendations. Joints shall be caulked.

3.4 THROUGH-WALL FLASHINGS

- .1 Install flashings on tops of foundation walls supporting masonry in first bed course, over all openings in exterior masonry walls and elsewhere as shown on drawings.
- .2 Carry through-wall flashings minimum 150 mm up backing material and turn top edge into joint or anchor top edge continuously. Keep flashing 12 mm from exterior exposed face. Lap joints minimum 150 mm.
- .3 Lap and completely seal joints with adhesive to manufacturer's instructions. Bond flashing to vertical surfaces over whole area using flashing material manufacturer's recommended adhesive.
- .4 All flashing installed shall be made to exclude moisture or divert it outside.

3.5 CUTTING MASONRY

- .1 Cutting of masonry units exposed in finished work is to be done with approved type power saw. Where electrical conduit outlets and switch boxes occur, grind and cut units before services are installed.
- .2 Obtain Departmental Representative's approval before cutting any part or area which may impair appearance or strength of the work.

- .3 Patching of masonry is not permitted without Departmental Representative's approval.

3.6 LINTELS

- .1 See Section 04 05 23.

3.7 REINFORCING

- .1 See Section 04 05 23.

3.8 BRACING

- .1 Design and Installation: Design, provide and install bracing for walls, lintels, and other masonry work that will assure stability of masonry during construction.
- .2 Duration: Maintain bracing in place until roof or other structural elements are complete and provide permanent support.

3.9 PROVISIONS FOR OTHER TRADES

- .1 Provide openings in masonry walls where required or indicated. As work progresses build in metal doorframes, fabricated metal frames, window frames, anchor bolts, diaphragm anchors, embedded plates and other items in the work supplied in other Sections.
 - .1 Metal Door and Glazed Frames.
 - .1 Metal Door and Glazed Frames.
 - .2 Fill frame void solid with grout.
 - .3 Fill masonry cores with grout minimum 300 mm from framed openings.
- .2 Accurately locate chases and openings and neatly finish to required sizes.
- .3 Where masonry encloses conduit, ducts and piping, bring to proper level indicated and as directed. Do not cover any pipe or conduit chases or enclosures until advised that work has been inspected and tested.
- .4 Build masonry neatly around conduit, ducts, sleeves and piping passing through.

3.10 PIPES THROUGH WALL

- .1 Complete through wall piping prior to masonry works.
- .2 Cut masonry/brick as required to make a neat round opening.
- .3 Seal space between masonry/brick with grout and flashing as required for a watertight seal.

3.11 CLEANING AND PROTECTION

- .1 Use good workmanship and job housekeeping practices to minimize the need for cleaning the masonry.
- .2 Dry brush masonry walls at end of each days work and also after final pointing. Maintain clean and free from mortar droppings.
- .3 Protect the wall by setting scaffolds so that mortar is not deflected onto the wall and at the end of each day set the scaffolding boards so that they do not deflect rainfall onto newly laid masonry.

- .4 Use a masonry laying technique shall be such that mortar does not run down the face of the wall, or smear the masonry face. After the joints are tooled, cut off mortar tailings with the trowel and brush excess mortar burrs and dust from the face of the masonry.
- .5 On completion, remove any excess mortar and smears that may remain, using wood paddles or scrapers.
- .6 If after using the above outlined techniques and additional cleaning of masonry is necessary:
 - .1 Wet masonry wall thoroughly with garden hose, apply cleaner with brush and scrub, rinse masonry wall thoroughly with garden hose. Clean the masonry only with an approved cleaning solution.
 - .2 Scrub surfaces to be cleaned using non-acid cleaning solution of type which will not harm constructed masonry. Check masonry unit manufacturer for acceptable solution. Clean trial test area and obtain approval to proceed.
 - .3 Use large amounts of water and do cleaning in accordance with solution manufacturer's instructions. Take care to prevent cleaning waste water from coming in contact with interior of potable water in reservoirs.
 - .4 Repeat cleaning operations as often as necessary until work is satisfactory.
 - .5 Do not clean with muriatic acid, sandblast or high pressure washers.
- .7 Point or replace defective mortar to match existing, as required or directed.

END OF SECTION

DIVISION 5

METALS

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel.
- .2 ASTM A53/A53M-20, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .3 ASTM A123/A123M-17, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- .4 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .5 ASTM D4956-19, Standard Specification for Retroreflective Sheeting for Traffic Control.
- .6 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel, Includes Update No. 1 (2014).
- .7 CSA S16-19, Design of Steel Structures, Includes Errata (2019).
- .8 CSA S157-17/S157.1-17, Strength Design in Aluminum/Commentary on CSA S157-17, Strength Design in Aluminum.
- .9 CSA W59-18, Welded Steel Construction, Includes Errata (2020).
- .10 CSA W59.2-18, Welded Aluminum Construction.
- .11 MPI Architectural Painting Specification Manual (2018).

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

1.3 QUALITY ASSURANCE

- .1 Test Reports: Submit Certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 Common Product Requirements.
- .2 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
- .3 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.
- .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: To CSA G40.20/G40.21, Grade 300W.
- .2 Steel pipe: To ASTM A53/A53M standard weight galvanized finish.
- .3 Aluminum: To CAN/CSA-S157.
- .4 Welding materials: To CSA W59 for steel and to CSA W59.2 for aluminum.
- .5 Bolts and anchor bolts: To ASTM A307.
- .6 Galvanizing: Hot dipped galvanizing with minimum zinc coating of 600 g/m2 to ASTM A123/A123M.
- .7 Shop coat primer: To MPI- 5.1A.
- .8 Galvanized primer: Zinc rich, ready mix to MPI-5.2c.

2.2 FABRICATION

- .1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Fabricate items from steel unless otherwise noted.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 SHOP PAINTING

- .1 Apply one shop coat of primer to metal items, with exception of stainless steel, aluminum, galvanized or concrete encased items.
- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.
- .3 Apply finish coat(s) of paint as per Section 09 91 00 – Painting.

2.4 COLUMN SUPPORT FOR CRANE

- .1 Co-ordinate with Division 41 to confirm height of column required.
- .2 Refer to plans for size of columns, supports to wall, supports to floor and connection to runway rail.
- .3 Provide shop drawings for proposed locations.

Part 3 Execution

3.1 ERECTION

- .1 Erect metalwork square, plumb, straight and true, accurately fitted, with tight joints and intersections.
- .2 Provide suitable means of anchorage acceptable to the Departmental Representative, such as dowels, anchor clips, bar anchors, expansion bolts and shields, toggles.

- .3 Make field connections with stainless steel bolts to CSA S16 or welded field connection.
- .4 Hand items over for casting into concrete to appropriate trades together with setting templates.
- .5 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with zinc primer after completion of erection.

END OF SECTION

DIVISION 6

WOOD, PLASTICS AND COMPOSITES

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit project Materials Source Separation Plan highlighting recycling and salvage requirements.
 - .3 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating the percentage of construction wastes were recycled or salvaged.

1.2 REFERENCES

- .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .3 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 CAN/CSA O80 Series-15, Wood Preservation.
- .5 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
- .6 CSA O112 Series-M1977 (R2006), CSA Standards for Wood Adhesives.
- .7 CSA O121-17, Douglas Fir Plywood.
- .8 CSA O141-05 (R2014), Softwood Lumber.
- .9 CSA O151-17 (R2014), Canadian Softwood Plywood.
- .10 National Building Code of Canada, 2015
- .11 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber August 1, 2017.

1.3 SOURCE QUALITY

- .1 Lumber identification: By grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: By grade mark in accordance with specified in most recent applicable CSA standards.
- .3 Structural Composite Lumber (SCL) – Laminated veneer lumber (LVL) and parallel strand lumber (PSL) design values according to manufacturers certified loaded carrying capacity and deflection.

1.4 COORDINATION

- .1 Coordinate the positioning of wall reinforcing blocking with other trades.

Part 2 Products

2.1 LUMBER MATERIALS

- .1 Lumber: Unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with the following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Framing and board lumber: In accordance with the National Building Code of Canada.
 - .1 Spruce construction except as indicated otherwise.
- .3 Furring, blocking, nailing strips, grounds, curbs, fascia backing and sleeper:
 - .1 S4S.
 - .2 Board Sized: "Standard" or better grade.
 - .3 Dimension sizes: "Standard" light framing or better grade.

2.2 PANEL MATERIALS

- .1 Interior Wall Sheathing:
 - .1 Canadian Softwood Plywood (CSP): To CSA O151, urea formaldehyde free, Class II.
 - .1 SHG Sheathing Grade, unsanded. Nominal thickness 12.5 mm, square edge.
- .2 Exterior Wall Sheathing:
 - .1 Preservative treated plywood: Douglas Fir to CSA O121, G1S good one side, pressure treated with CCA to CAN/CSA O80, minimum retention of 4.0 kg/m³ (above ground) and 6.4 kg/m³ (below ground) by assay.
 - .1 For above grade wall sheathing that is protected from weather: Use Category UC 3.1 plywood in accordance with CAN/CSA O80.
 - .2 For below grade wall sheathing in contact with ground: Use Category UC 4.2 plywood in accordance with CAN/CSA O80.
 - .3 Preservative: Chromated copper arsenate (CCA) to AWPA P5 as amended by CAN/CSA O80.

2.3 FASTENERS

- .1 Nails, spikes and staples: To CSA B111.
- .2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary Fasteners: Toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .4 Fastener Finishes:
 - .1 Galvanizing: To ASTM A123/A123M and ASTM A653/A653M, use galvanized fasteners for exterior work, interior highly humid areas and fire-retardant treated lumber.

2.4 WOOD PRESERVATIVE

- .1 Surface-applied wood preservative: Clear or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

Part 3 Execution

3.1 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat all material as indicated as follows:
 - .1 Wood sheathing over perimeter foundation insulation in contact with ground.

3.2 CONSTRUCTION

- .1 Comply with requirements of the NBC.

3.3 DEFACEMENT MARKS

- .1 Install lumber and panel materials, as indicated so that grade-marks and other defacing marks are not visible on surfaces specified to be left unfinished or to be finished with translucent or transparent type coating.
- .2 Complete surface cutting or sanding to remove defacement marks only in locations where the surface cutting or sanding will not be evident after finishing.

3.4 WALL SHEATHING

- .1 Install wall sheathing in accordance with manufacturer's printed instructions.

3.5 FURRING AND BLOCKING

- .1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes facings, fascia, soffit, siding and other work as required and applicable to towel bars and grab bars, toilet paper holders, surface mounted soap dishes, handrail, shelving brackets, non load bearing walls, cabinets and vanities, coat racks, mirrors, light fixtures, etc.
- .2 Align and plumb faces of furring and blocking to tolerance of 1:600.

3.6 WALL STRAPPING AND ROOF PURLINS

- .1 Install members true to line and levels. Space uniformly as per spacing indicated on the plans.
- .2 Install wall strapping and roof purlins to thickness as per drawings.
- .3 Stagger joints of strapping and purlins.

3.7 NAILING STRIPS AND GROUNDS

- .1 Install nailers and linings to rough openings as required to provide backing for frames and other work.

3.8 SLEEPERS

- .1 Install sleepers as indicated.

3.9 VENT SCREEN

- .1 Install vent screen aligned without denting. Carefully put together for continuous venting.
- .2 Provide shop drawing of roof venting details.

3.10 FASTENERS

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B18.6.1-1981 (R2016), Wood Screws (Inch Series)
 - .2 ASME B18.2.1-2012 (R2021), Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series), Includes Errata (2013).
- .2 ASTM International (ASTM)
 - .1 ASTM A47/A47M-99(2018)e1, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A653/A653M-20, Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
 - .2 CSA G40.20-13/G40.20-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
 - .3 CAN/CSA O80 Series:21, Wood Preservation.
 - .4 CSA O86:19, Engineering Design in Wood, Includes Errata 1 (2020, Errata 2 (2021, and Errata 3 (2021).
 - .5 CSA O121-17, Douglas Fir Plywood.
 - .6 CSA O141-05 (R2019), Softwood Lumber.
 - .7 CSA O151-17, Canadian Softwood Plywood
 - .8 CSA S307-M1980 (R2001), Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings.
 - .9 CSA S347-14 (R2018), Method of Test for Evaluation of Truss Plates Used in Lumber Joints.
 - .10 CSA W47.1:19 Certification of Companies for Fusion Welding of Steel.
- .4 National Lumber Grades Authority (NLGA)
 - .1 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber August 1, 2017.
- .5 Truss Plate Institute of Canada (TPIC)
 - .1 TPIC, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses, 2019

1.2 DESIGN REQUIREMENTS

- .1 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures for wood truss chords and webs in accordance with engineering properties in CSA O86. Loads to be carried include:
 - .1 Associated dead loads.

- .2 Live loads such as snow and drift loads for building locality as ascertained by NBC Supplement No. 1, Climatic Information for Building Design in Canada.
- .3 Equipment loads such as:
 - .1 HVAC ducting and fans.
 - .2 Electrical conduit and lighting
- .2 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures for truss joint designs to test engineering properties in accordance with CSA S347 and listed in CCMC Registry of Product Evaluations.
- .3 Design trusses, bracing and bridging in accordance with CAN/CSA-O86.1 for loads indicated and minimum uniform and minimum concentrated loadings stipulated in NBC commentary.
- .4 Limit live load deflections to 1/240th of span unless otherwise specified or indicated.
- .5 Provide camber for trusses as indicated.

1.3 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.
- .2 Certify preservative and fire retardant treated wood in accordance with CAN/CSA O80 Series.

1.4 QUALIFICATION OF MANUFACTURERS

- .1 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.

1.5 QUALITY ASSURANCE

- .1 Provide Certificate of Quality Compliance from truss manufacturer upon completion of fabrication.
- .2 Provide Certificate of Quality Compliance upon satisfactory completion of installation.

1.6 SUBMITTALS

- .1 Each shop drawing submission shall bear signature and stamp of professional Engineer registered or licensed in Province of Manitoba, Canada.
- .2 Indicate TPIC Truss Design Procedure and CSA O86 Engineering Design in Wood and specific CCMC Product Registry number of the truss plates.
- .3 Indicate species, sizes, and stress grades of lumber used as truss members. Show pitch, span, camber, configuration and spacing of trusses. Indicate connector types, thicknesses, sizes, locations and design value. Show bearing details. Indicate design load for members.
- .4 Submit stress diagram or print-out of computer design indicating design load for truss members. Indicate allowable load and stress increase.
- .5 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .6 Show method of seating trusses to supports.
- .7 Show lifting points for storage, handling and erection.
- .8 Show location of lateral bracing for compression members.

1.7 DELIVERY AND STORAGE

- .1 Store trusses on job site in accordance with manufacturer's instructions. Provide bearing supports and bracing to prevent bending, warping or overturning of trusses during transit and storage.

Part 2 Products

2.1 MATERIALS

- .1 Lumber: SPF species, #2 grade to CSA O141, S4S, with maximum moisture content of 15% at time of fabrication:
 - .1 CAN/CSA-O141.
 - .2 NLGA (National Lumber Grading Association), Standard Grading Rules for Canadian Lumber.
- .2 Connector Plates: Galvanized sheet steel to ASTM A653, grade 'A', with Z600 zinc coating, with holes, plugs, teeth or prongs uniformly spaced and formed.
- .3 Fasteners: nails to be zinc coated steel to CSA B111, sized as required. Screws to be zinc coated steel, purpose made to ASME B18.6.1. Lag screws to be to ASME B18.2.1. Split rings to be hot rolled carbon steel to CSA G40.21, type 260W. Shear plates to be malleable iron, grade 35018, to ASTM A47. Metal gussets to be carbon steel plate to CSA G40.21, type 260W. Plywood gussets to be plywood to CSA O151 or CSA O121.

2.2 FABRICATION

- .1 Fabricate wood trusses in accordance with reviewed shop drawings.
- .2 Cut truss members to accurate length, angle and size to provide tight joints on finished trusses.
- .3 Assemble truss members in design configuration by securing tightly in jigs or with clamps.
- .4 Provide for design camber and roof slopes when positioning truss members.
- .5 Connect members using metal connector plates.

Part 3 Execution

3.1 ERECTION

- .1 Hoist trusses into position in accordance with manufacturer's instructions.
- .2 Indicated lifting points to be used to hoist trusses into position.
- .3 Make adequate provisions for handling and erection stresses.
- .4 Exercise care to prevent out-of-plane bending of trusses.
- .5 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
- .6 Install permanent bracing, bridging and related components in accordance with reviewed shop drawings, prior to application of loads to trusses.

- .7 Do not cut or remove any truss material without approval of Departmental Representative.
- .8 Remove chemical and other surface deposits on treated wood, in preparation for applied finishes.

3.2 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment on completion of installation.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
- .2 Manufacturer's instructions, printed product literature and data sheets for products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide maintenance data for incorporation into maintenance manual.

1.2 REFERENCES

- .1 CSA O151-17, Canadian Softwood Plywood.
- .2 ULC S102 (2018), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies (ULC S102).

1.3 STORAGE

- .1 Store panels in a dry area.
- .2 Remove foreign material from panel with a soft bristle brush.

Part 2 Products

2.1 MATERIALS

- .1 Flat PVC surface with web design- color white. Width: 400 mm, Thickness: 12.5 mm.
- .2 PVC Liner Panel to have the following properties:
 - .1 Flame Spread classification of 5 as per CAN/ULC S102.1-10.
 - .2 Constructed with an inner truss design for rigidity and strength.
 - .3 100% virgin PVC.
 - .4 Fastening system to use hidden fasteners with a pre-punched nailing flange.
- .3 Sealant and Adhesive: Use Sealant and Adhesive colour matched to white panelling.
- .4 Use matching trims and flashings for all edges and corners including top and bottom edges. Provide shop drawings.
 - .1 Edge of wall panel near floor: J trim.
 - .2 Top of wall to a PVC interlocking liner panel: Inside/outside corner.
 - .3 Around openings: J trim with wood blocking.
 - .4 Between two PVC interlocking liner panels that cause a joint due to length of panel and area being covered: H divider.
 - .5 Outside corners: Outside corner trim.
 - .6 Near floor at start of panel: Base trim.
- .5 Provide matching trims and flashings for transition from PVC interlocking liner panel to metal liner panels. Provide shop drawings.
- .6 Use sealants and adhesives recommended by the manufacturer.

2.2 BACKING

- .1 Use 12.5 mm Canadian Softwood Plywood (CSP) in accordance with CSA O151 behind all PVC Interlocking Liner Panels.

Part 3 Execution

3.1 APPLICATION

- .1 Walls: Run PVC panels vertically.
- .2 Ceilings: Run parallel to ceiling joists or roof trusses.
- .3 Panel lengths: as long as possible to minimize joints.
- .4 Check surfaces for straightness and install strapping where necessary. Measure dimensions as shown on plans from floor level and upward.
- .5 Panel edge near floor: Use J trim located 12 mm above floor. Drill 6 mm diameter drain holes in the bottom of the J-Trim at 400 mm on center for drainage.
- .6 Extend panels a minimum 300 mm above the suspended ceiling. For the storage room and exterior walls, extend panels to the building ceiling.
- .7 For inside corners.
 - .1 Cut ends to closely match without gaps, ensure entire edge is within trim piece.
 - .2 Install J-Trim vertically to finish the ends of the butt joints or use inside cove trim when the panel comes to the corner, then proceed with the rest of the wall installation starting at the inside cove moulding and work away from it.
- .8 Allow all panels to slide free after nailing to allow for expansion and contraction. Always fasten in the center of the slots.
- .9 Allow a minimum of 1.6 mm (about the thickness of a dime) between the back of the fastener head and the nailing flange. Leave a minimum of 6 mm clearance at ends of all panels and trims to allow for expansion and contraction. Do not fasten tightly.
- .10 Ensure panel fasteners are located into solid backing no more than 600 mm apart and within 100mm from the ends of the panel. Before fastening, double-check to make certain that PVC interlocking liner panel is interlocked along its entire length.
- .11 Keep the joints uniform to ensure that all joints remain parallel.
- .12 Sealants and caulking as per Section 07 90 00 Joint Protection. Use sealant to seal all corners, to seal around all fixtures and to repair small holes.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All FRP products listed in Item 1.1.1 above.
 - .2 Spare Parts (if applicable).
 - .3 Include material data sheets, dimensional and layout data of all fabricated products.
 - .4 Shop drawings for ladders to be sealed by a professional engineer registered in the Province of Manitoba.

1.2 REFERENCES

- .1 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
- .2 ASTM D696-16, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer.
- .3 ASTM D790-17, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- .4 ASTM D2344/D2344M-16, Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
- .5 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .6 National Building Code of Canada, 2015

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed operation and maintenance instructions of the FRP ladders and related grating materials for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

Part 2 Products

2.1 FIBERGLASS GRATING MATERIALS

- .1 Grating shall be reinforced with continuous strand rovings, interwoven with the reinforcements of the crossbars. Gratings shall be constructed of structural load and cross-bar components, assembled and bonded into a one piece panel. Dry glass fibers shall not be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, resin rich or resin starved areas.
- .2 Finished surfaces shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure to corrosives, wear or weathering.

- .3 Grating depth to be 38 mm.
- .4 Spacing of the load bars shall be 38 mm on centre. Spacing of the cross bars shall be 150 mm on centre.
- .5 Open area of the grating shall be 40%.
 - .1 Provide integral cover plate on grating where indicated on the plans.
- .6 Resin Systems shall include inhibitors for UV protection.
- .7 Glass fiber reinforcements shall be 60% to 70% of the material weight.
- .8 Resin shall be vinyl ester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- .9 Mechanical grating clips and fasteners shall be manufactured of Type 316 SS (stainless steel).
- .10 Provide grating with a silica grit slip resistant surface on the top of each grate. The embedded grit shall not penetrate beyond 4.75mm.
- .11 Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E-84.
- .12 Colour of grating to be gray.
- .13 Load/deflection not to exceed the following:
 - .1 Uniform distributed load of 4.8 kPa on grating with a clear span of 610 mm with maximum deflection of 1mm OR Concentrated line load of 340 kg/m on grating with a clear span of 610 mm with a maximum deflection of 5.2 mm.
 - .2 Maximum allowable loading of grating shall be determined using a 2.5 safety factor.
- .14 Provide support beams as required and as identified on the plans. Manufacturer to size support beams and attachment method. Size support beams so they do not conflict with equipment.

2.2 STAIRWAY AND RAISED PLATFORM MATERIALS

- .1 All structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified.
- .2 Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, bi-directional roving mat and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
- .3 Resins shall be a vinyl ester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.
- .4 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
- .5 All structural components shall be further protected from ultraviolet (UV) attack with integral UV inhibitors in the resin and a synthetic surfacing veil to help produce a resin rich surface.
- .6 Type 316 stainless steel bolts shall be provided for attaching all structural members.

- .7 Structural shapes used are to have the minimum longitudinal mechanical properties listed below:

Property	ASTM Method	Value	Units
Tensile Strength	D-638	206 (30,000)	MPa (psi)
Tensile Modulus	D-638	17.2 (2.5 x 10 ⁶)	GPa (psi)
Flexural Strength	D-790	206 (30,000)	MPa (psi)
Flexural Modulus	D-790	12.4 (1.8 x 10 ⁶)	GPa (psi)
Flexural Modulus (Full Section)	N/A	19.3 (2.8 x 10 ⁶)	GPa (psi)
Short Beam Shear (Transverse)	D-2344	31 (4,500)	MPa (psi)
Shear Modulus (Transverse)	N/A	3.1 (4.5 x 10 ⁵)	GPa (psi)
Coefficient of Thermal Expansion	D-696	1.4 x 10 ⁻⁶ (8.0 x 10 ⁻⁶)	cm/cm/°C (in/in/°F)

- .8 All fasteners used in the ladder system are to be 316 SS. Rivets will be 18-8 stainless steel.
- .9 Design and lay-out all handrails out in strict accordance with Manitoba Workplace Health and Safety and OSHA regulations.
- .10 Construct stair treads from the fiberglass grating material identified in Item 2.1. Provide a yellow gritted nosing on each stair tread, stair treads to be grey. Stairs to accommodate a 136 kg concentrated load at mid span with less than 4 mm deflection.
- .11 All hand rail components are to be integrally pigmented yellow. All structural components to be beige in colour.

2.3 FABRICATION - GRATINGS

- .1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. Provide and/or verify measurements in field for work fabricated to fit field conditions, as required by grating manufacturer to complete their fabrication work.
- .3 Determine correct size and locations of required holes or cutouts from field dimensions before field fabricating grating.
- .4 Each grating section shall be readily removable, except where indicated on drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- .5 Fabricate gratings free from warps, twists, or other defects which affect appearance and serviceability.
- .6 Seal all grating cuts by coating with vinyl ester resin to provide maximum corrosion resistance as per manufactures recommendation.

- .7 Grating shall be as free from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits.
- .8 Hardware: Two (2) Type 316 stainless steel hold-down clips shall be provided and spaced at each load bar support member, or a maximum of four feet apart, with a minimum of six per piece of grating, or as recommended by the manufacturer.

2.4 FABRICATION - HAND RAILS

- .1 Design and lay-out all handrails in strict accordance with NBC 2015, Manitoba Workplace Health and Safety and OSHA regulations.
- .2 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .3 Provide and/or verify measurements in field for work fabricated to fit field conditions, as required by manufacturer to complete their fabrication work.

2.5 MANUFACTURERS

- .1 All Fiberglass Reinforced Plastics to be supplied by one manufacturer.

Part 3 Execution

3.1 INSTALLATION - GRATINGS

- .1 Size as shown on drawings.
- .2 Install additional support beams. Secure to concrete with stainless steel anchors and stainless steel hardware.
- .3 Install gratings in accordance with manufacturer's assembly drawings and recommendations. Install gratings plumb, straight and true, accurately fitted, with tight joints and intersections.
- .4 Lock grating panels securely in place with suitable hold-down fasteners acceptable to the Departmental Representative.
- .5 Utilize carbide or diamond tipped bits and blades for field cuts or drilled holes in gratings. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.
- .6 Seal cut, drilled or scarred surfaces with a compatible resin, in accordance with manufacturer's instructions, to prevent corrosive attack of the glass reinforcements.
- .7 Clip grating to framing by manufacturer's standard method to allow removal.

3.2 STAIRWAY AND RAISED PLATFORM MATERIALS

- .1 Size as shown on drawings.
- .2 Install stairway in accordance with manufacturer's assembly drawings and recommendations. Install structural members plumb, straight and true, accurately fitted.
- .3 Utilize manufacturer recommended wall mount, bottom wall mount, floor mount and ladder splice kits as required for assembly and mounting.
- .4 Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

- .5 Seal cut, drilled or scarred surfaces with a compatible resin, in accordance with manufacturer's instructions, to prevent corrosive attack of the glass reinforcements.

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All supplied rigid Board Insulation as listed in 1.1. above.
 - .2 Include material data sheets for each insulation used, RSI values, dimensional data and thermal breaks at walls and ceiling.

1.2 REFERENCES

- .1 CGSB 71-GP-24M-AMEND-77 (R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .2 ULC 701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.

Part 2 Products

2.1 EXTERIOR BUILDING WALLS - ABOVE GRADE

- .1 Extruded polystyrene (XPS): To CAN/ULC S-701.
 - .1 Type: 3.
 - .2 Thickness: As indicated on plans.
 - .3 Size: As indicated on plans.
 - .4 Thermal Resistance: RSI of 0.88 per 25 mm.
 - .5 Compressive Strength: Minimum 140 kPa
 - .6 Use behind masonry walls.

2.2 FOUNDATION AND OTHER AREAS

- .1 Extruded polystyrene (XPS): To CAN/ULC S-701.
 - .1 Type: 3 or 4
 - .2 Thickness: As indicated on plans.
 - .3 Size: As indicated on plans.
 - .4 Thermal Resistance: RSI of 0.88 per 25 mm.
 - .5 Compressive Strength: Minimum 140 kPa.
 - .6 Use on foundation walls below grade, grade beams and for pipe insulation.
- .2 Polystyrene Adhesive: Conforming to CGSB 71-GP-24M.
- .3 Spray polyurethane foam for use as additional insulation at cracks and fittings.
- .4 Pressure treated plywood to cover board insulation as per Section 06 10 00.
- .5 Pressure treated blocking to full rigid board insulation thickness to support insulation and to fasten plywood.
- .6 Concrete Anchors- Cadmium plated or stainless steel bolts and washers, minimum 6 mm.
- .7 Fasten flashing as shown on the plans.

2.3 ADHESIVE

- .1 Adhesive suitable for bonding polystyrene and mineral fibre insulation to substrates as indicated. In accordance with CGSB 71-GP-24M

2.4 ACCESSORIES

- .1 Insulation clips: Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.
- .2 Joint sealing tape: Air resistant pressure sensitive adhesive tape as recommended by insulation manufacturer.

Part 3 Execution

3.1 PERIMETER INSULATION

- .1 Install polystyrene perimeter insulation on exterior as shown on plans.
- .2 Outside wall face application: Extend boards below finished outside grade down to level indicated on the plans.
- .3 Provide treated wood nailers (treated board strapping to full Styrofoam thickness) at top and bottom of styrofoam. Use bolt type fasteners at maximum 400 mm on center to attach nailers to wall.
- .4 Apply adhesive to walls or to insulation boards using 25 mm diameter x 8 mm thick spots of adhesive at 450 to 600 mm on center, press to firm contact with walls.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges.
- .6 Use spray polyurethane foam to fill any and all areas void of insulation.
- .7 Use self drilling stainless steel fasteners and washers to fasten treated plywood over insulation. Space at 600 mm centers (requires a row between nailers). Length to extend into concrete wall as per manufacturer's recommendations. Provide shop drawings.
- .8 Install flashing where indicated on plans.

3.2 CAVITY WALL INSULATION

- .1 Install polystyrene insulation boards on outer face of inner cavity of masonry cavity walls.
- .2 Fit boards tightly between wall ties. Bring butt joints to tight contact.
- .3 Cut and fit boards in largest pieces possible to reduce number of joints.
- .4 Secure to plywood using nailers with a head (washer) diameter of minimum 25 mm dia.
- .5 Use spacing of nailers to have 1 nail per 0.25 sq m.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All supplied Fibrous Batt Insulation as listed in 1.1.1 above.
 - .2 Include material data sheets for each insulation used, RSI values, dimensional data and thermal breaks at walls and ceiling.

1.2 REFERENCES

- .1 ASTM C518-21, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- .2 ASTM C665-17, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .3 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .4 CAN/ULC-S702-14(R2019), Standard for Thermal Insulation Mineral Fibre for Buildings.

1.3 STORAGE

- .1 Deliver, store and handle glass fibre blanket thermal insulation in accordance with manufacturer's printed instructions.
- .2 Store materials in their original packaging in a dry interior location.
- .3 Protect materials from the weather and store at a temperature and a relative humidity recommended by the manufacturer.
- .4 Store batt insulation onsite off the ground and provide protection from wet weather. Do not use any insulating materials that has become wet.

1.4 SITE ENVIRONMENTAL REQUIREMENTS

- .1 Apply insulation only when the ambient climatic conditions (risk of rainfall, high humidity levels) and the temperature of surfaces to be insulated are within acceptable limits to prevent risk of condensation.
- .2 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of insulation materials.
- .3 Protection:
 - .1 Ensure applicator's personnel wears protection equipment such as breathing masks (dust-proof type masks prescribed in Product Data Sheet), face and eye protection (safety goggles or eye glasses) and skin protection (gloves, long-sleeved shirts and pants).

Part 2 Products

2.1 FIBROUS BATT INSULATION

- .1 Thermal batt and blanket mineral fibre:
 - .1 Unfaced glass fiber thermal insulation to CSA/ULC-S702 Type:I, thickness and RSI value as indicated on drawings.
 - .2 Semi-rigid mineral wool batt insulation to CSA/ULC-S702 Type:I, made from basalt rock and slag, thickness and RSI value as indicated on drawings.
 - .3 Thermal resistance: In accordance with manufacturer's tested performances and to requirements of ASTM C518.

2.2 VAPOUR BARRIER

- .1 Refer to Section 07 26 13 Above-Grade Vapour Retarders.

2.3 OTHER MATERIALS

- .1 Select all other materials such as fasteners, retainers and sealants not specifically described but required for a complete and proper installation of building insulation and obtain Departmental Representative's approval.
- .2 Attic (roof-space) baffles to prevent blanket thermal insulation from blocking air circulation at the eaves.

Part 3 Execution

3.1 WORKMANSHIP- GENERAL

- .1 Compliance: Comply with manufacturer's written data, including product Technical Bulletins, Product Catalogue installation instructions, product carton installation instructions, and Product Data Sheets.
- .2 Examine installation conditions: Ensure adjacent and support materials and products are dry and ready to receive the insulation, and that mechanical and electrical services to be covered by the insulation have been inspected.
- .3 Do not commence installation until base work has been corrected and inspections completed.

3.2 INSULATION INSTALLATION

- .1 Install batt insulation by friction fit method to maintain continuity of thermal protection to building elements and spaces.
- .2 Attics: Install rigid polystyrene baffles and ensure no obstacle impedes free air circulation where ventilation is required.
- .3 Do not compress insulation to fit voids but extend the full depth of the space. No side face of studs or joists shall show when the insulation is installed. Completely fill all cavities with insulation.
- .4 In-wall electrical wires, plumbing piping and conduits: Split batts around in wall piping, wires and conduits to provide a tight fit.
- .5 Where batts are laid side by side, bend back vapour barrier backing to allow insulation to fit closely together.

- .6 Do not install insulation that has been damaged by moisture.
- .7 Do not puncture or penetrate insulation vapour barrier. Seal (air tight) all adjacent lengths of insulation to maintain continuous sealed envelope dictated.
- .8 Do not puncture or penetrate foil insulation liner.
- .9 Seal (air tight) all adjacent lengths of insulation to maintain continuous sealed envelope dictated below.

3.3 VAPOUR BARRIER INSTALLATION

- .1 See Section 07 26 13 Above-Grade Vapour Retarders.

END OF SECTION

Part 1 General

1.1 STORAGE

- .1 Deliver, store and handle in accordance with manufacturer's printed instructions.
- .2 Store materials in their original packaging in a dry interior location.
- .3 Store onsite off the ground and provide protection from wet weather.

1.2 REFERENCES

- .1 ASTM C920-18; Standard Specification for Elastomeric Joint Sealants.
- .2 ASTM C1193-16; Standard Guide for Use of Joint Sealants.
- .3 ASTM D882-18; Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- .4 ASTM D1117-01; Standard Guide for Evaluating Non-woven Fabrics.
- .5 ASTM E84-19a; Standard Test Method for Surface Burning Characteristics of Building Materials.
- .6 ASTM E96/E96M-21; Standard Test Methods for Water Vapor Transmission of Materials.
- .7 ASTM E1677-19; Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.
- .8 ASTM E2178-21a; Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.
- .9 ASTM E2357-18; Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- .10 AATCC TM127-2017(2018)e; Water Resistance: Hydrostatic Pressure Test.
- .11 TAPPI T 410 om-19; Grammage of Paper and Paperboard (Weight per Unit Area).
- .12 TAPPI T-460 om-21; Air Resistance of Paper (Gurley Method).

Part 2 Products

2.1 WEATHER BARRIER MEMBRANE

- .1 Spunbonded polyolefin, non-woven, non-perforated weather barrier with the following performance characteristics:
 - .1 Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677 ≤ 0.04 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2357.
 - .2 Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
 - .3 Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.
 - .4 Basis Weight: 91.5 g/m² (2.7 oz/yd²), when tested in accordance with TAPPI Test Method T-410.

- .5 Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
- .6 Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
- .7 Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
- .8 Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

2.2 ACCESSORIES

- .1 Seam Tape: Highly waterproof, oriented polypropylene film with a permanent acrylic adhesive.
- .2 Fasteners: Masonary screws with 50 mm plastic caps.
- .3 Sealants: Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions as recommended by the weather barrier manufacturer.
- .4 Adhesives: Provide adhesives as recommended by weather barrier manufacturer
- .5 FlexWrap: self adhered, extendable flashing backed with a 100% butyl-based adhesive layer
- .6 StraightFlash: Weather barrier membrane identified above with a 100% butyl-based adhesive layer.

Part 3 Execution

3.1 EXAMINATION

- .1 Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .2 Store weather barrier materials as recommended by system manufacturer.
- .3 Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 INSTALLATION

- .1 Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations
- .2 Start weather barrier installation at a building corner, leaving 150 to 300 mm of weather barrier extended beyond corner to overlap.
- .3 Install weather barrier in a horizontal manner starting at the lower portion of the wall surface. Maintain weather barrier plumb and level.
- .4 Extend bottom roll edge over sill plate interface 50 mm to 75 mm minimum. Seal weather barrier with sealant or tape. Shingle weather barrier over back edge of thru-wall flashings and seal weather barrier with sealant or tape. Ensure weeps are not blocked.
- .5 Subsequent layers shall overlap lower layers a minimum of 150 mm horizontally in a shingling manner.
- .6 Overlap to be a minimum of 300 mm at corners.

- .7 Openings: Extend weather barrier completely over openings.

3.3 WEATHER BARRIER ATTACHMENT

- .1 Attach weather barrier securely using weather barrier manufacturer recommended fasteners, spaced 300 to 450 mm vertically on center along vertical line, and 600 mm on center, maximum horizontally.

3.4 SEAMING

- .1 Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- .2 Seal any tears or cuts as recommended by weather barrier manufacturer.

3.5 OPENING PREPARATION

- .1 Cut weather barrier membrane in a modified "I-cut" pattern.
 - .1 Cut weather barrier horizontally along the bottom of the opening.
 - .2 Cut weather barrier vertically 2/3 of the way down from top center of window opening.
 - .3 Cut weather barrier diagonally from bottom of center vertical cut to the left and right corners of the opening.
 - .4 Fold side and bottom weather barrier flaps into window opening and fasten.
- .2 Cut a head flap at 45-degree angle in the weather barrier membrane at window head to expose 200 mm of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

3.6 FLASHING

- .1 Cut 225 mm wide flashing a minimum of 300 mm longer than width of sill rough opening. Apply primer as recommended by the manufacturer.
- .2 Cover horizontal sill by aligning FlexWrap edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 150 mm. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- .3 Fan weather barrier membrane at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- .4 On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- .5 Apply 100 mm wide strips of StraightFlash at jambs overlapping entire mounting flange. Extend jamb flashing 25 mm above top of rough opening and below bottom edge of sill flashing.
- .6 Apply 100 mm wide strip of StraightFlash as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- .7 Position weather barrier head flap across head flashing. Adhere using 100 mm wide StraightFlash over the 45-degree seams.
- .8 Tape head flap in accordance with manufacturer recommendations.

- .9 On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.7 PROTECTION AND CLEANING

- .1 Protect air barrier materials from damage during installation and the remainder of the construction period.
- .2 Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the air barrier assembly manufacturer.
- .3 Spray applied on membrane should not occur in excessive winds. Care should be taken to minimize overspray during application. Protection of adjacent, finished, surfaces is recommended.

END OF SECTION

Part 1 General

1.1 DELIVERY AND STORAGE

- .1 Deliver, store and handle in accordance with manufacturer's printed instructions.
- .2 Store materials in their original packaging in a dry interior location.
- .3 Store onsite off the ground and provide protection from wet weather.

1.2 REFERENCES

- .1 CAN/CGSB 19.21-M87; Sealing and Sedding Compound, Acoustical
- .2 CAN/CGSB 51.34-M86; Vapour Barrier, Polyethylene Sheet for Use in Building construction.

1.3 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and datasheet and include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Limitations.
- .2 Quality assurance submittals:
 - .1 Certificates: submit certificates certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

Part 2 Products

2.1 SHEET VAPOUR RETARDER

- .1 Polyethylene film: To CAN/CGSB 51.34.
 - .1 0.15 mm thick (6 mil).

2.2 ACCESSORIES

- .1 Joint sealing tape: Air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: To CAN/CGSB 19.21, compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
- .3 Staples: minimum 6 mm leg.

Part 3 Execution

3.1 INSTALLATION

- .1 Ensure Departmental Representative's inspection occurs prior to installation of vapour barrier.
- .2 Install sheet vapour barrier on warm side of ceiling assemblies tight to insulation prior to installation of finish to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Join sections of vapor retarder and seal penetrations in vapor retarder with mastic tape. Ensure vapor retarder surfaces to receive mastic tape are clean and dry.
- .5 Inspect sheets for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 EXTERIOR SURFACE OPENINGS

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.
- .2 Extend vapour retarder tight to perimeter of door and window frames, other items interrupting continuity of membrane. Seal with sealant.

3.3 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour retarder as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm full contact and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 WALL PENETRATIONS

- .1 Seal all wall penetrations to vapour barrier prior to installing interior liner panel, (i.e. electrical conduits, plumbing fixtures, etc.).

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Fire Stops.
- .2 ASTM E2393-20a: Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .3 FM Approvals 4990, Firestopping.
- .4 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .5 NFPA 101-18, Life Safety Code, 2021 Edition.
- .6 NFPA (Fire) 221, Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls, 2021 Edition.
- .7 NFPA (Fire) 251, Standard Methods of Tests of Fire Resistance of Building Construction and Materials, 2006 Edition.
- .8 ULC 101, Standard Methods of Fire Endurance Tests of Building Construction and Materials (CAN/ULC S101-14).
- .9 CAN/ULC-S102-18, Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies (ULC S102).
- .10 CAN/ULC-S115-18, Standard Method of Fire Tests of Firestop Systems.
- .11 National Building Code of Canada, 2015

1.2 SUBMITTALS

- .1 Submit Manufacturers Product Data Sheets for each type of product selected. Certify that Firestop material shall be asbestos free and complies with local regulations.
- .2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
- .3 Submit manufacturer's engineering judgement identification number and drawing details when no ULC or cUL system is available. Engineering judgement must include both project name and contractor's name who will install firestop system as described in drawing.
- .4 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation. Include manufacturer's specifications, training letter, and technical data for each material including the composition and limitations, documentation of ULC or CUL firestop systems to be used.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Person specializing in fire stopping installations with minimum five (5) years documented experience approved by the fire stopping manufacturer.

- .2 Manufacturer: Company with minimum five (5) years experience in producing of material used for Work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in Work.
- .2 All fire stopping materials for this project to be supplied by a single manufacturer.
- .3 Field Constructed Mockup:
 - .1 Prior to installing firestopping, erect mockups for each different firestop system indicated to verify selections made and to demonstrate qualities of materials and execution.
 - .2 Allow two (2) working days for inspection of mock-up by Departmental Representative before proceeding with membrane Work.

1.4 LOCATIONS

- .1 Firestop systems shall be used in locations including, but not limited to, the following:
 - .1 Penetrations through fire-resistance-rated wall assemblies including both empty openings and openings that contain penetrations.
 - .2 Membrane penetrations in fire-resistance-rated wall assemblies where items penetrate one side of the barrier.
 - .3 Joints in fire-resistance-rated assemblies to allow independent movement.
 - .4 Perimeter of the horizontal fire resistance rated assembly and exterior wall between a rated floor/roof and an exterior wall assembly.
 - .5 Joints, through penetrations and membrane penetrations in assemblies such as Smoke Barriers, Smoke Partitions and those assemblies required to limit, restrict or retard the passage of smoke.

Part 2 Products

2.1 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance.
- .2 Fire stopping and smoke seal systems: In accordance with CAN-S115.
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN-S115 and not to exceed opening sizes for which they are intended.
 - .2 Firestop system rating: As indicated on drawings.
- .3 Service penetration assemblies: Certified and tested by ULC or cUL in accordance with CAN-S115 and listed in ULC Guide No. 40 U19.
- .4 Service penetration firestop components: Certified and tested by ULC or cUL in accordance with CAN-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .6 Non-curing, re-penetrable intumescent sealants, caulking or putty material for use with flexible cables or cable bundles.

- .7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal. Consult with Departmental Representative and damper manufacturer prior to installation ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- .8 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe. No silicone based firestop are allowed to be applied on plastic pipes.
- .9 Primers: To manufacturer's recommendation for specific material, substrate, and end use.
- .10 Water (if applicable): Potable, clean and free from injurious amounts of deleterious substances.
- .11 Damming and backup materials, supports and anchoring devices: To manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .12 Sealants for vertical joints: Non-sagging.
- .13 Acceptable products produced by FCIA Manufacturer Members in good standing.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Notify the responsible party or parties of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification or UL Products Certified for Canada (CUL) and manufacturer's instructions.
- .1 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

- .2 Coordinate with other trades to assure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
- .3 Schedule the Work to assure that partitions and all other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.
- .4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .5 Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
- .6 Install materials so they contact and adhere to substrates formed by openings and penetrating items.
- .7 Tool or trowel exposed surfaces to a neat finish.
- .8 Remove excess compound promptly as work progresses and upon completion.
- .9 Joint Systems:
 - .1 Install joint forming materials to provide support of firestop materials during application and at the position required to produce the cross-sectional shapes and depths of installed firestop material relative to joint widths that allow optimum sealant or mechanical joint movement capability and develop fire-resistance rating required.
 - .2 Install systems that result in firestop materials:
 - .1 Directly contacting and fully wetting joint substrates.
 - .2 Completely filling recesses provided for each joint configuration,
 - .3 Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability and meet tested and listed system requirements.
 - .3 Tool or smooth non-sag firestop materials immediately after their application and prior to the time skinning or begins as stated in the manufacturers installation instructions. Form smooth, uniform beads of configuration indicated or required to:
 - .1 Produce fire-resistance rating
 - .2 To eliminate air pockets
 - .3 To ensure contact and adhesion with sides of joint.

3.4 INSPECTION

- .1 Notify Departmental Representative when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.5 SCHEDULE

- .1 Firestop and smoke seal at:
 - .1 Penetrations through fire-resistance rated gypsum board partitions and walls.
 - .2 Top of fire-resistance rated gypsum board partitions.
 - .3 Intersection of fire-resistance rated exterior wall and gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

- .5 Openings and sleeves installed for future use through fire separations.
- .6 Around mechanical and electrical assemblies penetrating fire separations.
- .7 Rigid ducts: Greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.6 CLEANING

- .1 Clean off excess fill materials and sealants adjacent to openings and joints as Work progresses. Use methods and cleaning materials approved by manufacturers of firestopping products and or assemblies in which penetrations, openings, gaps and joints occur.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.
- .3 Protect firestopping during and after curing period from contact with contaminating substances.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM C919-19, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
- .3 ASTM C1135-19; Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
- .4 CGSB 19-GP-5M (R1984), Sealing compound, one component, acrylic base, solvent curing.
- .5 CAN/CGSB Specification 19.13-M87, Sealing compound, one component, silicone base, chemical curing.
- .6 CAN2 Specification 19.24-M90, Multicomponent, Chemical-curing sealing compound.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Product/material data sheets for each sealant used.
 - .2 Samples if requested, for Departmental 's approval, are:
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.3 QUALIFICATIONS

- .1 Installation of sealant and caulking work shall be carried out by a recognized specialized applicator having skilled mechanics, thoroughly trained and competent in all phases of caulking work, for at least five (5) years.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.
- .3 Condition products to approximately 16 to 20 degrees C for use in accordance with manufacturer's recommendations.
- .4 Handle all products with appropriate precautions and care as stated on the Material Safety Data Sheet.

1.5 ENVIRONMENTAL CONDITIONS

- .1 Apply sealants only to completely dry surfaces and at air material temperatures above minimum established by manufacturer's specifications.

1.6 GUARANTEE

- .1 Submit the guarantee of the work of this section covering the period of two (2) years from date of Substantial Performance of the Contract.
- .2 Defective work shall include, but not restricted to, joint leakage, cracking, crumbling, melting, running, loss of adhesion, loss of cohesion, or staining of adjoining or adjacent work or surfaces.

Part 2 Products

2.1 FILL MATERIALS

- .1 Colors of sealant, to the approval of the Departmental Representative and matching the predominant material to which sealant is applied. Review colors of all products listed to provide best match.
- .2 Primers are to be type recommended by sealant manufacturer, for the appropriate sealant and corresponding substrate.
- .3 Joint backing material shall be compatible with primers, sealants, outsized 30%, polyethylene, extruded closed cell foam, Shore "A" hardness 20, tensile strength 137 - 206 kpa (20 - 30 psi).
- .4 Bond breaker, where joint configuration does not allow for proper depth/width ratio with the use of backer rod shall be a pressure sensitive plastic tape such as 3M #226 or #481 placed at the back of the joint which shall not bond to the sealant.
- .5 Sealants:
 - .1 Neutral Cure silicone:
 - .1 Extension/compression capability of +100/-50 percent
 - .2 Tensile Strength, maximum 0.07 kg/mm²
 - .3 Peel Strength ASTM C 1135 at 50% extension 1.015 kg/mm²
 - .2 Urethanes Two Part:
 - .1 Multi-component, polyepoxide urethane sealant to CGSB CAN2-19.24.
 - .3 Use at all locations, except where another type is specified.
 - .3 Acrylic One Part:
 - .1 Acrylic solvent release, one part sealant to CGSB Specification 19-GP-5M.
 - .3 Use at interior joints between windows, door frames and screen frames.
 - .4 Acoustical Sealant:
 - .1 To ASTM C919, primerless, Grade NS, SWRI validated.
 - .5 Review color charts of all above products and provide color chart, building product sample color (metal, brick, etc) and a proposed sealant color for Departmental Representatives review (based on best color match using custom color if applicable).
 - .1 Allow Departmental Representative to accept or choose alternate color to best match area requiring a sealant.
- .6 Cleaning material for surfaces to receive sealant - Xylol, methylethylketone, tuluol, or as recommended by the manufacturer of sealant.

2.2 ACCESSORIES

- .1 Primer: Type as recommended by sealant manufacturer. Primer to be compatible with joint forming materials.
- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer and compatible with joint forming materials.
- .3 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 30 to 50 %.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid rod, Shore A hardness 70.
 - .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify at the site that joint and surfaces have been provided as specified under the work of other section; and that joint conditions will not adversely affect execution, performance or quality of completed work; and that they can put into acceptable condition by means of preparation specified in this section.
- .2 Ascertain that sealers and coating applied to sealant substrates are compatible with sealant used and that full bond between the sealant and substrate is attained.
- .3 Verify that specified environmental conditions are ensured before commencing work.
- .4 Ensure that releasing agents, coatings or other treatments have either not been applied to joint surfaces or that they are entirely removed.
- .5 Do not use sealant to “mask” or cover sloppy cuts and pieces that do not fit properly.
- .6 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this Section.

3.2 PREPARATION

- .1 Remove dust, paint, loose mortar and other foreign matter and dry joint surfaces.
- .2 Remove dust, silt, scale and coatings from metals brushing, grinding and sandblasting.
- .3 Remove oil, grease and other coatings from non-ferrous metal with xylol or methylethylketone, (MEK).
- .4 Prepare concrete, wood and glazed surfaces as recommended by sealant manufacturer.
- .5 Examine joint sizes and correct to achieve proper width/depth ratio:

- .1 Less than 6 mm wide - minimum joint depth of 6 mm.
- .2 6 mm to 12 mm wide - depth shall equal width.
- .3 12 mm to 24 mm wide - depth shall equal half of width.
- .4 24 mm to 50 mm wide - maximum sealant depth to be 12 mm.
- .5 For joints wider than 50 mm, the sealant manufacturer's representative shall be contacted.
- .6 Install joint filler or apply bond breaker tape to achieve correct joint depth.
- .7 Where necessary to prevent staining, mask adjacent surfaces with tape prior to priming and/or caulking.
- .8 Prime sides of joint to manufacturer's directions, immediately prior to caulking.
- .9 Before any caulking or sealing is commenced, ensure joint surfaces are dry and frost free and a test of the material shall be made for indications of staining or poor adhesion.

3.3 APPLICATION

- .1 Apply sealants in accordance with manufacturer's directions, using a gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid.
- .2 Form surface of the sealant with full bead, smooth, free from ridges, wrinkles, sags and imbedded impurities. Neatly tool surface to a slight concave joint.
- .3 Clean adjacent surface immediately and leave work neat and clean. Remove excess using recommended cleaners as work progresses. Remove masking tape immediately after tooling of joints.
- .4 Superficial pointing with the skin bead is not acceptable.
- .5 Apply acoustical at openings, floors and ceilings in manner shown and recommended by manufacturer.

3.4 CLEANING

- .1 Clean adjacent surfaces immediately and leave Work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.

END OF SECTION

DIVISION 8

OPENINGS

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Clearly indicate each type of door and frame, color, material, steel core thickness, insulation details, mortises, reinforcements, thermal breaks, location of exposed fasteners, anchors, glazing, openings, details on paint finishes, all accessories.
- .3 Provide listing of wall opening widths and ability of each frame to accommodate required width.
- .4 Provide detailed schedule of doors for building.

1.2 REFERENCES

- .1 SDI A250.10-2011, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 CAN/CSA A440.4:19, Window, Door and Skylight Installation.
- .5 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
- .6 CSA W59-18, Welded Steel Construction, Includes Errata (2020).
- .7 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
- .8 CSDMA, Selection and Usage Guide for Commercial Steel Doors and Frame Products, 2009.
- .9 NFPA (Fire) 80, Standard for Fire Doors and Other Opening Protectives, 2022 Edition.
- .10 NFPA (Fire) 252, Fire Tests of Door Assemblies, 2022 Edition.
- .11 ULC S104, Standard Method for Fire Tests of Door Assemblies (CAN/ULC S104-15).
- .12 ULC S105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104 (CAN/ULC-S105:2016).
- .13 ULC 701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering (CAN/ULC S701-11).
- .14 ULC S704.1, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 FABRICATION STANDARDS

- .1 Fabricate doors and frames to Canadian Manufacturing Specification for Steel Doors and Frames, except where specified otherwise.

1.4 FACTORY APPLIED PRIMER

- .1 Door and frames:

- .1 Surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on.
- .2 Finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10.
- .3 Field apply touch up at those areas where coating is required.

1.5 DELIVERY STORAGE AND HANDLING

- .1 Deliver, store, handle and protect doors and frames in accordance with Section 01 61 00-Common Product Requirements.
- .2 Deliver, handle and store doors and frames at the job site in such a manner as to prevent damage.
- .3 Store doors and frames under cover with doors stored in a vertical position on blocking, clear of floor and with blocking between doors to permit air circulation.

1.6 LOCATIONS

- .1 Supply and install doors and frames per locations as shown on the drawings.
- .2 Door swing direction as per plans.

1.7 FIRE RATING

- .1 Steel fire rated doors and frames: Labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 and NFPA 252 for ratings specified or indicated.

Part 2 Products

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75.

2.2 DOOR CORE MATERIALS

- .1 Honeycomb construction:
 - .1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.
- .2 Stiffened: Face sheets welded insulated core.
 - .1 Expanded polystyrene: CAN/ULC-S701, density 16 to 32 kg/m³.
 - .2 Polyurethane to CAN/ULC-S704 rigid, modified polyisocyanurate, closed cell board. Density 32 kg/m³.
- .3 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250°C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN/ULC-S104, ASTM E152 or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

- .4 Thermal Insulation material must:
 - .1 Not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act.
 - .2 Be manufactured using a process that uses chemical compounds with the minimum zone depletion potential (ODP) available.

2.3 ADHESIVES

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

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB 1.181.

2.5 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior top and bottom caps: Steel.
- .3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .4 Door bottom seal: Section 08 71 00 Door Hardware.
- .5 Metallic paste filler: To manufacturer's standard.
- .6 Fire labels: Metal riveted.
- .7 Sealant: Section 07 90 00 Joint Protection.
- .8 Provide low expanding, single component polyurethane foam sealant installed at head and jamb perimeter of door frame for sealing to building air barrier, vapour retarder and door frame. Foam sealant width to be adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder foam interior.
- .9 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for dry glazing of snap-on type.
 - .2 Design exterior glazing stops to be tamperproof.
- .10 Finish Painting: To Section 09 91 00 Painting and Coating.

2.6 EXTERIOR DOOR FRAME COMPONENTS

- .1 Welded type suitable for concrete block wall buildings.
- .2 Fabricate frames in accordance with CSDMA specifications.
- .3 Fabricate frames to profiles and maximum face sizes as indicated.
- .4 Exterior frames: 2 mm (14 gauge) cold rolled G90 galvanized steel to ASTM A653M.
Hinge support to be heavy duty 4.76 mm (7 gauge) steel, pre drilled and threaded for hardware using templates provided by finish hardware supplier.

- .6 Manufacture strike with 1.6 mm (16 gauge) steel hardware provided by finish hardware supplier.
- .7 Provide 2 mm (14 gauge) flush bolt reinforcement for hardware provided by finish hardware supplier.
- .8 Shim and anchor new doors in accordance with CAN/CSA A440.4.
- .9 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .10 Conceal fastenings except where exposed fastenings are indicated.
- .11 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .12 Insulate exterior frame components with polyurethane insulation.

2.7 INTERIOR DOOR FRAME COMPONENTS

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Interior frames: 1.6 mm (16 gauge) cold rolled G90 galvanized steel to ASTM A653M.
- .4 Mortise hinge preparation for 3 hinges (1.5 pairs). Hinge support to be 4.76 mm (7 gauge) steel, pre-drilled and threaded for hardware using templates provided by finish hardware supplier.
- .5 Strike to be manufacturer with 1.6 mm (16 gauge) steel hardware provided by finish hardware supplier.
- .6 Provide 2 mm (14 gauge) flush bolt reinforcement for hardware provided by finish hardware supplier.
- .7 Surface hardware reinforcement: 2.75 mm (12 gauge).
- .8 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .9 Conceal fastenings except where exposed fastenings are indicated.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.8 FIRE RATED DOOR FRAME

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Frames: 1.6 mm (16 gauge) cold rolled G90 galvanized steel to ASTM A653M.
- .4 Hinge support to be heavy duty 4.76 mm (7 gauge) steel, pre drilled and threaded for hardware using templates provided by finish hardware supplier.
- .5 Strike to be manufacturer with 1.6 mm (16 gauge) steel hardware provided by finish hardware supplier.
- .6 Provide 2 mm (14 gauge) flush bolt reinforcement for hardware provided by finish hardware supplier.
- .7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .8 Conceal fastenings except where exposed fastenings are indicated.

- .9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .10 Labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 and NFPA 252 for ratings specified or indicated.
- .11 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and NFPA 252 and listed by nationally recognized agency having factory inspection services and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
- .12 Width of frame to be as required for opening.

2.9 FRAMES ANCHORAGE

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

2.10 FRAMES WELDING

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

2.11 EXTERIOR DOOR SLAB COMPONENTS

- .1 Exterior doors: Swing type, flush, insulated, hollow steel construction.
- .2 Door face sheet steel skin to be 2 mm (14 gauge) G90 galvanized steel to ASTM A653M.
- .3 Fabricate doors with longitudinal edges locked seam. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .4 Door core insulation to be expanded polystyrene or polyurethane RSI - 2.112 (R-12) insulation with a density of 32 kg/m³.
- .5 Hinges to be minimum of 4.76 mm (7 gauge) thickness pre drilled and threaded for hardware using templates provided by finish hardware supplier.
- .6 Prepare door edge for mortise lock with 2 mm (14 gauge) reinforcement box as required by finish hardware supplier.

- .7 Rim reinforcement for surface mounted exit device application: 1.3 mm (18 gauge) G90 galvanized steel.
- .8 Provide 1.6 mm (16 gauge) G90 galvanized steel flush top and bottom channel welded to door skin.
- .9 Door closer reinforcement: 1.3 mm (18 gauge) G90 galvanized steel.
- .10 Lock reinforcement: 1.6 mm (16 gauge).
- .11 Astragal - welded to face of door for exterior pairs and single.
- .12 Primer paint as per specification Section 09 91 00.
- .13 Door undercut to suit threshold provide by finish hardware supplier.

2.12 INTERIOR DOOR SLAB COMPONENTS

- .1 Interior doors: Swing type, flush, honeycomb hollow steel construction.
- .2 Door face sheet steel skin to be 1.3 mm (18 gauge) G90 galvanized steel to ASTM A653M.
- .3 Fabricate doors with longitudinal edges locked seam. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .4 Door core to be structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.
- .5 Hinges to be minimum of 4.76 mm (7 gauge) thickness pre drilled and threaded for hardware using templates provided by finish hardware supplier.
- .6 Prepare door edge for mortise lock with 2 mm (14 gauge) reinforcement box as required by finish hardware supplier.
- .7 Rim reinforcement for surface mounted exit device application: 1.3 mm (18 gauge) G90 galvanized steel.
- .8 Provide 1.6 mm (16 gauge) G90 galvanized steel flush top and bottom channel welded to door skin.
- .9 Door closer reinforcement: 1.3 mm (18 gauge) G90 galvanized steel.
- .10 Lock reinforcement: 1.6 mm (16 gauge).
- .11 Door undercut to suit threshold provide by finish hardware supplier.
- .12 Painting as per Section 09 91 00. Factory primed.

2.13 FIRE RATED DOOR SLAB COMPONENT

- .1 Fire rated doors: Swing type, flush, insulated, hollow steel construction.
- .2 Door face sheet steel skin to be 1.3 mm (18 gauge) G90 galvanized steel to ASTM A653M.
- .3 Fabricate doors with longitudinal edges locked seam. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .4 Door core insulation to be polystyrene (R-7) insulation.
- .5 Hinges to be minimum of 4.76 mm (7 gauge) thickness pre drilled and threaded for hardware using templates provided by finish hardware supplier.

- .6 Prepare door edge for mortise lock with 2 mm (14 gauge) reinforcement box as required by finish hardware supplier.
- .7 Rim reinforcement for surface mounted exit device application: 1.3 mm (18 gauge) G90 galvanized steel.
- .8 Provide 1.6mm (16 gauge) G90 galvanized steel flush top and bottom channel welded to door skin.
- .9 Door closer reinforcement: 1.3 mm (18 gauge) G90 galvanized steel.
- .10 Lock reinforcement: 1.6 mm (16 gauge).
- .11 Door undercut to suit weather-stripping by finish hardware supplier.
- .12 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104 or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

2.14 DOUBLE DOOR

- .1 Double door unit(s) as per plans.
- .2 Flush Bolts: See Section 08 70 00 Hardware.

2.15 PRIMING AND PAINTING

- .1 See Section 09 91 00.
- .2 Colour as per colour schedule, submit samples for approval as part of shop drawing submission.
- .3 Protect finish from damage prior and after inserting in wall cavity.
- .4 Apply primer (in addition to factory coat) and paint top coat finish only when conditions forecast for entire period of application fall within Manufacturer's recommendations.
- .5 Final finish upon building take over is to be free of any and all imperfections i.e. scratches, dust, dents, uniform gloss, etc. Sand and repaint as required.
- .6 Mask or remove all door hardware prior to painting.

Part 3 Execution

3.1 INSTALLATION

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.
- .3 Install metal frames and glazed screens plumb, square, level and at correct elevation, with a maximum diagonal distortion of 1.6 mm. Ensure frames are securely and rigidly anchored to adjacent construction.
- .4 Finish repairs:
 - .1 During installation touch up, with primer finishes, scratched or damaged surfaces.

- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.
- .5 Fully insulate exterior frames before installing. Use polyurethane foam.
- .6 Caulk perimeter of frames between frame and adjacent material.
- .7 Maintain continuity of air barrier and vapour retarder.
- .8 Adjust operable parts for correct function.

3.2 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Install interior doors after mechanical and electrical works are completed to protect doors from damage during construction.
- .3 Protect exterior doors and frames from damage during construction i.e. temporary wood door or hard board covering until mechanical and electrical is complete. Remove temporary protection only upon approval by Departmental Representative.
- .4 Provide even margins between doors and jambs and doors and finished floor as follows:
 - .1 Hinge side: 1.0 mm.
 - .2 Latch side and head: 1.5 mm.
 - .3 Finished floor: 13 mm.
- .5 Adjust operable parts for correct function.
- .6 Install louvers where applicable.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 BHMA A156.1-2021, Standard for Butts & Hinges.
- .2 BHMA A156.2-2017, Bored and Preassembled Locks and Latches.
- .3 BHMA A156.3-2020, Standard for Exit Devices.
- .4 BHMA A156.4-2019, Door Controls - Closers.
- .5 BHMA A156.5-2020, Standard for Cylinders and Input Devices for Locks.
- .6 BHMA A156.6-2015, Architectural Door Trim.
- .7 BHMA A156.8-2021, Standard for Door Controls - Overhead Stops and Holders.
- .8 BHMA A156.16-2018, Auxiliary Hardware.
- .9 BHMA A156.18-2020, Standard for Materials and Finishes.
- .10 BHMA A156.21-2019, Standard for Thresholds.
- .11 BMHA A156.22-2017, Door Gasketing and Edge Seal Systems.
- .12 ASTM F883-13 (2022), Standard Performance Specifications for Padlocks.
- .13 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.
- .14 NBC 2015 – National Building Code of Canada.
- .15 NFPA (Fire) 80; Standard for Fire Doors and Other Opening Protectives, 2022 Edition.
- .16 NFPA (Fire) 101; NFPA 101: Life Safety Code, 2021 Edition.

1.2 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Only products meeting ANSI/BHMA standards are acceptable. Items that are equal in design, function and quality will be accepted upon approval of the Owner's Representative.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples.
- .2 Provide detailed hardware schedule of all doors for building.
- .3 Clearly indicate hardware for each type of door and frame, including make, model, material, finish, thermal breaks, locations, fasteners, anchors and all accessories.
- .4 Submit manufacturer's product specification for proposed product.

1.4 MAINTENANCE

- .1 Provide maintenance data, parts list, and manufacturer's instructions for each type door closers, locksets, door holders and fire exit hardware for incorporation in to maintenance manual specified in Section 01 78 00 Closeout Submittals.
- .2 Instruct maintenance staff regarding proper care, cleaning and general maintenance.
- .3 Supply two sets of wrenches for door closers, locksets and fire exit hardware.

1.5 DELIVERY AND STORAGE

- .1 Store finishing hardware in locked, clean and dry area.
- .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

1.6 WARRANTY

- .1 Provide a written manufacturer's warranty for work of this Section for failure due to defective materials for ten (10) years, dated from substantial completion certificate.
- .2 Provide a written Contractor's warranty for work of this Section for failure due to defective installation workmanship for one (1) year, dated from submittal completion certificate.

Part 2 Products

2.1 HARDWARE ITEMS

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

2.2 LOCKS AND LATCHES

- .1 Bored and Preamsembled Locks and latches to ANSI 156.2, Series 4000 Grade 1 for strength and operation. ULC listed, extra heavy duty.
 - .1 Type: Lever, contoured angles return to meet ADA accessibility guidelines. Hollow cavity levers not acceptable.
 - .2 Material: Wrought brass.
 - .3 ANSI function: F75 (passage) or F86 (outside entrance by key, inside always unlocked). Refer to schedule in Item 3.2.
 - .4 Finish: BHMA 626 stain chromium plated.
 - .5 Lockset body: Hub, side plate, anti-rotational studs, one-piece casting.
 - .6 Chassis: Two solid cast hubs with single piece level sleeve.
 - .7 Anti-Rotational Studs: Through-bolted hardened steel.
- .2 Cylinder to be small format interchangeable core with keying to be 7 pin. To be compatible with Best 9k series.
 - .1 Keyway: As instructed by Departmental Representative at time of ordering.
 - .2 Quantities of interchangeable cores: one per each door and/or other locking device, plus two spares, all of these not pinned to a masterkey system (pinning to be by Stony Mountain Institution).
 - .3 Quantities of blank keys: Four (4) per lock.

- .3 Provide lockable 7 pin cores for all doors during construction. Institution staff will re-key locks.
- .4 Acceptable manufacturer: Stanley or Best.

2.3 HINGES

- .1 Hinges to ANSI/BHMA A156.1, designated by letter A and numeral identifiers listed in standard, followed by size and finish, specified in Hardware Schedule.
- .2 Doors up to 2,286 mm in height to have 3 hinges.
- .3 Hinges for all exterior doors opening outward shall have non-removable pins. All other hinges shall have non-rising pins.
- .4 Provide hinge width to clear trim and allow full 180 degree swing.
- .5 Exterior door hinges: Heavy weight stainless steel full mortise five knuckle 4 ball bearing hinges.
 - .1 ANSI: A5111.
 - .2 Size: 114 x 103 mm.
 - .3 Finish: BHMA 629.
- .6 Interior door hinges: Standard weight stainless steel full mortise five knuckle 2 ball bearing hinges.
 - .1 ANSI: A5112.
 - .2 Size: 114 x 103 mm.
 - .3 Finish: BHMA 629.

2.4 SINGLE DOOR EXIT DEVICE

- .1 Provide a panic style rim exit with horizontal heavy duty push rail bar and mortised lock at all exterior doors.
- .2 Listed by Underwriters Laboratories and bear the UL label for life safety in full compliance with NFPA 80 and 101. UL listed to Canadian Standards.
- .3 Certified to meet ANSI/BHMA A156.3 Grade 1 requirements.
 - .1 Outside trim: Lever with ANSI function F08 (key locks and unlocks). Refer to schedule in Item 3.2.
 - .2 Finish: BHMA 628.
- .4 Be heavy duty push rail and cast chassis type construction. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze brass no less than 1.8 mm thick. Push rails shall be constructed of 1.6 mm thick material in the same manner as the mounting rail.
- .5 Unit to have a mortised locking latch assembly, 70 mm x 273 mm x 21 mm escutcheon plate and thumb piece handle. Inside knob/lever retracts deadbolt and dead latch stimulatingly for immediate exit. Provide cylinder for key operation to retract latch bolt from exterior.
- .6 Exit device mortise cylinders suitable for small format interchangeable cores 7-pin.
 - .1 Provide required cylinder housings, collars, rings and springs as recommended by manufacturer for proper installation.
 - .2 Construction core: Provide with temporary construction core.

- .3 Cores, keys and keying: See Item 2.2.
- .7 Provide recessed integral strike.

2.5 DOUBLE DOOR EXIT DEVICE

- .1 Provide a panic style surface vertical rod mounting exit with horizontal heavy duty push rail bar and mortised lock on active exterior door slab.
- .2 Listed by Underwriters Laboratories and bear the UL label for life safety in full compliance with NFPA 80 and 101. UL listed to Canadian Standards.
- .3 Certified to meet ANSI/BHMA A156.3 Grade 1 requirements.
 - .1 Outside trim: Lever with ANSI function F08 (key locks and unlocks) or F01 (Exit only). Refer to schedule in Item 3.2.
 - .2 Finish: BHMA 628.
- .4 Be heavy duty push rail and cast chassis type construction. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze brass no less than 1.8 mm thick. Push rails shall be constructed of 1.6 mm thick material in the same manner as the mounting rail.
- .5 Unit to have a mortised locking latch assembly, 70 mm x 273 mm x 21 mm escutcheon plate and thumb piece handle. Inside knob/lever retracts deadbolt and dead latch stimulatingly for immediate exit. Provide cylinder for key operation to retract latch bolt from exterior.
- .6 Exit device mortise cylinders suitable for small format interchangeable cores 7-pin.
 - .1 Provide required cylinder housings, collars, rings and springs as recommended by manufacturer for proper installation.
 - .2 Construction core: Provide with temporary construction core.
 - .3 Cores, keys and keying: See Item 2.2.
- .7 Provide recessed integral strike.

2.6 DOOR CLOSER

- .1 Active slab of all exterior and interior doors to have a heavy duty door closer with mounting hardware as follows:
 - .1 Certification to ANSI/BHMA Standard A156.4. Grade 1 and be UL and ULC listed and suitable for push side of door mount.
 - .1 ANSI function:
 - .1 CO2081 – exterior doors.
 - .2 CO2041 – interior doors.
 - .2 Cast iron or cast aluminum cylinder assembly.
 - .3 Cover: Standard non handed cover.
 - .4 Arm: Door hold open arm.
 - .5 Finish: Stainless steel or chrome plate.
 - .6 Top jam push side mount.
 - .7 Where used on a fire door, unit to be rated for such use.
 - .8 Provide stop arm for exterior doors.

2.7 ARCHITECTURAL DOOR TRIM

- .1 Products shall be to ANSI/BHMA A156.6, designated by letter J and numeral identifiers as listed below and specified in Hardware Schedule.
 - .1 Door Protection Plates: Kick plate type, 1.27 mm thick stainless steel finished to BMHA 630.
 - .1 203 mm x door width less 50 mm for single doors.
 - .2 203 mm x door width less 25 mm for double doors.
 - .3 Countersunk holes for screws.

2.8 AUXILIARY HARDWARE

- .1 Products shall be to ANSI/BHMA A156.16, designated by letter L and numeral identifiers as listed below and specified in Hardware Schedule.
 - .1 Combination Stop and Holder, floor mounted: Type L11371, BHMA 702 finish.
 - .1 Provide door floor stops at all doors that swing towards a wall.
 - .2 Stop to have a non marring rubber bumper material.
 - .3 Door stop elevation to suit elevation of door undercut.
 - .4 Provide concrete expansion shield with galvanized 7 mm x 57 mm threaded stud.
 - .2 Kick Down Holder, door mounted: Type L11383, BHMA 702 finish.
 - .1 Door kick down holders is to be constructed with replaceable non-marring corrugated rubber shoe and stainless steel spring.
 - .3 Manual Flush Bolts: Type L04251, BHMA 702 finish.
 - .1 Passive door slab of double doors to have top and bottom recessed lever flush bolts with strikes as follows:
 - .1 Rod length to suit door manufacturer requirements.
 - .2 Provide dust proof bottom strike.
 - .4 Door Silencer: Type L03011.
 - .1 Provide three - 12 mm diameter x 3 mm tamper proof rubber silencers for each door.
 - .2 Pneumatic design with formed air pocket to absorb shock and reduce noise.
 - .3 Colour: Grey or Black.
 - .5 Chain Door Guard: Type L12231, Grade 1, BHMA 702 finish.
 - .1 Applies only to doors without closures.
 - .2 Provide heavy duty solid welded steel twist type chain with heavy compression spring and tear resistant vinyl covering to prevent rattling and marring.
 - .3 Chain to be zinc plated with zinc plated sheet metal screws.
 - .4 Chain to have an adjustable length.
 - .6 Slide/Barrel Bolt Lock
 - .1 Suitable for Hollow metal doors. Use in left or right hand applications.
 - .2 Light duty
 - .3 Length: 75 mm
 - .4 Material: 304 stainless steel.

- .5 Finish: brushed.
- .6 Mounting: screwed-in fastening with tamper-resistant, security-type fasteners, of type acceptable to slide/barrel bolt manufacture and to suit substrate.

2.9 PADLOCKS

- .1 Case
 - .1 Housing: for small format interchangeable core, 7-pin.
 - .2 Machined from solid brass.
 - .3 Size: 49.2 mm wide by 52.4 mm long by 22.2 mm thick.
 - .4 Finish: 606, satin brass.
- .2 Shackle: To ASTM F883, grade 4.
 - .1 Cut resistant type to ATSM F883: mets Grade 6 for shackle cutting force.
 - .2 Shackle diameter: 9.5 mm
 - .3 Shackle height: as scheduled, measured from top of case to inside of shackle when padlock is locked: 50 mm
 - .4 Locks at both heel and toe
 - .5 Function code: non-key retained throw member.
- .3 Stamp: By factory, bottom mark.
- .4 Acceptable material: Best 41B772-606-XSPL,
- .5 See Item 2.2 for cores, keys and keying.

2.10 WEATHERSTRIPPING AND DOOR SEALS

- .1 Products shall be to ANSI/BHMA A156.22.
 - .1 Head and Jamb Seals:
 - .1 Seal: Extruded aluminum frame and hollow closed cell neoprene insert, clear anodized aluminum finish.
 - .2 Seal UL (fire rated): Extruded aluminum frame and hollow closed cell neoprene insert, clear anodized finish.
 - .3 Provide surface mounted door jamb weather-stripping on all exterior doors (sides and top).
 - .2 Door Bottom Seal:
 - .1 25 mm extruded aluminum frame and vinyl brush sweep, clear anodized finish c/w slotted holes for height adjustment.
 - .3 Astragal: Overlapping, extruded aluminum frame with vinyl insert, finished to match doors.

2.11 THRESHOLDS

- .1 Thresholds: To ANSI/BHMA A156.21, minimum 150 mm wide x full width of door opening, extruded aluminum finish, serrated surface, with thermal break of rigid PVC.
 - .1 Provide thresholds at all exterior doors, interior process room door and electrical room interior door
 - .1 Exterior doors to have thermal break located under automatic door bottom and stop strip.

.2 Interior process room door and electrical room interior door to be UL (fire) rated.

.2 Threshold clearance between bottom of door slab and top of threshold to be as required for automatic door bottom operation.

2.12 OVER HEAD RAIN DRIP

.1 Provide 63 mm wide clear anodized aluminum rain drip with slotted holes and zinc plated screws on all exterior doors.

2.13 FASTENINGS

.1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware. Tamper-resistant security type as supplied by lock manufacturer.

.2 Exposed fastening devices to match finish of hardware.

.3 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.4 Use fasteners compatible with material through which they pass.

2.14 KEYING

.1 At all locksets, exit device cylinders and padlocks, refer to Item 2.2 for description of construction cores, permanent small format interchangeable cores and keys.

2.15 DOOR LITE

.1 Glazing to be a dual pane sealed unit with security wire and tempered glass.

2.16 DOOR GRILL

.1 Grill to be inverted "Y" Type, with 50% free area design for sight proof application.

.2 Frame and blades to be made of 18 gauge steel.

.3 Size to be 450 mm wide by 300 mm high.

.4 Paint to match door colour.

2.17 DOOR SCHEDULE

.1 Refer to table at the end of this section for schedule. Compare schedule to plans, use most stringent.

Part 3 Execution

3.1 INSTALLATION INSTRUCTIONS

.1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Furnish manufacturer's instructions for proper installation of each hardware component.

.3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

- ### 3.2 SCHEDULES FOR DOORS

[illegible]

Door ID	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Fire Rating	-	-	-	-	-	-	45 min	45 min	45 min	-

Legend:

Hollow Metal: HM, Push Side: PS, Both Sides: BS, Vinyl Accordion Door: VA, Insulated with polyurethane foam core: IN, Honeycomb comb cardboard core: HC, Exterior Door: EXT, Interior Door: INT, Single Door Exit Device: SDED, Double door exit device: DDED, Yes: Y, Act: Active, Pass: Passive.

Notes:

- 1 – Steel astragal welded to exterior of door surface.
- 2 – All Door Lites to be 558mm x 762mm unless otherwise noted.

3.3 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.
- .4 Where hardware is found defective, repair or replace or correct.

3.4 CLEANING

- .1 Perform cleaning after installation i.e. clean door and hardware with approved non-abrasive cleaner, and polish in accordance with manufacture's instructions.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.5 PROTECTION

- .1 Doors and hardware shall be protected against damage from paint, calking, plaster, construction damage or other defacing situations.

END OF SECTION

DIVISION 9

FINISHES

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM C475/C475M-17, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C840-20, Specification for Application and Finishing of Gypsum Board.
- .3 ASTM C954-18, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- .4 ASTM C1002-20, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .5 ASTM C1047-19, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .6 ASTM C1396/C1396M-17, Standard Specification for Gypsum Wallboard.
- .7 CAN/ULC-S101-14 – Standard Methods of Fire Endurance Tests of Building Construction and Materials
- .8 CAN/ULC-S102-18 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .9 CGSB 19.21M- 87 – Sealing and Bedding Compound, Acoustical

1.2 DELIVERY AND STORAGE OF MATERIALS

- .1 All materials shall be delivered in their original unopened pack-ages, and stored in an enclosed shelter, providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the Work site.
- .2 All materials shall be kept dry until ready to be used. They shall be kept off the ground, under cover, and away from sweating walls and other damp surfaces. Metal goods shall be protected from rusting.
- .3 Gypsum board shall be neatly stacked (flat), with care taken to avoid damage to edges, ends and surfaces.

1.3 ENVIRONMENTAL CONDITIONS

- .1 Ensure temperature of surrounding areas are within the recommended range: min. 12°C., max. 20°C., 24 hours before, during and after entire gypsum wallboard and joint treatment operations. Avoid concentrated or irregular heating during drying.
- .2 Do not start work until conditions are satisfactory. Report any unsatisfactory conditions to the Departmental Representative. Commencement of work shall imply acceptance of conditions.
- .3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

1.4 QUALIFICATIONS

- .1 Dry wall installers: minimum 5 years proven experience.

Part 2 Products

2.1 MATERIALS

- .1 Conform to ASTM C1396/C1396M Standards for regular and Type X board.
- .2 Fire-Rated Gypsum Wallboard: Type "X", 16 mm thickness as shown in wall types, in dimensions of 1,220 mm by lengths for minimum joints and to have ULC labels.
- .3 Tape: 50 mm perforated paper tape, of type approved by manufacturer of gypsum wallboard products.
- .4 Jointing Compound: to ASTM C475, asbestos free.
- .5 Metal Accessories:
 - .1 Corner Beads: 0.30 mm galvanized sheet steel, surface mounted, with perforated flanges, suitable for taping and filling.
 - .2 Casing Beads: minimum 0.30 mm galvanized sheet steel, with perforated steel flanges, suitable for taping and filling, one-piece length per location.
 - .3 "J" mouldings for both 12 mm and 20 mm wallboard in areas such as wallboard to window and door jamb, ceilings to drywall walls extending past ceilings as may be required.
 - .4 Wallboard screws to lengths required for thickness of wall boards and type of wood backing.
 - .5 Supply any other necessary accessories for a complete job.
- .6 Acoustic and Thermal Sealant: to CGSB 19.21M.

2.2 FINISHES

- .1 Texture finish: asbestos-free (standard white) texture coating and primer-sealer, recommended by gypsum board manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed are acceptable for gypsum board assemblies installation in accordance with manufactures written instructions.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions including environmental conditions have been remedied.

3.2 INSTALLATION

- .1 Install gypsum board plumb, true, free of warps and defects.
- .2 Do work in accordance with ASTM C840 except where specified otherwise.
- .3 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
- .4 Apply gypsum board vertically or horizontally, providing sheets lengths that will minimize end joints.

- .5 Apply single layer gypsum board as shown to framing using screw fasteners. Maximum spacing of screws 300 mm o.c.
- .6 Do not install damaged or damp side boards.
- .7 Locate edge or end joints over supports.
- .8 Apply type "X" gypsum board where indicated, to obtain fire ratings as shown or required.

3.3 ACCESSORIES

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre using contact adhesive for full length.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board or casing beads abutting metal window or exterior door frames, to provide thermal break.

3.4 TAPING AND FILLING

- .1 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .2 Embed tape for joints and interior angles i.e. corner beads, control joints and trim, as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces ensuring surfaces are smooth and free of tool marks and ridges.
- .3 Fill screw depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after painting is completed.
- .4 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .5 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for painting.
- .6 As per the National Building Code, all layers of drywall used in a fire separation wall must have all joints filled with drywall compound, taped and finished.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
- .2 Leave work area clean at end of each day.
- .3 Final Cleaning: upon completion, remove surplus materials, rubbish, tools and equipment in accordance with section 01 71 11 – Cleaning.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect work of other trades from damage resulting from the Work of this Division.

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM C645-18, Standard Specification for Nonstructural Steel Framing Members.
- .2 ASTM C754-18, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .3 MPI Architectural Painting Specification Manual (2018), MPI #26, Primer, Galvanized Metal, Cementitious.
- .4 ULC 102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies (ULC S102).

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples.
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to ASTM C645, roll formed hot dipped galvanized steel sheet:
 - .1 92 mm studs: 0.88 mm design thickness (20 ga.) unless indicated otherwise on the drawings, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres. Stud designation 362S162-33.
 - .1 Provide structural punch outs 38 mm wide by 100 mm high to allow for domestic water piping to pass through.

Floor and ceiling tracks: To ASTM C645; in widths to suit stud sizes, 30 mm flange height and 50 mm flange height for ceiling.

Part 3 Execution

3.1 ERECTION

- .1 Align partition tracks at floor and ceiling and secure at 600 mm o/c maximum.
- .2 Place studs vertically at 406.4 mm o/c and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .3 Erect metal studding to tolerance of 1:1000.
- .4 Attach studs to tracks using self tapping stainless steel screws.
- .5 Secure horizontal furring channel.

- .6 Coordinate erection of studs with installation of door frames and special supports or anchorage for work specified in other sections.
- .7 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .8 Erect track at head of door openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .9 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .10 Extend partitions to ceiling height except where noted otherwise on drawings.
- .11 Maintain clearance under beams and structural members and roofs to avoid transmission of structural loads to studs.
- .12 Install minimum 600 mm long by stub width 19 mm plywood backing in wall cavity to support wall mounted equipment in each location equipment is shown to be mounted. Coordinate with the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 –Shop Drawings, Product Data and Samples.
 - .1 If requested, submit samples; all material used to be equal to approved samples.

1.2 REFERENCES

- .1 ASTM C635/C635M-17; Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- .2 ASTM C636/C636M-19; Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- .3 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
- .4 ASTM E2638-10(2017), Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.
- .5 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .6 ULC 102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies (ULC S102).

1.3 LOCATIONS

- .1 Install all acoustical suspended ceiling systems and associated works shown on the plans including:
 - .1 Control Room.
 - .2 Washroom.
 - .3 Storage Room.
 - .4 Vestibule.

1.4 WORKMANSHIP

- .1 Complete work by skilled applicators ensuring tiles are in close contact, joints true and perfectly aligned and all joints level (1: 1200).
- .2 Maximum deflection shall be 1/360th of span, as measured under ASTM C635.
- .3 Border tiles shall be of similar width, no border tile shall be less than 150 mm wide.

1.5 EXTRA MATERIALS

- .1 Provide 6 complete spare tile units after all works are complete.
- .2 Extra materials to be from same production run as installed materials.
- .3 Clearly identify each type of acoustic unit, including colour and texture.
- .4 Store where directed by Departmental Representative.

Part 2 Products

2.1 SUSPENSION SYSTEM

- .1 Finish exposed flanges for suspension members in white baked enamel of 25 mm face.
- .2 Include metal bearing channels wire hangers, edge moldings, etc.

2.2 ACOUSTIC TILE

- .1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1.
 - .1 Type III, Fire Class A.
 - .2 Pattern: Fissured.
 - .3 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
 - .4 Smoke developed 50 or less in accordance with CAN/ULC-S102.
 - .5 Noise reduction coefficient (NRC) designation of 0.55 to 0.65.
 - .6 Ceiling Attenuation Class (CAC) in accordance with ASTM E1264.
 - .7 Light reflectance: 0.81.
 - .8 Edge type: Square.
 - .9 Colour: White.
 - .10 Size: 610 x 1220 x 16 mm thick.
 - .11 Shape: Flat.
- .2 Hold down clips: Purpose made clips to secure tile to suspension system, approved for use in fire-rated systems.

Part 3 Execution

3.1 INSTALLATION

- .1 Do not start work until building is heated, wet work is completed, floor is cleaned and all conditions in the current bulletin of the Acoustical Materials Association are met.
- .2 Support main runners from structural members at maximum 1.2 m spacing or as required to support load of tiles and electrical fixtures.
- .3 Interlock cross members to the main runner to provide a rigid assembly.
- .4 Ensure wall molding fits tightly to wall without any ripples.
- .5 Framing to be "square" and to allow for border panels to be the same size on opposite side of the room.
 - .1 When trimming panels cut pane face up.
- .6 Complete all works in accordance with manufacturer's instructions.
- .7 Install ceiling at a uniform height approx 2.7 m above the floor in control room, washroom, storage room and vestibule. Allow for overhead piping where applicable.

3.2 CLEANING

- .1 Remove and replace units which are damaged or improperly installed.
- .2 Perform any required touch-up work after the other trades, where applicable, have completed their work.

- .3 Once the work is completed, remove all stains from walls, woodwork, etc.
- .4 Remove scrap materials and leave the worksite in a clean state.

END OF SECTION

Part 1 General

1.1 DESCRIPTION OF WORK AREAS

- .1 A partial listing of items to be painted are:
 - .1 Walls
 - .2 Door and door frames.
 - .3 Crane beam, runway and columns.
 - .4 Genset fuel and vent piping.
 - .5 Touch up all scratches and marks.
- .2 **Exclusions** list of items not requiring painting:
 - .1 Electrical conduits.
 - .2 Domestic copper water piping - 20 mm and smaller.
 - .3 Stainless steel or aluminum materials (this does not apply to piping).
 - .1 Clean all materials after placement to be uniform shiny without marks or imperfections.
 - .4 Equipment that is factory pre painted or coloured such as factory painted steel panels, electrical motors, coloured plastic, domestic water supply, etc.
 - .5 Galvanized material.
 - .1 Any galvanized material specifically listed in Item 1.2.1 above is to be painted.

1.2 REFERENCES

- .1 ASTM D522/D522M-17(2021); Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
- .2 ASTM D2247-15(2020); Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- .3 ASTM D3363-20; Standard Test Method for Film Hardness by Pencil Test.
- .4 ASTM D4060-19; Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- .5 ASTM D4541-17; Standard Test Method of Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- .6 ASTM D4585/D4585M-18; Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- .7 Architectural Painting Specifications Manual, Master Painters Institute (MPI), 2018.
- .8 Systems and Specifications Manual, SSPC Painting Manual, Volume Two, Society for Protective Coatings (SSPC).
- .9 SSPC SP1 (2017); Surface Preparation Standard No. 1: Solvent Cleaning.
- .10 SSPC SP2; Surface Preparation Specification No. 2: Hand Tool Cleaning.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Submit paint type, brands, colours, etc. for each specific area applicable for Departmental Representative's review prior to any painting.
- .3 Submit manufacturer's maintenance instructions, including maintenance procedures and materials for stain removal and surface repair, and recommended schedule for cleaning.
- .4 Copy of SSPC standards referenced to be used that will be maintained onsite.
- .5 Methods and equipment to be used to measure coat thickness as applied.
- .6 Material Safety Data Sheets (MSDS) for posting on site.

1.4 QUALITY ASSURANCE

- .1 Contractor shall have a minimum of 5 years proven satisfactory experience. When requested, provide a list of last 3 comparable jobs including, job name and location, specifying authority, and project manager.
- .2 Employ persons trained for application of specified materials. Use qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency". Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance to trade regulations.
 - .1 Provide Certificate a minimum of 2 weeks prior to site works.
- .3 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- .5 Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.
- .6 Steel coatings: Record dry film thickness of each coat at maximum 0.25 m² intervals. Recoat as required to ensure coating thickness meets requirements in all areas.
- .7 Allow Departmental Representative to utilize Contractor's equipment to measure coating thickness.
- .8 Ensure a copy of all manufacturer's installation instructions including specifications for cleaning as referred to herein are onsite at all times.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 In addition to the specifications below see Section 01 35 43 Environmental Procedures for aspects of protection i.e. disposing of wastes, spontaneous combustion, etc. Item 3.2 in this specification further outlines protective measures etc.
- .2 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number, date of manufacture and expiry date.

- .3 Store containers of volatile materials in well ventilated location, not exposed to excessive heat, direct sunlight or freezing conditions.
- .4 Store materials in accordance with manufacturer's instructions.
- .5 Keep containers sealed until ready for use.
- .6 Protect materials during handling and application to prevent damage or contamination.
- .7 All materials used shall be factory pre-weighed and pre-packaged in single, easy-to-manage batches to eliminate onsite mixing errors. No onsite weighing or volumetric measurements allowed.
- .8 All containers to have Workplace Hazardous Material Information System (WHMIS) labels indicating contents.
- .9 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

1.6 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.
 - .4 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless specifically pre-approved perform no painting work when:
 - .1 Ambient air and substrate temperatures are below 10°C.
 - .2 Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is above 60% or when the dew point is less than 3°C variance between the air/surface temperature.
 - .2 Do not paint work when the maximum moisture content of the substrate exceeds:
 - .1 12% for concrete and masonry (clay and concrete brick/block).
 - .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

- .2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
- .3 Apply paint only when previous coat of paint is dry or adequately cured.
- .4 Additional Interior Application Requirements:
 - .1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.7 COORDINATION

- .1 Coordinate work with other Divisions.

1.8 FINISHES

- .1 Final painted surface finish upon building take over is to be free of any and all imperfections ie. scratches, dust, dents, runs, ropiness, sags, orange peel, uniform gloss or other surface imperfections. Sand and repaint as required.
- .2 Use a roller, size and type as required, for all flat areas to avoid surface imperfections created by brushwork.

1.9 MEASUREMENT OF FILM THICKNESS

- .1 Prior to application provide method to Departmental Representative to be employed to control wet film thickness application rate.
 - .1 If quality control is based on volume of product over a controlled area provide a sketch and volume of epoxy to be used for the controlled areas. Provide such information a minimum of 5 days before application. Record actual usage over calibrated area and provide written summary to confirm application (wet) film thickness.
 - .2 If quality control is wet film gauge provide detailed procedures to be followed for approval as well as details of all measurements completed (in writing).
- .2 After epoxy is dry provide a calibrated dry film thickness gauge (electronic with a tolerance of plus-or-minus three percent.) suitable for substrate that is epoxy coated. Measure dry film thickness in the presence and at the direction of the Departmental Representative. Readings to be minimum every 5 m² or a tighter frequency where directed by Departmental Representative. Record all values and provide data to Departmental Representative.

1.10 NUMBER OF COATS

- .1 Wherever the number of coats is specified, this number is to be considered as a minimum number. Apply coats as required beyond the minimum number specified to produce a complete uniform painted surface, regardless of number of coats specified.

1.11 EXTRA MATERIALS

- .1 Submit maintenance materials from same product run as products installed in accordance with Section 01 78 00 - Closeout Submittals. Package products with protective covering and identify with descriptive labels.
- .2 Submit one - four litre can of each type and colour of finish coating in unopened sealed containers. Identify colour and paint type in relation to established colour schedule and finish formula.

- .3 Deliver and store where directed.

1.12 WASTE MANAGEMENT AND DISPOSAL

- .1 Paint and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal.
- .2 Remove from site and dispose of packaging materials at appropriate facilities.
- .3 Place materials defined as hazardous or toxic in designated containers and dispose at official hazardous material collections site.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials listed in the latest edition of the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Paint materials for successive coatings on same surface to be products of a single manufacturer.
- .3 Primers - As specified by applicable protective maintenance coatings data sheet by manufacturer.
- .4 Low odour products: Whenever possible, select products exhibiting low odour characteristics. If two products are otherwise equivalent, select the product with the lowest odour.
- .5 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .6 Water-borne surface coatings must have a flash point of 61.0°C or greater.

2.2 COLOURS

- .1 As stated on plans.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Departmental Representatives written permission.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

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

Gloss Level Category	Units @ 60E	Units @ 85E
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Gloss Level Category	Units @ 60E	Units @ 85E
G1 - matte finish	max. 5	max. 10
G2 - velvet finish	max. 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

- .2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5 STEEL/METALS PRIMER

- .1 Applies to door frames, doors, exposed building columns, metal piping, stainless steel piping, monorails, galvanized piping and any equipment that require painting.
- .1 Alkyd Primer suitable for ferrous and non-ferrous metal and galvanized metal.
- .1 Colour- gray.
- .2 Product to be minimum 56% solids by volume.
- .3 Adhesion ASTM D 4541- > 7,000 kPa.
- .4 Humidity Resistance ASTM D 4585 15,000 hours – no effect.
- .5 Abrasion ASTM D 4060 CS-17 wheels – 1000 kg load, 1000 cycles – 250 mg loss.

2.6 STEEL –STAINLESS OR PLAIN

- .1 MPI #108: Two part high build epoxy rated industrial grade high solids epoxy (75% solids) for use on steel and formulated without lead, chromate or mercury.
- .1 Adhesion ASTM D 4541- Excellent.
- .2 Humidity Resistance ASTM D 2247- Excellent.
- .3 Minimum 0.1016 – 0.2032 mm dry thickness.
- .4 G5 finish.

2.7 DOORS AND FRAMES TOP COAT

- .1 MPI #48: Alkyd gloss enamel suitable for ferrous and non-ferrous metal.
- .1 Pencil Hardness ASTM D 3363- 2B-B.
- .2 Flexibility ASTM D 522 Method B - 1/8", Method A 15.5%.
- .3 Abrasion ASTM D 4060 CS-10 wheels – 500 kg load, 1000 cycles – 40 mg loss.
- .4 Adhesion ASTM D 4541- Excellent.
- .5 Humidity Resistance ASTM D 2247- Excellent.
- .6 Product to be minimum 48% solids by volume.
- .7 G7 finish.
- .2 Two coats minimum 0.051 – 0.064 mm dry thickness each coat.

2.8 INTERIOR CONCRETE MASONRY UNITS

- .1 Primer:
- .1 Vehicle: acrylic blended latex.

- .2 Number of coats: 1
- .2 Top coat:
 - .1 Vehicle: cross linking alkyd
 - .2 Percent solids by volume: 33%
 - .3 Number of coats: 1
 - .4 Minimum dry mm thickness: 0.0254 mm.

2.9 INTERIOR CONCRETE AND EQUIPMENT BASES

- .1 Complete as per Section 09 96 56 Epoxy Coatings.

Part 3 Execution

3.1 GENERAL

- .1 Complete cleaning to NACE SSPC SP1 or SSPC SP2 or as directed in this specification, whichever is the most stringent.
- .2 Thoroughly examine all surfaces to be finished prior to commencement of work. Report in writing to Departmental Representative any condition that may potentially affect proper application. Do not commence work until all defects have been corrected.
- .3 Remove all grease, rust, scale, dirt, dust, loose particles and all foreign matter from surfaces. Use a cleaning solution where applicable.
 - .1 Zinc coated surfaces and unprimed steel surfaces – Use wire brushing or any other necessary method for cleaning and wash with a solvent.
 - .2 Concrete and unit masonry surfaces to be painted – Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.
- .4 Apply primer and top coat application in accordance to manufacturer's recommendations.
- .5 Sand lightly between coats.
- .6 Use clean brushes and rollers without imbedded dry paint or dirt.
- .7 Wait until paint is dry to apply the next top coat.
- .8 Power mix two component paints in proper ratios to a homogeneous mixture. Let stand as per manufacturer's recommendations.
- .9 Do not exceed pot life as recommended by manufacturer.
- .10 Do not paint over any galvanized or prepainted surfaces or equipment identification tags and valve stems.
- .11 Immediately clean away any paint smears or other such imperfections from all brackets, floors, walls, ceilings, etc.
- .12 Clean up spills and marks immediately with appropriate thinner.
- .13 Monorails: Mask surface in contact with wheels- do not paint area in contact with trolley wheels.
- .14 Coordinate work with all trades.

3.2 PROTECTION

- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage. Immediately clean away any paint smears or other such imperfections from all brackets, floors, walls, ceilings, etc. with appropriate thinner.
- .2 Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.
- .3 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .4 Do not paint over any galvanized or prepainted surfaces or equipment identification tags and valve stems.
- .5 Monorails: mask surface in contact with wheels- do not paint area in contact with trolley wheels.
- .6 Protect factory finished products and equipment and protect all pre-painted material delivered to the site from damage during and after installation until all works are accepted.
- .7 Remove electrical cover plates, light fixtures, surface hardware on doors, door stops, bath accessories and other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation and replace after painting is completed.
- .8 As painting operations progress place "WET PAINT" signs and bar traffic as necessary in occupied areas to approval of Departmental Representative.

3.3 SURFACE PREPARATION

- .1 Interior/Exterior Steel and Steel Piping.
 - .1 The surface to be coated must be clean, dry and well prepared to receive coating. Use appropriate wipes to clean surface.
- .2 Stainless Steel.
 - .1 Cleaning surface: SSPC-SP 1 solvent clean.
 - .2 The surface to be coated must be clean, dry and well prepared to receive coating.

3.4 APPLICATION

- .1 Apply primer and top coat application in accordance to manufacturer's recommendations.
- .2 Primer and top coat to be two different colours.
 - .1 For PVC: Tint primer to match top coat.
- .3 Apply coat(s) to obtain recommended manufacturer's dry film thickness or as stated in Part 2 above in each coat, wait a minimum of 2 hours between coats. Apply coats as required to produce a complete uniform painted surface - minimum of two coats.
- .4 Do not paint over any galvanized or prepainted surfaces. Immediately clean away any paint smears or other such imperfections from all brackets, floors, walls, ceilings, etc.

3.5 TWO PART COMPONENTS

- .1 Complete application in accordance to manufacturer's recommendations.
- .2 Power mix components in proper ratios for 15 minutes.

- .3 Do not exceed pot life of 12 hours.
- .4 Prepare surfaces such that they are sound, dry, free of oil, grease, dirt, and other foreign substances.
- .5 Do not paint over any galvanized or prepainted surfaces. Immediately clean away any paint smears or other such imperfections from all brackets, floors, walls, ceilings, etc.
- .6 Apply one coat to obtain 0.102- 0.152 mm wet, coverage 6.5 - 9.8 m²/L.
- .7 Clean up spills and marks immediately with appropriate thinner.

3.6 DOORS AND FRAMES

- .1 Complete application in accordance to manufacturer's recommendations.
- .2 Tint to provide colours as specified.
- .3 Prepare surfaces such that they are sound, dry, free of oil, grease, dirt, and other foreign substances, scratches and dents.
- .4 Solvent wipe to remove all dust.
- .5 Apply primer and paint finish only when conditions forecast for entire period of application fall within Manufacturer's recommendations.
- .6 Apply two coats of top coat after prime coat (above) has set to obtain minimum 0.127 mm dry thickness (total). Use short nap roller.
- .7 Clean up spills and marks immediately with appropriate thinner.
- .8 Final finish upon building take over is to be free of any and all imperfections ie. scratches, dust, lint, dents, runs, ropiness, sags, orange peel, non-uniform gloss or other surface imperfections. Sand and repaint as required.

3.7 SAFETY

- .1 Use proper protective clothing and equipment as recommended by the product manufacturer.
- .2 Maintain on site an operational fire extinguisher of suitable size and suitable for flammable volatile products.
- .3 Visibly post a copy of the Material Safety Data Sheets (MSDS) for products being used in work area. Provide a copy to the Departmental Representative.
- .4 Store all materials in a safe approved manner and in suitable containers.
- .5 Remove used wiping cloths from building daily.
- .6 Protect against spontaneous combustion by drenching with water or place in airtight metal containers.
- .7 Follow the applicable Workplace Health and Safety Guidelines.

3.8 CO-ORDINATION

- .1 Co-ordinate painting with all sub trades.
- .2 Ensure piping is empty of liquid and is at room temperature.

3.9 RESTORATION

- .1 Clean and re-install all hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashing on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

END OF SECTION

Part 1 General

1.1 AREAS OF USE

- .1 Epoxy coat all concrete surfaces prior to equipment and piping placement.
 - .1 Allow coating to cure before placing equipment.
- .2 Where textured surfaces are used the texture shall not interfere with the use of EPDM rubber squeegee. Apply epoxy coating system complete with a texture to:
 - .1 Entire building floor area.
- .3 Apply epoxy coating system without a texture to:
 - .1 Housekeeping and equipment pads: all vertical (sides/edges) and horizontal surfaces.
 - .2 Walls of basement area in process room
 - .3 Exposed vertical edges (sides) of curbs.
 - .4 Channel slopes and floor.

1.2 CONDITIONS FOR APPLICATION

- .1 Ensure concrete has sufficiently cured and concrete moisture content is within recommended tolerances before applying coating.
- .2 Prior to applying epoxy coating system confirm with Departmental Representative that the concrete surfaces have been aesthetically accepted i.e. that there are no concrete imperfections, bugholes, areas of ponding, etc. All concrete imperfections are to be repaired before application of the epoxy coating system.
- .3 Do not start coatings until surface thermometer, concrete moisture content measurement device, applied coat thickness measuring device and all required types of products are on-site.
- .4 Provide sufficient experienced workforce to complete applications within specified times.

1.3 REFERENCE STANDARDS

- .1 ASTM D523-14(2018); Standard Test Method for Specular Gloss.
- .2 ASTM D638-14; Standard Test Method for Tensile Properties of Plastic
- .3 ASTM D695-15; Standard Test Method for Compressive Properties of Rigid Plastics
- .4 ASTM D1868-20; Standard Test Method for Detection and Measurement of Partial Discharge (Corona) Pulses in Evaluation of Insulation Systems
- .5 ASTM D2240-15(2021); Standard Test Method for Rubber Property - Durometer Hardness.
- .6 ASTM D4060-19; Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- .7 ASTM D4258-05(2017); Standard Practice for Surface Cleaning Concrete for Coating.
- .8 ASTM D4259-18; Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application.

- .9 ASTM E84-21a; Standard Test Method for surface Burning Characteristics of Building Materials.
- .10 ASTM D4260-05(2017); Standard Practice for Liquid and Gelled Acid Etching of Concrete.
- .11 ASTM D4262-05(2018); Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
- .12 ASTM D4263-83(2018); Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method.
- .13 ASTM D4541-17; Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- .14 ASTM E84-21a; Standard Test Method for Surface Burning Characteristics of Building Materials.
- .15 ASTM F1869-16a; Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- .16 ASTM F2170-19a; Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In situ Probes.

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Samples: Submit, for verification purposes, 100 mm x 100 mm square sample of each type of epoxy flooring required, applied to a rigid backing, in colour and finish indicated.
 - .1 For initial selection of colours and finishes, submit manufacturer's colour charts showing full range of colours and finishes available.
- .3 Since epoxy coatings are required for various surfaces that can only be prepared at different times multiple trips to site will be required to complete the works. Provide detailed schedule for Departmental Representatives approval based on equipment installation and coating applications.
 - .1 Materials and areas where material is to be applied.
- .4 Submit manufacturer's application instructions and confirmation that all manufacturer's application instructions are to be implemented.
- .5 Submit manufacturer's maintenance instructions, including maintenance procedures and materials for stain removal and surface repair, and recommended schedule for cleaning.
- .6 Material Safety Data Sheets (MSDS) for posting on site.
- .7 Confirm and describe how edges are to be cut to ensure no epoxy is applied to wall panels, baseboards or equipment.
- .8 Methods and equipment to be used to measure coat thickness as applied.
- .9 Number of persons onsite, duties and qualifications.
- .10 Procedures to meet pot life, measure application thickness and address cure times.
- .11 Procedures to check and monitor substrate moisture and temperature.
- .12 Submit inspection check list to be prepared prior to and during topping operations. Include as a minimum the following items:

- .1 Floor condition: Slopes for drainage as per drawings, concrete age, pads in place.
- .2 Environment: Temperature, are barricaded, adjacent surfaces masked off or covered.
- .3 Concrete base slab preparation: Concrete moisture meets limits, grind high areas, patch low areas, concrete free of dust, oil grease, concrete properly prepared and cleaned.
- .4 Materials: Materials meet specifications, date of factory pre-packaged containers, storage temperature, manufacturer's instructions onsite, method to check depth of coatings onsite.
- .5 Primer: Number of litres required for area being covered, proper application tools onsite, proper application thickness applied.
- .6 Mixing: Mixing as per manufacturer's instructions.
- .7 Topping Application: Spread topping full depth, listing of hand trowelled areas, check depth with gauge, install and tool coves, pot life not exceeded, use flood light parallel to floor to see and eliminate trowel marks, use masking tape, etc.
- .8 Cure: Foot traffic not permitted for 12 hours, no use of area for 5 days.
- .9 Acceptance: Color and finish is uniform throughout, floor flooded to verify no ponding.

1.5 SUBSTITUTES

- .1 Product substitution:
 - .1 Equivalent products of the same generic type may be submitted for approval by Departmental Representative.
 - .2 Product can be used providing it meets or exceeds the performance criteria of the coatings specified.
 - .3 Obtain primary epoxy flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer.
 - .4 Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

1.6 QUALITY ASSURANCE

- .1 Provide qualifications of persons who will be completing product applications, for Departmental Representative's approval at time of shop drawing submittal. Submission to include:
 - .1 Names of personnel that will complete site work.
 - .2 Confirmation that personnel has a minimum of 5 years of proven satisfactory experience in the application of specified materials on projects of similar size and complexity.
 - .3 List of the last three comparable jobs, including job name and location, specifying authority, project manager and product site applicator.
 - .4 List persons trained by the manufacture for application of specified materials. Use qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency". Provide Certificate a minimum of 2 weeks prior to site works. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance to trade regulations.
 - .5 Include manufacturer's approval of specific personnel.

- .2 Job area to be free of other trades during application and remain free of other trades for a period of 24 hours, after and in between floor coating(s) application.
- .3 All of the specified materials shall be installed in strict compliance with the technical literature published and available from the manufacturer.

1.7 STORAGE AND HANDLING

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number, date of manufacture and expiry date.
- .2 Store materials in accordance with manufacturer's instructions.
- .3 Keep containers sealed until ready for use.
- .4 Protect materials during handling and application to prevent damage or contamination.
- .5 All materials used shall be factory pre-weighed and pre-packaged in single, easy-to-manage batches to eliminate onsite mixing errors. No onsite weighing or volumetric measurements allowed.
- .6 All containers to have Workplace Hazardous Material Information System (WHMIS) labels indicating contents.
- .7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

1.8 ENVIRONMENTAL CONDITIONS

- .1 Maintain minimum substrate surface temperature of 18°C (65°F) for a minimum of 48 hours before, during and after installation, or until cured. Maintain relative humidity not higher than 40% during same period.
- .2 Do not apply materials if relative humidity is above 85%.
- .3 Concrete must be free of hydrostatic, capillary or moisture vapor pressure. Concrete must be properly cured for a minimum of 30 days. Concrete in contact with ground must have a properly installed, effective vapor barrier to help prevent potential problems resulting from hydrostatic, capillary or moisture vapor pressure. Concrete must contain less than 3% moisture when tested per ASTM D 1868.
 - .1 Complete vapour transmission test by placing a 1.2 m x 1.2 m plastic sheet sealed at all edges with duct tape to prevent moisture transmission by evaporation. Test period is a minimum of 24 hours. There shall be no accumulation of moisture on enclosed surface of polyethylene sheeting.

1.9 PREPARATION AND FINAL PRODUCT

- .1 Mask items near and inset into concrete that do not get coated such as floor grating, conduit stubs, items imbedded into floor, walls in tight spaces, etc.
- .2 Do not perform painting work unless a minimum lighting level of 300 Lux is provided on surfaces to be painted.
- .3 Be responsible to restrict traffic on floor between coatings. Ensure there is no dirt or foreign matter of any kind on surface at time of any coating application.
- .4 Ensure only floor and equipment bases are coated- no splash marks on items not to be coated.

- .5 Apply grit uniformly throughout the entire surface ensuring corners and restricted areas have the same look as open areas. Pay particular attention to vertical sides of equipment bases and lip of equipment bases to ensure grit coverage is even.
- .6 Thumb print test: If the primer feels tacky and you can leave a thumb print in the paint film without getting any paint on your thumb the primer is "Ready-to-Overcoat".
- .7 Apply floor coating to produce a smooth surface, uniform in sheen, colour and finish, free from marks, dirt, runs, crawls, curling, holes, air pockets and other defects and to achieve smooth, even finish.
- .8 Allow proper cure time for each installation procedure.
- .9 Standard of Acceptance:
 - .1 No visible paint drip, spills or over application.

1.10 MEASUREMENT OF FILM THICKNESS

- .1 Prior to application provide method to Departmental Representative to control wet film thickness application rate.
 - .1 If quality control is based on volume of product over a controlled area provide a sketch and volume of epoxy to be used for the controlled areas. Provide such information a minimum of 5 days before application. Record actual usage over calibrated area and provide written summary to confirm application (wet) film thickness.
 - .2 If quality control is wet film gauge provide detailed procedures to be followed for approval as well as details of all measurements completed (in writing).
- .2 After epoxy is dry provide a calibrated dry film thickness gauge (electronic with a tolerance of plus-or-minus three percent) suitable for concrete that is epoxy coated. Measure dry film thickness in the presence and at the direction of the Departmental Representative. Readings to be minimum every 5 m² or a tighter frequency where directed by Departmental Representative. Record all values and provide data to Departmental Representative.

1.11 MEASUREMENT OF MOISTURE

- .1 Provide Departmental Representative, prior to application, method to be employed to measure and confirm that the moisture content of the concrete and the rate of moisture emissions is within manufacturer's recommended tolerances prior to coating concrete. Two separate tests are required.
 - .1 Utilize an electronic meter to assess the moisture contained in the concrete that can potentially be emitted at the surface, testing as per ASTM F2170.
 - .2 Utilize a calcium chloride test to measure the moisture vapor actually being emitted, testing as per ASTM F1869-11.
- .2 The air space above or around the concrete slab must be at application temperature and application relative humidity for at least 48 hours before making humidity measurements in the concrete slab.
- .3 Complete concurrent testing (both values) for every 100 m² of area to be coated.
- .4 Prior to testing provide listing of equipment proposed to obtain values for Departmental Representative's approval. Include make and model numbers of proposed testing equipment and conformance documentation to ASTM standards.

- .5 Provide written report of moisture testing results completed and conformance confirmation to manufacturer's guidelines prior to coating application.

Part 2 Products

2.1 PRIMER

- .1 Provide a primer system compatible with the finished epoxy system.
- .2 Use a green concrete primer for epoxy installations where concrete has less than 28 days curing.

2.2 EPOXY POLYMER COATING – FLOORS AND HOUSEKEEPING PADS

- .1 Provide epoxy polymer coating and any additional primers, base coats, or overcoats as required for epoxy floor system.
- .2 Two component, 100% solids solvent free, tough and chemical resistant epoxy coating.
- .3 Compressive Strength, ASTM D695: 40 MPa (5,800 psi)
- .4 Tensile Strength, ASTM D638: 22 MPa (3,164 psi)
- .5 Tensile Elongation, ASTM D638: 1.75%
- .6 Impact Resistance, Gardner Impact: 185 kg-cm
- .7 Hardness, ASTM D2240, Shore D: 85.
- .8 Specular Gloss Factor, ASTM D523: 70 - 80.
- .9 Abrasion Resistance, ASTM D4060: 0.067 g loss maximum.
- .10 Solids: 100% by weigh and volume.
- .11 Fire Resistance, ASTM E 84:
 - .1 Flame Spread Index: 3.
 - .2 Smoke Development: <5.
 - .3 Classification "1" or "A".
- .12 Floor finish: Slip resistant fine texture suitable for use with a neoprene rubber squeegee.
 - .1 Stonhard: Texture #2.
 - .2 Sika: "fine type" texture created by aggregate broadcast onto base coat as described herein.
- .13 Colour: As selected by Departmental Representative.

2.3 EPOXY POLYMER COATING – WALLS

- .1 Provide epoxy polymer coating and any additional primers, base coats, or overcoats as required for epoxy wall system.
- .2 Two component, 100% solids solvent free, tough and chemical resistant epoxy coating.
- .3 Tensile Strength, ASTM D638: 15.5 MPa (2,247 psi)
- .4 Tensile Elongation, ASTM D638: 5.3%
- .5 Abrasion Resistance, ASTM D4060: 0.097 g loss maximum.
- .6 Adhesion to concrete, ASTM D4541: greater than 4.2 MPa

- .7 Solids: minimum 40% by weight and volume.
- .8 Fire Resistance, ASTM E84:
 - .1 Flame Spread Index, CAN/ULC S102: 15.
 - .2 Smoke Development, CAN/ULC S102: 35.
- .9 Wall finish: Satin finish. Submit sample for Departmental Representative to make final selection.
- .10 Colour: As selected by Departmental Representative.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine surfaces to receive epoxy coating. Notify Departmental Representative if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.
- .2 As stated in item 1.4 above, prior to applying epoxy coating system confirm with Departmental Representative that the concrete surfaces have been aesthetically accepted.
- .3 Do not install epoxy until the concrete is a minimum of 28 days old or epoxy must be installed with a green concrete primer. Provide manufacturer's written recommendation for epoxy application on concrete less than 28 days old.
- .4 Confirm to Departmental Representative and obtain Departmental Representative approval on:
 - .1 How edges are to be cut, ensuring no epoxy is applied to wall panels, baseboards or equipment.
 - .2 Moisture content of concrete is within acceptable parameters based on site measurements.
 - .3 Air temperature and relative humidity at time of application will be within required tolerances.
 - .4 Method to confirm and measure thickness of product applied.
 - .5 Expected cure and re-coat times based on present and expected site temperatures.
 - .6 Method to apply texture where applicable.
- .5 Ensure 2 printed copies of all complete manufacturer's installation instructions and check sheets as per 1.6 above are available onsite.
- .6 Commencement of work implies acceptance of existing conditions.

3.2 FLOOR GRINDING

- .1 Grind all surface imperfections using a wet dustless grinding system prior to epoxy coating.
- .2 Use tarps, dust hoarding, water and other methods to control dust. Be responsible for damage.

3.3 SURFACE PREPARATION

- .1 Prepare concrete surface in accordance with manufacturer's instructions and ASTM D 4258.

- .2 Remove all dirt, oil, grease, wax, laitance, curing compounds, water soluble concrete hardeners, and other surface contaminants.
- .3 Remove sealers, finishes and paints in accordance with manufacturer's instructions.
- .4 Remove laitance and unbounded cement particles by abrasive blasting or scarifying.
- .5 Remove unsound concrete by scarifying, sand blasting, shot blasting, or high pressure water blasting.
- .6 Prepare concrete to have a rough, sandpaper finish using mechanical methods or by acid etching.
- .7 Mechanical Surface Preparation
 - .1 Mechanically abrade concrete surface in accordance with manufacturer's instructions, if chemical surface preparation cannot be used.
 - .2 Leave surface with a uniform texture showing open pores throughout and have a medium grit sandpaper texture.
 - .3 Remove concrete dust.
 - .4 Conform to ASTM D 4259.
 - .5 Achieve a profile equivalent to International Concrete Repair Institute (I.C.R.I.) – Concrete Surface Profile (CSP) 3-4.
- .8 As applicable protect electrical panels, motors, lights, mechanical equipment and other building surfaces from construction dust.
- .9 Complete measurements as required to confirm moisture content of the concrete and the rate of moisture emissions is within manufacturer's recommended tolerances.

3.4 HOUSEKEEPING PADS

- .1 Coat all vertical and horizontal surfaces of housekeeping pads.
 - .1 Coat concrete housekeeping pads prior to equipment installation.

3.5 COVING: BUILDING CURBS/FLOOR JOINT

- .1 Complete grouting of cove, curb to floor connection, providing a 45° edge prior to coating epoxy on floor so coating overlaps the cove.
 - .1 Use non shrink concrete grout for curb to floor connection.
 - .2 Apply grout uniformly 20mm high and 20 mm wide providing a 45° edge.
- .2 Extend epoxy floor coating up the interior portion of the building curbs, at curb to floor connection, to within 10 mm of the bottom edge of the finished wall liner panel where installed.
 - .1 Use a brush for all cutting around edges.
 - .2 Ensure a straight and level line is made as a finish edge.
- .3 Do not get epoxy on wall panels or trim.
 - .1 Protect (cover) walls and trim as required prior to epoxy application.

3.6 FLOOR PROTECTION

- .1 Protect epoxy flooring during curing period from traffic and chemical spillage.
 - .1 Close area of application for a minimum of 24 hours.

.2 Minimum finished epoxy flooring cure time is 7 days.

.2 If necessary provide temporary protection until floor is cured. Follow manufacturer's written instructions.

3.7 MIXING

.1 Comply with manufacturer's instructions for mixing procedures.

.2 Carefully measure and mix the components together.

.3 Pre-mix each component before every batch to ensure uniformity consistency.

.4 Use a slow speed mixer with manufacturer recommended mixing paddle to mix.

.5 Scrape down the sides and bottom of the container with a flat or straight edge trowel at least once, to ensure complete mixing.

.6 Do not exceed pot life.

3.8 APPLICATION

.1 Follow manufacturer's written instructions. Ensure all instructions are onsite.

.2 For all product applications measure area to be coated to determine volume of product that is required based on manufacturer's recommendations. Provide calculations to Departmental Representative verbally and as hard copy.

.3 Apply floor coating to produce a smooth surface, uniform in sheen, colour and finish, free from marks, dirt, runs, crawls, curling, holes, air pockets and other defects and to achieve smooth, even finish. Apply grit uniformly throughout the entire surface ensuring corners and restricted areas have the same look as open areas. Pay particular attention to vertical sides of equipment bases and lip of equipment bases to ensure grit coverage is even.

.4 Do work in a manner such that bubbles or out gassing does not occur, take all required precautions. Apply when the floor temperature is constant or decreasing during the epoxy curing process.

.5 Ensure there is no water or steam in the vicinity of the application including curing time.

3.9 CLEANING

.1 Clean all equipment immediately after use with scouring pads and warm, soapy water or with mineral spirits. Hardened material will require mechanical means of removal.

.2 If an unusually long delay should arise, such as a break for lunch, completely clean all mixing paddles and pails before ceasing operations. Ensure there is no contamination of partly cured material with new batches when the mixing operation resumes.

.3 Carefully measure and mix the components together.

.4 Clean area of rubbish and dispose in an approved manner.

END OF SECTION

DIVISION 10

SPECIALTIES

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Main Building sign.
 - .2 Secondary Building signs.
 - .3 Process Flow Diagram Display.
 - .4 Traffic signs.
 - .5 Miscellaneous signs.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for hardware complete with pertinent details, colour charts, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 Technical Criteria Correctional Institutions (2014); Correctional Service Canada.
- .2 Signage: System Overview and Implementation (1992); Treasury Board of Canada Federal Identity Program Manual.
- .3 CGSB 109.1M(1989); Signage System, Extruded Aluminum, FIP
- .4 CGSB 109.2M(1989); Letters and symbols, Die-cut Film, FIP

Part 2 Products

2.1 MAIN BUILDING SIGN

- .1 Main building sign to be a "Primary Identification Sign" as per volume 4.2 of the Treasury Board Secretariat (TBS) FIP Manual as found on the TBS Web site at http://www.tbs-sct.gc.ca/fip-pcim/man_pdfs-eng.asp
- .2 Design elements such as material, size, shape, colour and graphic/text as well as installation requirements are included within this section of the FIP manual.
- .3 Provide shop drawings for review of wording and layout.
- .4 Signage to be as per CGSB 109.1M
- .5 Letters and symbols to be as per CGSB 109.2M

2.2 SECONDARY BUILDING SIGNS

- .1 Use 100 mm and 300 mm high "Arial" style 15 mm thick (Relief) cast aluminum letters. Center all wording to have an even spacing all around and in between each line of letters. Letters to be white.
- .2 Provide an all weather finish for all components.

- .3 Provide a minimum 25 mm wide (minimum 15 mm relief from front face of sign) border around sign for strength and aesthetics.
- .4 Mount cast aluminum letters directly to 1.6 mm pre-painted black aluminum backing plate. Mount aluminum on minimum 12 mm pressure treated plywood primed and painted both sides.
- .5 Black aluminum backing plate to be one piece.
- .6 Ensure all mounting brackets and hardware for fastening the sign unit to the building are completely hidden.
- .7 Sign and overall size for sign for each site as per drawing.
- .8 Building number and letter "code" wording to be provided by the Departmental Representative
- .9 Obtain approval of sign wording from Departmental Representative.
- .10 Submit shop drawings of signs, related mounting hardware, spacing between lines and spacing to borders.
- .11 Refer to Plans for number of signs.

2.3 PROCESS FLOW DIAGRAM DISPLAY

- .1 Provide Departmental Representative with red-lined flow diagram, full valve tag list. List each valve on re-line drawing.
- .2 Departmental Representative to revise process flow diagrams to record and provide Contractor with paper copy with dimensions of approximately 559 mm x 864 mm.
- .3 Mounting board: Secure diagram to a foam board that has a self-adhesive side, ensure no air bubbles.
 - .1 Raised.
- .4 Frame: Black metal 25 mm wide-grooved, overall frame dimensions 610 mm x 914 mm.
- .5 Matte: 40 mm wide light grey matte with beveled edge (white).
 - .1 Select grade: Chemically treated to reduce acidity when the pulp is still in liquid form.
- .6 Acrylic: Anti glare glazing.
- .7 Hanging: Plastic coated wire, hangers for attaching wire to frame and two wall bumpers.
- .8 Provide shop drawings.
- .9 Provide 1 unit.

2.4 DOORS

- .1 Signs to be in accordance with "Signage: System Overview and Implementation" and "Technical Criteria Correctional Institutions".
- .2 Provide self-adhesive laminated plastic plate tags with 12 mm lettering and numbers for all interior doors.
- .3 Label "Vestibule RM 101", "Control Room RM 102", "Washroom RM 103", "Storage Room RM 104", "Electrical Room RM 105" and "Process Room RM 106".
- .4 Submit list of nameplates for review prior to engraving.

2.5 MAXIMUM OCCUPANCY SIGN

- .1 Provide sign indicating the maximum occupancy.
- .2 Refer to the plans for maximum Occupancy.
- .3 Provide 2 signs. Locate signs inside the building near each entrance.

2.6 SAFETY SIGNS

- .1 Provide regulatory sign with pictogram and wording to CSA Standards as following:
 - .1 Wording: "Hearing Protectors Required":
 - .1 Location: Vestibule side of door D9.
 - .2 Provide 1 unit.
 - .2 Wording: "High Voltage":
 - .1 Location: Vestibule side of door D9.
 - .2 Provide 1 unit.
 - .3 Wording: "No Smoking"
 - .1 Location: Vestibule side of doors D9 and D10.
 - .2 Provide 2 units.
- .2 Provide information signs with pictogram and wording to CSA Standards as follows:
 - .1 Wording: "Eye Wash Station".
 - .1 Location: Above eyewash station.
 - .2 Provide 1 unit.
 - .2 Wording: "First Aid Kit": Location: Above first aid kit(s).
 - .2 Provide 1 unit.
 - .3 Manufacturer: Brady 20104MLS or approved equal.
 - .3 Wording: "Caution: Sewer Gas Present"
 - .1 Location: Exterior side of door D4 and Vestibule side of door D10.
 - .2 Provide 2 units.

2.7 TRAFFIC SIGNS

- .1 Signs to be 1.6 mm aluminum.
- .2 Provide 2 - RA-1 75cm x 75cm "STOP" signs.
- .3 Each sign to include 3.3 m U-channel hardened steel post c/w metal plate attached to bottom of post and sign mounting hardware.
- .4 Install signs at locations as shown on plans.

Part 3 Execution

3.1 TRAFFIC AND STREET SIGNS

- .1 Install signs at locations shown on the plans.
- .2 Posts to be straight and plumb.
- .3 Set post c/w metal plate attached to bottom of post 1,000 mm deep in 250 mm diameter hole. Compact soil above metal plate to secure post in place.

- .4 Signs to be at 2.3 m height above ground.

3.2 BUILDING MOUNTED SIGNS

- .1 Attach sign to building straight, plumb and snug to face of exterior wall at location as depicted on the enclosed plan portion.
- .2 Use stainless steel screws secured to structural building members.
- .3 Ensure mounting brackets and related hardware are not openly visible.

3.3 PROCESS FLOW DIAGRAM DISPLAY

- .1 Hang frames on building walls with two supports.
- .2 Frame height and exact location to be field determined by Departmental Representative.

3.4 TOUCHUP

- .1 Galvanized surfaces: Clean damaged surface with wire brush serving loose and cracked castings. Apply two coats of approved zinc pigmented paint to damaged area.
- .2 Building Sign: Clean flaked or chipped surface with wire brush. Apply two coats of approved paint to damaged area. Field paint to match factory applied paint as approved by Departmental Representative.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations. Dispose of surplus excavated and construction material.
- .2 Re-level ground around posts.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Toilet Tissue Dispenser.
 - .2 Towel Bar.
 - .3 Soap Holder.
 - .4 Liquid Soap Dispenser.
 - .5 Paper Towel Dispenser.
 - .6 Mirror.
 - .7 Hat and Coat Rack.
 - .8 Waste Bin.

1.2 REFERENCES

- .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM A924/A924M-20, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .5 ASTM B456-17, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- .6 CAN/CSA G164-M92 (R2003); Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 EXTRA MATERIALS

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
- .2 Deliver special tools to Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Sheet steel: Commercial quality to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: To ASTM A167, Type 304 with BA finish.
- .3 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.

- .4 Fasteners: Concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 TOILET TISSUE DISPENSER

- .1 Surface mounted.
- .2 Single roll dispenser, stainless steel c/w hood, plastic spindles.
- .3 Provide 48 double rolls of toilet tissue.
- .4 Provide 1 unit.

2.3 TOWEL BAR

- .1 Surface mounted.
- .2 Stainless Steel, 19 mm square bar.
- .3 610 mm long.
- .4 Provide 4 sets of bath towels, hand towels and wash clothes.
- .5 Provide 1 units.

2.4 SOAP HOLDER

- .1 Surface mounted.
- .2 Stainless Steel, one-piece c/w concealed mounting bracket.
- .3 Provide 1 unit (washroom).

2.5 LIQUID SOAP DISPENSER

- .1 Surface mounted.
- .2 Stainless Steel with satin finish.
- .3 Corrosion resistant valve.
- .4 Compatible with all-purpose hand soaps.
- .5 Capacity 1.2 L.
- .6 Fill dispenser with liquid soap.
- .7 Provide 3 units (washroom, vestibule, process room).

2.6 PAPER TOWEL DISPENSER

- .1 Surface mounted.
- .2 Stainless steel c/w satin finish.
- .3 Door c/w knob latch and piano hinge.
- .4 Capacity: 400 C-fold or 525 multifold towels (79mm to 97mm) deep.
- .5 Provide 4,000 sheets of multifold paper towels.
- .6 Provide 3 units (washroom, vestibule, process room).

2.7 MIRROR

- .1 Surface mounted.
- .2 One piece, roll formed 19 mm x 19mm angle frame.
- .3 Stainless steel with satin finish.
- .4 Corners: Heliarc, welded, ground and polished smooth.
- .5 Beveled frame edge.
- .6 Galvanized steel back.
- .7 Secured to concealed wall hanger with theft-resistant mounting.
- .8 457 mm wide x 762 mm high.
- .9 Provide 1 unit.

2.8 HAT AND COAT HOOK

- .1 Surface mounted.
- .2 Stainless steel c/w concealed wall plate.
- .3 Hook: 25 mm x 165 mm.
- .4 Provide 1 unit.

2.9 WASTE BIN

- .1 Floor standing bin, open top c/w wall bumper and rubber feet.
- .2 Stainless steel c/w satin finish.
- .3 320 mm x 320 mm x 560 mm high. (49.2 L capacity).
- .4 Provide 3 units (washroom, vestibule, process room).

2.10 ACCESSORIES

- .1 Toilet Brush – 1 unit.
- .2 Plunger – 1 unit.

2.11 FABRICATION

- .1 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .2 Back paint components where contact is made with building finishes to prevent electrolysis.
- .3 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .4 Shop assemble components and package complete with anchors and fittings.
- .5 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .6 Provide steel anchor plates and components for installation on studding and building framing.

Part 3 Execution

3.1 GENERAL

- .1 Install bathroom accessories to manufacturer's instructions, fastened securely to block backing, properly plumbed and aligned at heights recommended by manufacturer.
- .2 Install shut off valves for all fixtures.

3.2 INSTALLATION

- .1 Install and secure accessories rigidly in place using mechanical fasteners.
- .2 Install grab bars on built-in anchors provided by bar manufacturer. Supply templates, details and instructions for building-in anchors in toilet partitions.
- .3 Fill units with necessary supplies shortly before final acceptance of building.

END OF SECTION

DIVISION 12

FURNISHINGS

Part 1 General

1.1 SUPPLY BY OTHERS

- .1 The following items will be provided by the Owner:
 - .1 Workbench
 - .2 Pegboard Assembly
 - .3 Storage Racking
 - .4 Computer Office Desk and Accessories
 - .5 Computer Desk Chair
 - .6 File Cabinet
 - .7 Shop Vacuum Cleaner
 - .8 Boot Tray
 - .9 Coat Tree
 - .10 Wall Clock
 - .11 Waste Basket
 - .12 Janitorial Supplies and Sundry
 - .13 Miscellaneous Tools and Equipment.

Part 2 Execution

2.1 EQUIPMENT

- .1 Provide access to the building as required for installation of materials.
- .2 Provide blocking behind lab cabinet as needed to securely mount against wall.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

Part 1 General

1.1 REFERENCES

- .1 The most recent of the following standards and criteria edition shall be used for design and construction of the building:
 - .1 National Building Code of Canada, 2015
 - .2 Applicable Provincial Building Code.
 - .3 ASTM A307-21; Standard Specification for Carbon Steel Bolts, Nuts, and Threaded Rod 60,000 PSI Tensile Strength.
 - .4 ASTM A653/A653M-20; Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
 - .5 CAN/CSA Z91-17, Health and Safety Code for Suspended Equipment Operations.
 - .6 OSHA 1910.66 (1996), Powered Platforms for Building Maintenance.
 - .7 Technical Criteria for Correctional Institutions, Correctional Service Canada, April 2015.

1.2 DESIGN REQUIREMENTS

- .1 Type: The building shall a structural block wall structure with steel metal cladding on the outside.
- .2 Roof: The slope of the roof shall be as per plan and shall be designed for the proposed building site.
- .3 Building shall be watertight. Ensure all joints (interior and exterior) are made resistant to condensation and water from a stream. Use flashings as required at all seams and joints.

1.3 FIRE CODE REQUIREMENTS

- .1 Electrical room, storage room and washroom interior walls up to underside of roof deck to have a one hour rated fire separation in accordance with the National Building Code.
 - .1 Provide a continuous smoke-tight barrier.
 - .2 Block wall that are to be fire rated are to be as per as per NBCC 2015, Appendix D-2.1)
 - .3 Steel stud walls that are to be fire rates are to be as per ULC Design No. U465).
- .2 Where indicated in the door schedule (Section 08 71 00), doors and hardware to have a 45 minute fire rating to the latest edition of the National Building Code and be complete with door closures and latching mechanisms as per the latest edition of the National Building Code.
- .3 Seal all abutments and service penetrations through the walls with ULC approved fire stop sealants as per the latest edition of the National Building Code.

1.4 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Details of trusses.

- .2 Profile of exterior cladding proposed including proposed screw locations and spacing.
- .3 Drawing of wall to ceiling connection, interior ceiling to wall connection and curb details.
- .4 Eavestrough location.
- .5 Trim proposed to hide all ethafoam fillers and related finishing trim.
- .6 All flashings and trim proposed for use including trim and flashing details used for door and other openings to account for "non standard" wall width in respect to door frame sizing.
- .7 Attic ventilation – soffit and ridge vents.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings complete with pertinent details, color charts, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.6 DIMENSIONS

- .1 No bid shall propose a building of clear interior dimensions which are less than those shown on the plans.

1.7 EQUIPMENT HUNG FROM CEILING

- .1 Co-ordinate hanging supports for equipment suspended from ceiling members. Provide sufficient support in roof to accommodate equipment being hung from the ceiling as shown on the plans. A partial listing is:
 - .1 HVAC – co-ordinate with Division 23 and 26.
 - .2 Electrical conduits and lighting - coordinate with Division 26

Part 2 Products

2.1 MATERIALS

- .1 Anchor Bolts: to ASTM A307 complete with nuts and washers.
- .2 Screws: 300 series stainless steel cap mechanically formed around a high strength carbon steel fastener, EPDM washer, self-tapping, Hi thread to provide positive engagement of the panel and prevent over drilling, purpose made, head color same as pre painted steel. Scots or approved equal.
- .3 Sheet steel: to ASTM A653, Grade A, Z275 coating designation, factory precoated with silicon modified polyester finish, "Dofasco 5000 Series", dry film thickness of 0.1 mm on exposed surface conforming to test procedures described in CSSBI Bulletin No. 5.
- .4 Air/Vapour Barrier: 20 mm profile steeliner gasket. For sealing, soft continuous closed cell, polyurethane foam. Seal air vapor barrier with sufficient connections to compress form gasket and provide an air tight seal. Seal wall/ceiling air vapor barrier.
 - .1 For ceiling also provide a 6 mil thick polyethylene vapor barrier.
 - .2 For exterior walls also provide Spunbonded polyolefin, won-woven, non-perforated weather barrier. Refer to Section 07 25 00.
- .5 Refer to Division 7 for insulation.

- .6 Steel Panels: All wall and roof panels, ridge covers, flashing, wall caps and fascia shall be fabricated of steel with a minimum tensile strength of 255 mPa (37,000 psi). The steel shall be ASTM A653 B coated with zinc at a minimum rate of 380 grams per square metre of surface area (2.5 oz. per sq. ft.).
- .7 PVC Panels: See Section 06 64 00 Plastic Paneling.
- .8 Roof panel rib sealant: Provide a bead of butyl "tape Seal" 3 mm x 9.5 mm between the male and female roof panel ribs full length.
- .9 Joints Vertical panel: Do not use joints in any vertical wall panels. Panels shall be one piece from base of floor to ceiling.

2.2 CURB

- .1 Refer to 03 30 00 Cast In Place Concrete.
- .2 Review design of curb as shown in the drawings to ensure that the design meets all requirements to support the intended building.
- .3 Building curb width shall be in accordance with the wall thickness (less Styrofoam thickness) and minimum height of 200 mm.
- .4 Provide shop drawing per 01 33 23 Shop Drawings, Product Data, and Samples, of curb design to match proposed building and all loads (horizontal and lateral) imposed by building.
- .5 Do not continue curb under doors.
- .6 Provide grout at corncorner of floor and curb. Epoxy coat floor and curb as shown on plans.

2.3 ROOF COMPONENTS

- .1 Exterior: Snap lock type. Use concealed fastener roof system of prepainted steel not less than 0.61mm (24 ga) thick or as specified on plans. The panels shall be one piece from eave to ridge and applied with ribs upstanding and parallel to the roof slope. Use fascia and ridge cover.
 - .1 Use wood trusses studs at maximum 600 mm O/C. Install 16 mm plywood over trusses and installed membrane underlayment on the bottom 1.5 m of the roof.
 - .2 Design roof panel to have a concealed fastening system (no through the roof fasteners) with side laps consisting of interlocking seams with return leg on lower edge of female rib, factory apply side lap sealant.
 - .3 Drip edge: Extend panels 50 mm over edge and hem over the drip edge flashing to permit thermal movement of the roof panels at the eave edge.
 - .4 Ice Rake/snow retention system: Provide ice rake to match color of roof.
 - .1 Provide stainless steel clamp for attachment with a rounded set screw.
 - .5 Accessories to roof cladding: Brake or bend to shape, of same material comprising cap flashings, gable end flashing, eave troughs, corner flashing, and gable end center covers.
 - .1 Coloured to match outside wall pre-painted panels or as directed by Departmental Representative.
- .2 Interior Ceiling: Use PVC Panels. See Section 06 64 00.

2.4 WALL COMPONENTS

- .1 Refer to Section 04 20 00

2.5 FLASHING/TRIM

- .1 Provide flashings and trim at corners (inside and outside), openings, wall - ceiling connection, end of panel finish (J-trim), and where they are required to provide weather tightness and a finished appearance.
 - .1 Same material and finish as adjacent material, profile to suit. Minimum metal thickness to be 0.61 mm (24 ga).
 - .2 Details may or may not be shown on the plans.
- .2 Provide closed cell laminated polyethylene foam filter, in the same configuration as the panels, for use at all locations where closure is required for weather and bird tightness.
- .3 Use fascias, flashing, closures and caulking to ensure water tightness at wall - ceiling connection.
- .4 All fascias, flashing etc. shall be factory painted to match steel panels.
 - .1 Minimum thickness to be 0.61 mm (24 ga).
- .5 Use prepainted flashings at building support structures, openings and other locations where a neat finish with a 6 mm or less opening tolerance is obtained.
- .6 Door frames: provide a "J" trim around all door frames regardless if door frame matches wall width or not. Where wall width does not match door frame fabricate "J" trim to account for difference in thicknesses.
- .7 Ridge Flashing: Exterior - provide pre-painted and of same or heavier gauge as roof panel formed panel in the same configuration as the roof panels as a ridge cap. Bend and edges to be "factory" finished.
 - .1 Use continuous caulking tape under flashing to provide watertight seal
- .8 Ridge Flashing: Interior - provide bent liner ridge cap prepainted and same or heavier gauge as roof panel. Bend and edges to be "factory" finished.
- .9 Soffit panel at building wall – use prepainted "J" trim.
- .10 Gutter bracket: Use gutter bracket to place gutter away from wall. Use caulking tape under gutter bracket on roof panel. Ensure gutter bracket is screwed to "chair" used to hold roof panels.
- .11 Gable: Provide gable flashing to finish roof panel/fascia panel connection. Use caulking tape (continuous) under gable trim on roof.
- .12 Exterior vertical rigid insulation covering: provide metal flashing to cover below and above grade rigid insulation as indicated on the plans. Provide watertight seal such that water running down wall is directed over rigid insulation.
 - .1 Extend below finished grade a minimum of 600 mm or greater if indicated on the plans.
 - .2 Extend minimum 50 mm above curb top elevation or longer if indicated on the plans.
- .13 Ceiling to wall liner panel connections of interior roof: Install flashing at end of all ceiling panels (at wall) to cover ends and provide a neat finish. Slide panels into flashing. Butting ceiling panels to wall without a flashing strip IS NOT acceptable.

2.6 BUILDING ANCHORING

- .1 Use anchor bolts (drilled or cast in place).
- .2 Truss to Wall – Use galvanized cold formed hurricane ties of sufficient capacity to resist upward lift. Simpson StrongTie or approved equal.

2.7 BUTYL TAPE

- .1 3 mm x 12 mm.
- .2 100% solid polyisobutylene cross-linked butyl preformed sealant.
- .3 Tremco 440 tape or approved equal.

2.8 CASEMENT INTERIOR WINDOWS

- .1 Fixed casement windows shall be fixed sash, hermetically sealed units. The two glass panes shall be double glazed clear plate glass no less than 6.35 mm (1/4 in.) thick. The fixed glass windows and shall be warranted by the manufacturer for five years against film formation and dust collection between the interior glass surface.
- .2 Frame to be constructed of colored PVC or fiberglass and be completely maintenance free. Coloring to match doors and frames.
- .3 Ensure window openings between process room and vestibule are sealed.

2.9 CASEMENT EXTERIOR WINDOWS

- .1 Fixed casement windows shall be fixed sash, hermetically sealed units. The interior two panes shall be triple glazed clear plate glass no less than 6.35 mm (1/4 in.) thick. The exterior pane shall be low emissivity glass no less than 6.35 mm (1/4 in.) thick. The three panes shall be separated by an argon filled space of 4.75 mm to 12.75 mm (3/16 in. to 1/2 in.) wide. The fixed glass windows shall be warranted by the manufacturer for five years against film formation and dust collection between the interior glass surface.
- .2 Frame to be constructed of colored PVC or fiberglass and be completely maintenance free. Coloring to match doors and frames.

2.10 EAVESTROUGH

- .1 Pre-painted steel 0.45 m (26 gauge) as per plans.
 - .1 Eavestrough: 150 mm.
 - .2 Downspout: 100 mm x 125 mm.
- .2 Downspouts at corners.

2.11 CAULKING

- .1 Refer to Division 7.

2.12 DOORS AND DOOR FRAMES

- .1 Refer to Division 8.

2.13 ATTIC VENTILATION

- .1 Soffit ventilation free area is to be equal to 1 square metre per 150 square metre (1/150). Provide prefinished metal soffit vents.

- .2 Size and design vent in gable end as removable attic access hatch.
- .3 Ridge vent to free area is to be equal to 1 square metre per 150 square metre (1/150). Provide pre-finished ridge vent.

2.14 EXHAUST FAN AND DAMPER

- .1 See Section 23 33 00 Louvres, Intakes and Dampers.

Part 3 Execution

3.1 TRADESMEN

- .1 Erect building by tradesmen proficient in their respective trades.
- .2 Ensure manufacturer's erection manual is onsite.
- .3 Complete all assembly and erection of all wall and ceiling panels including tightening of screws in a manner to prevent warping, crinkling, ripples, dents and other such deformations. Replace panels that have warping, crinkling, dents and other such deformations.

3.2 BRACING

- .1 Brace structure in all directions to safely withstand all lateral forces which may be encountered during erection. Keep bracing in place until all permanent bracing, cladding and decking are in place.
- .2 Refer to Truss Plate Institute of Canada (TPIC) guidelines for the erection and bracing of roof trusses.

3.3 STORAGE

- .1 Never unload steel panels with one support, a minimum of two supports/slings must be used.
- .2 Store all panels in a dry location off the ground. Do not use any damaged panels.
- .3 Dry and immediately use any material that does become wet.
- .4 Keep panels clean during storage and assembly. Wash and clean all marks, dirt and other extraneous coatings.

3.4 CUTTING

- .1 Cut and bend all panels in straight lines.
- .2 Cut panels with methods that do not produce heat, flip panel over when cutting. Use an electric nibbler, electric shear or electric cold metal cutting saw with ceramic tipped blades with a catcher for the swarf (burr-free).
- .3 Final finish: No exposed cuts or projecting edges of sheet metal, all edges to be hemmed or covered with flashing.
- .4 At bottom of interior vertical wall panels ensure distance to Z flashing is constant as shown on the plans with a tolerance of no more than plus or minus 3 mm.

3.5 ERECTION (PRIMARY AND SECONDARY FRAMING)

- .1 Erect building in accordance with the instructions of the manufacturer, approved shop drawings and in a manner approved by the Departmental Representative.
- .2 To avoid buckling, carry panels on its edge, not on the flat.
- .3 Touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion or erection.
- .4 Erect to 1:500 tolerance.

3.6 ROOF ERECTION

- .1 Secure sheets to structural members; terminate sheet ends over structural supports.
- .2 Secure side laps.
- .3 Continuously seal end and side laps.
- .4 Install butyl tape full length between the male and female roof panel ribs.
- .5 Butt together joints, do not overlap.
- .6 Bolt to secure roof panels at both the eave and the ridge.
- .7 Provide flashing as indicated herein and on the plans and caulk at the eave, ridge and ribs.
- .8 Install ice rakes.

3.7 SEALANTS AND CAULKING

- .1 Sealants and caulking in accordance with Division 7.
- .2 Caulk with colour matched (same as flashing) silicone: Caulk to provide an air tight and watertight seal. Caulk all gutter and downspout joints, rake flashing laps, ridge flashing laps, doors, windows, louvers and all other openings. Clean all surfaces prior to caulking.

3.8 THERMAL INSULATION

- .1 Refer to Division 7.

3.9 PARTITIONS

- .1 Install one piece wall panel partitions ensuring end connections are flashed to make a neat finished wall.
- .2 Install closures and flashing.
- .3 Install horizontal support between studs as required to provide full support to prevent bending or deformation of liner panels when hand pressure is applied. Alternately decrease metal stud spacing.
- .4 Prior to locating partition door locate all furniture to ensure door does not provide any interference.

3.10 DEFECTIVE PANEL REPLACEMENT

- .1 Where screws are placed in locations that do not provide a straight line, miss support members or deform the panel due to improper tightening immediately replace panel in its entirety as the panel is deemed to be defective.

- .2 If a panel is scratched, cracked, dented, cut incorrectly or has other imperfections replace panel in its entirety as it is defective.
- .3 Failure to immediately replace a defective panel does not relieve the Contractor from future disassembly of multiple panels to replace defective panel(s).

3.11 SCREWS

- .1 For PVC liner panels, refer to Section 06 64 00.

3.12 FLASHINGS/TRIM

- .1 Install prepainted flashings and weatherstripping around windows and doors to provide an airtight seal. The overall building shall be sealed from water leakage and vapor barrier shall be continuous.
- .2 Ensure that no ethafoam or similar product is visible at any connection after works are complete. Use flashings to cover all such products.
- .3 Use flashings to “finish” all corners, cut outs, edges and other similar surfaces as described in Section 2 above.
- .4 Ensure flashing are installed full length with straight, clean edges without ripples, dents, crinkles, ripples and other such deformations. Minimize joints by using only full length pieces.
- .5 Door frames: Provide a “J” trim around all door frames regardless if door frame matches wall width or not. Where wall width does not match door frame fabricate “J” trim to account for difference in thicknesses.
 - .1 Fabricate coloured flashings as required to accommodate and finish area around perimeter of door frame for full width of door openings.
- .6 Interior walls bottom of liner panels: Use laser level to mark a straight line for installation of Z flashing. Ensure concrete floor below Z flashing is smooth and straight.
- .7 Fan, intake and other miscellaneous openings: Fabricate colored flashings (“J” trim) as required to accommodate and finish area around perimeter of door frame and other openings for full width of openings.

3.13 MISCELLANEOUS OPENINGS

- .1 Provide miscellaneous openings through the building walls and/or roof in accordance with the plans. Ensure structural integrity for all openings.
- .2 Install ductwork between equipment and motors to exterior openings in a neat manner. Ensure wall openings line up on the same plane in all directions with equipment to be connected with ductwork to the exterior. Obtain and confirm dimensions of all equipment to be serviced prior to cutting or placing wall openings to ensure proper alignment and placement of openings.
- .3 Co-ordinate with other Divisions for all required openings for electrical and mechanical works that penetrate the exterior wall. Frame in all openings for all mechanical and electrical works to ensure all penetrations are neat with a continuous insulation and vapor barrier. Provide additional support in wall to accommodate the equipment.

3.14 EAVESTROUGH

- .1 Complete all downspout works in a neat manner ensuring that all piping is as close to vertical or horizontal as possible (no diagonal runs).

- .2 Install to prevent all water from the roof from coming in contact with the vertical sidewalls.
- .3 Rivet together all eavestrough and fittings such as corners and bends, caulk edges after riveting.
- .4 Provide a downspout outlet "fitting" to connect downspout to eavestrough. Caulk fitting to eavestrough and ensure edges are sealed watertight to prevent dripping.
- .5 Provide clips to securely attach assembly.
- .6 Install concrete splash pad at eavestrough downspout according to plan.

3.15 CAVITY WALL INSULATION

- .1 Refer to Division 7.

3.16 PAINTING

- .1 Provide touch-up paint for all interior or exterior surfaces to match factory finish. Supply minimum 500 ml of touch up paint of each type used in the building.
- .2 Touch up of panels that are scratched or marked during installation is not permitted, such panels are to be deemed defective.

3.17 WALL MOUNTED EQUIPMENT

- .1 Coordinate the location of all wall mounted equipment with other trades. i.e. fire extinguishers, control panels, hose reels, heaters, etc. Install 19 mm plywood in the wall cavity to allow for mounting the equipment. Size mounting board 150 mm larger than equipment in all directions and a minimum size of 600 mm x 600 mm.

3.18 ATTIC VENTILATION

- .1 Install pre-finished soffit vent in a manner to maintain maximum free area and airflow.
- .2 Install pre-finished ridge vent in a manner to maintain maximum free area and airflow. Refer to manufacturer instructions for installation procedures.
- .3 Install gable end vent as per plan.

3.19 CLEAN UP

- .1 Upon completion and before final acceptance of work, the Contractor shall remove from within the limits of the works all machinery, equipment, surplus materials, falsework, excavated and useless materials (ie. metal scrap, concrete debris, rubbish or temporary buildings, barricades and signs) to the satisfaction of the Departmental Representative.
- .2 Sweep, clean and wash down building floor. Clean all drains of debris and flush. All siding, interior paneling, interior ceiling shall be wiped down and washed to provide a clean surface without streaks, dust or marks.
- .3 Remove all stickers from glass and polish glass surfaces.
- .4 Wipe down all furniture and polish as directed by Departmental Representative.

END OF SECTION

DIVISION 21

FIRE SUPPRESSION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Fire Extinguisher.
- .2 Model numbers for various laboratory and safety equipment herein specified may have changed, obtain approval from Departmental Representative for the most current alternative to that specified.

1.2 REFERENCES

- .1 UL 711 (2018), Rating and Fire Testing of Fire Extinguishers.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for hardware complete with pertinent details, colour charts, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 - Closeout Submittals.

1.4 COORDINATION

- .1 Provide Departmental Representative equipment check off list. Review list prior to completion of work.

Part 2 Products

2.1 FIRE EXTINGUISHER

- .1 Provide 4.5kg rechargeable aluminum cylinder dry chemical fire extinguisher with wall bracket located near each exit door and as per the following:
 - .1 Stored pressure rechargeable type with hose and self-closing lever or squeeze-grip operation, fully charged, ULC labelled for A, B and C class protection.
 - .2 Provide suitable plastic backing on wall. Coordinate location with Departmental Representative.
 - .3 Locations: Vestibule - 1, Electrical Room – 1, Process Room - 2.
 - .4 Coordinate mounting locations with Departmental Representative.

Part 3 Execution

3.1 FIRE EXTINGUISHER

- .1 Mount fire extinguisher on wall.

END OF SECTION

DIVISION 22

PLUMBING, MECHANICAL

Part 1 General

1.1 GENERAL

- .1 In addition to the requirements of Division 1, this section shall apply to and govern all sections of Division 22, 23, 40 and 46.
- .2 Supply of various mechanical components are included in Divisions other than Divisions 22, 23, 40 and 46. Be responsible to:
 - .1 Review all specification sections and all related shop drawings as prepared by other Divisions but related to required mechanical Works.
 - .2 Coordinate Work with other trades such as electrical to ensure all components are operational and integrated as required by the contract documents.
 - .3 Supply materials and complete Works as required to fully integrate and make Work operational if not specifically itemized in other Divisions.

1.2 REFERENCES

- .1 NSF/ANSI/CAN 61-2021; Drinking Water System Components – Health Effects.
- .2 CSA C390-10 (R2019); Test Methods, Marking Requirements, and Energy Efficiency Levels for Three Phase Induction Motors, Includes Update No. 1 (2015), Update No. 2 (2016), and Update No. 3 (2020).
- .3 IEEE 112-2017; IEEE Standard Test Procedure for Polyphase Induction Motors and Generators.
- .4 ANSI/NEMA MG 1-2016, with 2021 Revisions; Motors and Generators, Includes 2021 updates to Parts 0, 1, 7, 12, 30 and 31.

1.3 STANDARDS

- .1 Within the text of these specifications, reference is made to the following standards:
 - SAE - Society of Automotive Engineers.
 - ASTM - American Society of Testing Materials.
 - CSA - Canadian Standards Association.
 - ASME - American Society of Mechanical Engineers.
 - ANSI - American National Standards Institute
 - ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
 - SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
 - ULC - Underwriters' Laboratories of Canada.
 - EEMAC - Electrical Equipment Manufacturers' Association of Canada.
 - NEMA – National Electrical Manufacturers Association
 - NSF – National Science Foundation.

- .2 Equipment and materials to carry CSA, ULC or cUL approval and conform with applicable standards, no exceptions or alternatives.
- .3 All materials and products in contact with potable water to be NSF/ANSI Standard 61 certified.
- .4 Refer to Division 1.

1.4 GENERAL EXECUTION

- .1 Complete installation of all equipment as per manufacturer's installation instructions as required for the installation of all equipment supplied.
- .2 Co-ordinate delivery of all material and co-ordinate integration of all components.
- .3 Furnish approved manufacturer's drawings, instructions and shop drawings for the installation of all equipment.
- .4 Complete all start up and training as required for an operating system and as outlined in specifications. Start up and training most stringent as outlined in specifications.
- .5 Review Divisions 22, 25, 26 and 40 and other Divisions as applicable for electrical instrumentation and transmitters that must be installed with piping completed by mechanical. Install tees and fittings as required for such equipment and complete mechanical installations.
 - .1 Review shop drawings and follow manufacturer's recommendations.
 - .2 Provide shop drawings indicating fittings to be used with a clear presentation of location and dimensions of probe tip in respect to piping flows.
- .6 Prior to commissioning, cycle components and make adjustments as required to related process components.

1.5 TRAINING

- .1 Be responsible to review Section 01 79 00 Demonstration and Training and include training requirements as outlined in Section 01 79 00 in scope of work.

1.6 WORK OF OTHER TRADES

- .1 Cooperate and coordinate the Work specified in this section with the requirements of other units of Work specified in other sections.
- .2 Supply other Divisions with all necessary details, roughing-in drawings, wiring diagrams, etc. as required.
- .3 Check drawings of all Divisions to verify space and headroom limitations for Work to be installed. Coordinate Work with all Divisions and make changes to facilitate a satisfactory installation. Make no deviations, without prior approval of the Departmental Representative.

1.7 DOCUMENTS

- .1 Examine all drawings, specifications, including those of other sections for information affecting this section.
- .2 Refer to Specification and Drawing Index to assure that sets are complete at time of tender and during construction period, and request any missing information immediately.

- .3 Where drawings show installation of piping, ductwork, and equipment diagrammatically, install equipment and services with due regard to details of building structure and services provided by other trades, and maintain maximum accessibility and use of space.

1.8 INTENT

- .1 Work shall be in accordance with the Drawings and Specifications and their intent, complete with all necessary components to make the system ready for operation, including those components not shown or itemized.
- .2 Where contradictions in specifications and drawings are implied, obtain ruling from the Departmental Representative. Where ruling is not obtained, include the item or arrangement of better quality, greater quantity, or higher cost in bid price.

1.9 RELATED WORK SPECIFIED ELSEWHERE

- .1 Painting and Colour Coding: See Section 09 91 00 and 22 05 54.
- .2 Epoxy Floor Covering: See Section 09 96 56.
- .3 Electric wiring and connections - see Division 26.

1.10 SITE EXAMINATION

- .1 Examine all local and existing conditions on which the work is dependent.
- .2 No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site, or from conditions that could have been reasonably ascertained from a visit to site.
- .3 Provide for avoidance of damage and interference to existing work and rectify any damage due to work by this section.

1.11 SCAFFOLDING, RIGGING AND HOISTING

- .1 Provide scaffolding, rigging, hoisting and related installation services for work under this Division, except where otherwise specified. The scaffolding, rigging and hoisting provided shall meet Workplace Health and Safety regulations.

1.12 EQUIPMENT BASES

- .1 Provide bases as housekeeping pad to raise all equipment off floor minimum 100 mm. Do not install any mechanical or electrical equipment directly on floor.
- .2 Provide concrete bases (non shrink grout or concrete as per Section 03 30 00) in accordance with equipment manufacturer's recommendations and as per drawings.
- .3 Ensure new concrete is "tied" to existing concrete with drilled in place anchors.
- .4 Provide 10M or wire mesh as reinforcing steel to prevent shrinkage cracking.
- .5 Provide a chamfered edge.
- .6 Do not restrict future equipment servicing.
- .7 Size base as required for footprint of equipment plus 100 mm all around. Provide drains through bases if overall floor drainage is affected.
- .8 Provide shop drawings and obtain Departmental Representative's approval.

1.13 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.14 RECORD DRAWINGS

- .1 Refer to Section 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.15 WORKMANSHIP

- .1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by Design Authorities and the trade.
- .2 Perform work in a competent manner in accordance with the best practices ensuring the finished work is neat in appearance and to the Departmental Representative's satisfaction. Lack of skill on the part of the installer will not be considered in the acceptance or rejection of the work.
- .3 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance.
- .4 Install all piping true and plumb.
- .5 Do not use compression type coupling(s) to correct misalignment between pipes.
- .6 Assume full responsibility for the layout of the work and for any damage caused through the improper location of materials and through poor workmanship.
- .7 Employ only tradesmen holding valid Provincial Trade Qualification certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.
- .8 Welding shall be completed by a Certified Welder and in accordance to applicable CSA standards for the type of welding being completed.

1.16 PROTECTION OF WORK

- .1 Protect equipment and material stored or in place during construction from weather, moisture, dust and physical damage.
- .2 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.
- .3 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative.

1.17 DESIGN AUTHORITY'S APPROVAL

- .1 It is not incumbent upon the Departmental Representative to superintend the work so as to relieve the Contractor of any responsibility.
- .2 Permission to proceed does not constitute approval of the work, or portion thereof.
- .3 Approval of the work shall be made only upon the successful conclusion of tests and satisfactory performance under design operating conditions.

1.18 OPERATING AND MAINTENANCE INSTRUCTION

- .1 Instructions and training shall be as per section 01 79 00 Demonstration and Training.
- .2 Submit O&M manuals in accordance with Section 01 78 00 Closeout Submittals.

1.19 TEMPORARY USE OF EQUIPMENT

- .1 No portion of any mechanical system or equipment provided under Mechanical Sections may be used for temporary heating or ventilation.
- .2 See also - General Requirements - Division 1.

1.20 SUPPORTS, BASES AND PITS

- .1 Provide supports for piping such that valves, mixers, pumps, and other related equipment can be removed for servicing without affecting pipe alignment.
 - .1 Do not use equipment supports for pipe support. Support piping independent from equipment.
- .2 Supply and erect all special structural work required for installation of tanks, pumps, fans, motors and other apparatus.

1.21 IDENTIFICATION

- .1 Ensure that equipment name plates, showing size, name of equipment, serial number and all other information usually provided, including name and address of manufacturer, are not painted over or removed, and where apparatus is insulated, provide adequate viewing openings.

1.22 INSTALLATION AND ERECTION

- .1 Information involving building dimensions shall be taken from drawings and checked by site measurement.
- .2 Drawings show general location and route to be followed by pipes, ducts, etc. Make necessary changes or additions, at no charge, to accommodate site conditions.
- .3 Install piping and ductwork parallel to building walls and ceilings unless otherwise indicated.
- .4 Install all piping and ductwork to conserve headroom and to reduce interference to use of space while maintaining accessibility for service and maintenance.
- .5 Check all levels shown before commencement of work to ensure adequate falls for graded pipes and report discrepancies immediately. Failure to so check and report does not relieve this section from responsibility for consequent extra expenditures.
- .6 Before installation of fixtures, fittings and equipment, consult detail drawings or obtain instructions for each location where details are not available.
- .7 Ensure that where equipment is to be built in, it is available when required, or direct size of openings to be left.
- .8 Where work is to be concealed, install close to structure, so that furred spaces may be kept to a minimum.
- .9 Excavate as required to accommodate mechanical work and remove surplus excavated material from site.

- .10 Secure approval prior to cutting holes. Employ section whose work is involved, cut openings no larger than necessary and without damage to adjoining work, and provide for repair of all damage to match adjacent work. This Division is responsible for all required cutting and patching relating to work in this Division, unless specifically noted otherwise.
- .11 Prior to the cutting of any openings in walls, ensure that the wall does not serve a load bearing function. All openings in load bearing walls and other structural members shall be approved by the Departmental Representative.
- .12 Provide and set bolts, templates, sleeves and fixing materials for fastening work under this section so as to permit other work to continue.
- .13 Locate all openings in walls, partitions, beams, etc. required for installation of ducts, pipes and equipment, etc. specified in this Section of the specifications, and frame all openings as required.
- .14 Where applicable to maintain fire rating: Pack free area between ducts or pipes and openings or sleeves with fireproof self-supporting insulation material subject to Departmental Representative's approval, and in accordance with requirements of authority having jurisdiction to maintain required fire rating of wall or floor assemblies.
- .15 All sleeves other than those noted above, shall be caulked between pipes and floor sleeves or openings to prevent seepage. Caulking compound and method of application shall be to the Departmental Representative's approval. Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.
- .16 Prior to coring openings, locations are to be checked by the Departmental Representative. Diamond core drilling machinery shall be used for all concrete coring.
- .17 Oversize openings for ductwork or piping to allow vapour barrier insulation to run continuously through walls and floors.
- .18 Protect equipment and systems from entry of dirt, dust, and other foreign material with fittings or covers appropriate to the system.
- .19 Ensure wheels of carts or other lifting and moving devices have rubber tires and that method of moving heavy equipment does not mark the floor.
- .20 Pipe all valves or drain lines to drain.

1.23 VAPOUR BARRIER

- .1 Ensure all screws used to fasten equipment to the walls and ceiling provide a "seal" that maintains the vapor barrier.
- .2 Provide samples of screws, gaskets and materials to be used to fasten equipment and maintain vapour barrier as per Section 13 34 24 Wood Frame Buildings Systems.

1.24 DRIVE PROTECTION

- .1 Provide guards for all drives. Provide openings through guards to permit easy access for lubrication and use of test instruments.
- .2 Install belt guards so as to permit movement of motors for adjusting belt tension.
- .3 Flexible coupling guards shall be removable, "U" shaped, minimum 1.6 mm thick galvanized mild steel.

- .4 Provide non-ducted fan inlets or outlets with minimum 19 mm galvanized wire or expanded metal screens. Net free area of guard to be not less than 80% of fan openings.

1.25 GENSET

- .1 Genset supply including muffler, thimble and flexible connection equipment is in Div 26. Division 26 will hand over exhaust components to Mechanical Division 23 for installation. All exhaust piping to exterior shall be under Division 23.
- .2 Be responsible to obtain a Fuel Safety Inspection Report.
- .3 Complete all fuel supply Works to engine.

1.26 REGULATORY AGENCIES

- .1 Promptly advise the Departmental Representative of any essential work omitted from the Contract, or if any specified equipment, material or installation are in violation of codes, ordinances, rules or regulations or which appear inadequate or unsuitable.
- .2 Make changes and alterations required by inspection authority to comply with all codes and regulations without additional cost.

1.27 ELECTRICAL REQUIREMENTS

- .1 Electrical equipment and motors specified under this section shall comply with the requirements of the Electrical Division. This Division is responsible for confirmation of electrical characteristics.
- .2 Motors
 - .1 General: Squirrel-cage induction motors of sufficient mechanical and electrical characteristics to start and operate the loads noted with the motor at normal operating temperature without damage to the insulation. EEMAC design B or C, voltage, horsepower and enclosure as detailed. Provide thermistors in the windings of all motors, 50 H.P. and larger.
 - .2 Enclosure: Suited to the pertaining environmental conditions or area as required by electrical classification of the Canadian Electrical Code.
 - .3 Insulation: Class F to provide for a maximum winding temperature of 155°C at a unity service factor. Life expectancy when operated continuously at 155°C to be 61,000 hours.
 - .4 Service factor: 1.15
 - .5 Bearings: Anti-friction roller type with grease lubricant suitable for operation at -30°C to 150°C. Bearing life to be in excess of motor life expectancy.
 - .6 All motors 1 HP and larger shall be high efficiency motors meeting the minimum efficiency levels listed by Manitoba Hydro. The basis for establishing efficiency will be CSA C390 and/or IEEE 112B. The Departmental Representative will sign all applications necessary for the contractor to obtain rebates from Manitoba Hydro.
- .3 Control Wiring
 - .1 Temperature control systems specified in Division 22 may or may not include the supply of control wiring. It is the responsibility of this Division to ensure that the electrical contractor is advised of all control or auxiliary wiring requirements by way of the scope of work in Division 26. Should there be no specific

direction given in the electrical sections, this division must include for the electrical work related to this division.

- .2 Further, this Section shall expedite as quickly as possible, the submission of suitable wiring schematics and drawings for mechanical items to the electrical section, to ensure no delay in work or omissions during the progress of work.
- .4 Electrical equipment provided under this section shall be CSA approved and bear CSA labels. Motors shall be tested to NEMA MG-1 standards and conform to insulation resistance and dielectric strength.
- .5 Motors shall have conduit terminal boxes and adequate starting protective equipment as defined by the local power utilities.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All equipment listed above in Item 1.1.1. Include material data sheets, dimensional and layout data of all equipment. Indicate each type of fixture, proposed finish and accessories.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of all plumbing equipment for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 CERTIFICATION OF RATINGS

- .1 Published ratings shall be those from tests carried out by manufacturer or from independent testing agency signifying adherence to codes and standards.

1.4 QUALIFICATIONS

- .1 Use qualified workmen who are fully familiar with this work and have a working knowledge of the system components.
- .2 Be thoroughly familiar with governing regulations applicable to this project.

1.5 REFERENCES

- .1 National Plumbing Code of Canada – 2015.
- .2 Manitoba Building Code – 2011. ASME B16.24-2016, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500.
- .4 ASME B16.15-2018, Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
- .5 ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings.
- .6 ASSE (PLUMBING) 1013-2021, Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies.
- .7 ASSE (PLUMBING) 1015-2021; Performance Requirement for Double Check Valve Backflow Prevention Assemblies.
- .8 ASSE 1016-2017; Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations.
- .9 ASTM B75/B75M-20; Standard Specification for Seamless Copper Tube.
- .10 ASTM B88M-20; Standard Specification for Seamless Copper Water Tube (Metric).
- .11 ASTM F876-20b, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- .12 ASTM F877-20, Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.

- .13 ASTM F1807-19b, Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.
- .14 ASTM F1960-21, Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing.
- .15 ASTM F2080-19, Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (RE-RT) Pipe.
- .16 ASTM F2159-21, Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.
- .17 AWWA C510-17 (R2021); Double Check Valve Backflow Prevention Assembly.
- .18 AWWA C511-17 (R2021); Reduced-Pressure Principle Backflow-Prevention Assembly
- .19 CAN/CSA B45 Series-02 (R2018), Plumbing Fixtures.
- .20 CAN/CSA B64 Series:21, Backflow Preventers and Vacuum Breakers.
- .21 CSA-B125.3-18, Plumbing Fittings.
- .22 CSA B137:20 Series Package; Thermoplastic Pressure Piping Standards Package – Consists of all the CSA B137:20 Standards.

1.6 CODE REGULATION

- .1 Supply, design and install systems according to the Manitoba Building Code Section 7 and National Plumbing Code of Canada - 2015. Provide a copy onsite.

1.7 COORDINATION

- .1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

Part 2 Products

2.1 SHOWER VALVE

- .1 Thermostatic mixing valve with cast brass body, single handle control and durable brass faceplate.
 - .1 Showerhead to be chrome plated brass c/w chrome plated estrucheon wall flange and arm.
 - .1 Minimum flow rate of 5.7 L/min.
 - .2 12 mm NPT connections.
 - .2 All valve components to accessible from the front and be corrosion resistant.
 - .3 Valve actuator to respond to temperature and pressure fluctuations and maintain a preset setting.
 - .4 Valve to virtually shut off in event of cold water supply failure.
 - .5 Integral stops and checks.
 - .6 Polished chrome plated finish.
 - .7 Inlets/outlets: 12 mm NPT or 12 mm” sweat.

- .8 Single shower unit only.
- .9 Maximum operating pressure: 862 kPa.
- .10 Minimum flow: 3.79 L/min
- .11 Capacity: 19 L/min \pm 0.9 L/min at 310 kPa pressure differential.
- .12 Maximum hot water operating pressure to be 88°C.
- .13 Thermostatic mixing valve to perform to requirements of standards ASSE 1016 and CSA B125.3.

2.2 SHOWER ENCLOSURE

- .1 Cabinet sandwich panel construction, bonderized white baked enamel finish on galvanized steel.
- .2 Size: 813 x 813 x 2083 mm high.
- .3 Base: Molded stone or terrazzo with chrome plated brass strainer and tailpiece with 12mm entry height threshold.
- .4 Accessories: Soap dish, top cover, dome light and frosted glass shower door with continuous hidden hinge.
 - .1 Minimum glass thickness: 6 mm.
- .5 Manufacturer warranty: Minimum 5 years.

2.3 WATER CLOSET

- .1 Floor mounted, flush tank white in colour.
 - .1 Bowl: Vitreous china, syphon jet, elongated rim, close-coupled combination, bowl and bolt caps.
 - .2 Closet tank: Vitreous china with tank liner, flapper type flush valve, 4.8 litres/flush.
 - .3 Complete with seat cover as part of factory supply.
 - .4 Glazed trap, minimum 54 mm.
- .2 Isolation valve
 - .1 Provide chrome plated angle stops c/w chrome plated wall collar and chrome plated pipe extension.

2.4 LAVATORY SINK

- .1 Sink:
 - .1 White steel enameled or vitreous china self rimming sink, approximately 520 x 430 mm, complete with faucet/aerator/metal drain pop up with plated flange and stopper.
 - .2 102 mm center drillings.
 - .3 Concealed overflow.
 - .4 Meet requirements of CSA B45.
- .2 Faucet:
 - .1 Two handle deck mount for two hole, 102 mm center installation.
 - .2 With integral check stops, pop-up waste with tail piece.
 - .3 Solid brass fabricated body with polished chrome plated finish.

- .4 Brass stems with ¼ turn handle stops.
- .5 Approximately 130 mm long x 90 - 130 mm high rigid spout.
- .6 Minimum flow rate of 5.7 L/min. at 414 kPa.

2.5 BATHROOM COUNTER AND VANITY

- .1 Vanity – All exposed edges and surfaces finished with pre-finished white plastic laminate. Dimensions as per plans.
 - .1 Fully assembled construction.
 - .2 Two doors, three drawers, arched toe kick, concealed hinges.
 - .3 Built with poplar, natural wood veneer and engineered wood.
 - .4 Chrome hardware.
 - .5 Colour: White.
 - .6 Dimensions: 940 mm long x 650 mm depth x 910 mm high.
- .2 Counter – White laminate countertop complete with backsplash suitable for dimensions of supplied vanity cabinet.
 - .1 Sink – As specified in 2.4 above with faucets and pop up waste.

2.6 VESTIBULE VANITY, SINK AND FAUCET

- .1 Vanity – All exposed edges and surfaces finished with pre-finished white plastic laminate. Dimensions as per plans.
 - .1 Fully assembled construction c/w sink top.
 - .2 Single door, arched toe kick, concealed hinges.
 - .3 Built with poplar, natural wood veneer and engineered wood.
 - .4 White cultured marble top with integrated backsplash and sink, pre-drilled for a 4" faucet Chrome hardware.
 - .5 Colour: White.
 - .6 Dimensions: 457 mm long x 406 mm depth x 889 mm high.
- .2 Faucet – As specified in 2.4 above with faucets and pop up waste.
- .3 Garbage can – linear low density polyethylene with 27 L capacity.

2.7 FLOOR DRAINS

- .1 125 mm diameter nickel bronze strainer with a 50mm diameter outlet pipe, adjustable floor drain with tile flange for finished floor, drainage weepholes, and a lacquered or epoxy coated all cast iron body.
 - .1 Grate rating: General duty.
 - .2 Corrosion resistant stainless steel set screws.
 - .3 Three (3) units for process room, one (1) unit for washroom, one (1) unit for storage room.

2.8 ELECTRONIC TRAP SEAL PRIMER SYSTEM

- .1 Provide encloses electronic trap seal primer system
- .2 120VAC control unit with 24 hour timer with relay

- .3 Unit to include brass ball valve, stainless steel solenoid valve, lead free vacuum breaker and copper manifold with minimum six 12 mm supply lines.
- .4 Provide painted access door with Allen key lock
- .5 19 mm diameter supply water connection.

2.9 HOT WATER HEATER

- .1 Natural gas, tankless water heater, to be complete with:
 - .1 Provide ports for cold water supply, hot water, condensate drain, 19 mm NPT natural gas connection, fresh air vent and exhaust air vent.
 - .2 Provide air-fuel ratio sensor, exhaust and water temperature safety control and overheat cut-off fuse.
 - .3 Maximum size of unit to be 700 mm high, 500 mm wide and 350 mm deep.
 - .4 Minimum 5 year warranty on all parts and minimum 6 year warranty on heat exchanger.
 - .5 Provide integrated temperature controller capable of providing diagnostic information, fault history and heater set temperature.
 - .6 Unit to have copper primary heat exchanger and 316L stainless steel secondary exchanger.
 - .7 Minimum total continuous flow rate of 0.63 L/s @ 37.7 °C.
 - .8 Provide 2 units in parallel.
 - .9 Provide multi-unit controller as required

2.10 BACK FLOW PREVENTERS

- .1 Hose Bibb Connections:
 - .1 Atmospheric vacuum breaker to CSA B64.
 - .1 Plain brass body with silicone disc.
 - .2 Suitable for temperatures up to 82°C.
 - .3 Maximum operating pressure: 860 kPa.
 - .4 Size: As indicated.

2.11 DOUBLE CHECK VALVE BACKFLOW PREVENTER (< 50 MM)

- .1 Provide 38mm FPT double check valve backflow prevention assembly on the domestic water distribution piping to the building as indicated on plans.
- .2 The assembly shall consist of two positive seating check modules with captured springs and rubber seated discs, include two resilient seated isolation valves and four top mounted test cocks.
- .3 Assembly shall meet requirements of ASSE 1015 and AWWA C510.
- .4 Rate unit for vertical or horizontal use.
- .5 Applies to backflow preventer installed after water meter as shown on plans.

2.12 REDUCED PRESSURE ZONE BACKFLOW PREVENTER (< 50 MM)

- .1 Provide 25 mm FPT reduced pressure zone backflow prevention assembly on the domestic water distribution piping to the building as indicated on plans.

- .2 The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seated discs.
- .3 Includes two resilient seated isolation valves and four top mounted test cocks and an air gap drain fitting.
- .4 Provide air gap and drain piping for relief discharge. Coordinate with building sewer layout.
- .5 Assembly shall meet requirements of ASSE 1013, AWWA C511 and CSA B64.4.
- .6 Rate unit for horizontal use.
- .7 Applies to BFP-101.

2.13 SOFT SEATED CHECK VALVE

- .1 Silent check valve with silicone seat.
- .2 25 mm NPT female ends.
- .3 Rated for minimum 100 psi.
- .4 Lead Free.
- .5 Applies to CHV-102.

2.14 PIPE INSULATION

- .1 Refer to Section 22 07 20.

2.15 INTERNAL HOSE BIBBS

- .1 Each internal hose bibb shall be a 13 mm cast brass lawn faucet with a regular pattern and a separate tamper-proof vacuum breaker.

2.16 NON-FREEZE WALL HYDRANT

- .1 Wall hydrant for flush installation in exterior walls in areas subject to freezing. Chrome plated bronze head casting and valve, c/w satin finish nickel bronze face box with hinged locking cover, removable operating key, 20 mm and integral vacuum breaker. Length as required for wall thickness. Provide spare operating key.
 - .1 Supply one unit.
- .2 Provide isolation ball valve on inside of exterior wall for each wall hydrant.

2.17 EMERGENCY WATER MIXING VALVE

- .1 Solid bimetal thermostat directly linked to valve porting to control the intake of hot and cold water and compensate for supply temperature and pressure fluctuations.
- .2 Thermostatic mixing valve temperature field adjustable.
- .3 Locking temperature regulator to prevent accidental movement set for 29°C.
- .4 Mixing valve will close down on failure of cold water.
- .5 Mixing valve with internal cold water bypass capable of a minimum of 1.26 L/s @ 210 kPa upon failure of hot water supply.
- .6 Adjustable high temperature limit stops set for 32°C.

- .7 Isolation check valves on inlet and outlet.
- .8 Outlet thermometer.

2.18 EYE WASH SHOWER STATION

- .1 Eye Wash Bowl
 - .1 Twin eye wash outlets with 250 mm diameter yellow or orange impact resistant plastic bowl.
 - .2 Eye wash valve to be 12 mm diameter chrome plated brass stay open ball valve operated with highly visible PVC push handle. Push type hand control chrome plated brass ball valve to stay open until manually closed.
- .2 Shower.
 - .1 Impact resistant plastic shower head to deliver 1.26 L/sec @ 210 kPa.
 - .2 25 mm stay open ball valve with pull rod.
- .3 Auxiliary Drench Hose.
 - .1 Hand held for rinsing body with 2.4 m of hose and hand hook.
- .4 Floor flange base.

2.19 DOMESTIC WATER DISTRIBUTION PIPING

- .1 Pipe that is cast in concrete, placed inside walls or exposed in the process room and sized 25 mm to service the fine screen equipment, 19 mm to service the HWT and eye wash and 12 mm for the other fixtures.
 - .1 Piping: shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14 and NSF/ANSI 61.
 - .2 Pipe shall be rated for continuous operation of 690 kPa @ 82°C, and 550 kPa @ 93°C.
 - .3 All fittings shall be third-party certified to applicable standards ASTM F877, NSF/ANSI 14, NSF/ANSI 61 and CSA B137.5 and approved by the manufacturer's PEX piping system, with applicable plumbing and mechanical code certifications.
 - .4 Where fittings are encased in concrete or buried underground, fittings shall be wrapped as per manufacturer's recommendation to protect the material.
 - .5 Supports: Rust proof and as recommended by manufacturer.
 - .6 Use two colours, one for cold water and another for hot water.
 - .7 Provide a "bending spring" rated by Manufacturer for each pipe size, use bending spring for all field bends.
 - .8 Provide method to "protect" vertical piping above floor during concrete casting and building erection such that possible kinking is mitigated.
 - .1 Use a long sweep 90 degree PVC electrical conduit as a sleeve.
- .2 Wall mounted piping, except in the process room.
 - .1 Copper pipe: Type M (hard) to ASTM B88M. Solder for joints shall not contain any lead, i.e. nickel instead of lead. Solder type to ANSI/ASME B16.18.
 - .2 Fittings: Cast bronze to ANSI/ASME B16.15. Refer to Section 40 05 51.

2.20 SANITARY SEWER

- .1 Piping: PVC.
- .2 Fittings: PVC.
- .3 Joint: Solvent weld.

2.21 HOSE REEL - GENERAL

- .1 Hose reel with mounting hardware, 15 m length of 16 mm 100% rubber garden hose with threaded adapter ends, nozzle, and plastic wind up type with slide track method of wrapping hose on reel without physically handling hose.
 - .1 Provide "Gardenia" spray nozzle and threaded adapter ends with each hose reel.
 - .2 Provide two (2) units for wastewater trash removal building interior.

2.22 CLEAN OUT COVER

- .1 Provide watertight cover consisting of cast brass body with solid brass cap c/w gasket and stainless steel screws.

2.23 PROCESS ROOM WASH UP SINK

- .1 457 mm by 457 mm by 355 mm deep, floor mounted, one compartment sink with rectangular basin, and back splash.
 - .1 To be welded 304 stainless steel with satin finish
 - .2 Provide stainless steel hot and cold faucets.

Part 3 Execution

3.1 PLUMBING FIXTURES

- .1 Install hot and cold water piping as required to hook up, to manufacturers' recommendations, the shower, outside taps, sink and eye wash.
- .2 Secure all products to walls and floors (as applicable) with appropriate fasteners.
- .3 Install shut off valves on all hot and cold lines to fixtures.
- .4 Shower- finish installation so that hot and cold water lines are not exposed.
- .5 Shower enclosure: Provide P trap.
- .6 Adjust and set flush valve for proper flushing. Flush all pressure piping prior to installation of fixtures.
- .7 Complete all drain and vent works in accordance with Manitoba Plumbing Codes.
- .8 Provide water/air tight seal drain line through floor.

3.2 FLOOR DRAINS

- .1 Set floor drains for positive drainage. Top of floor drain to be in level position from edge to edge. Confirm and verify rim elevations prior to pouring of concrete.
- .2 Provide P trap ensuring P trap is placed to prevent mechanical damage.
- .3 Co-ordinate work with works in Division 3.
- .4 Complete all drain and vent works in accordance with applicable Plumbing Codes.

3.3 ELECTRONIC TRAP SEAL PRIMER SYSTEM

- .1 Install on vestibule wall as shown on plans.
- .2 Minimum height 900 mm above finished floor.

3.4 EYE WASH

- .1 Provide all materials to install eye wash station to manufacturer's recommendations.
- .2 Pipe hot and cold water to station and seal drain pipe at floor.
- .3 Install thermostatic mixing valves to regulate temperature to 29°C.

3.5 WALL HYDRANTS

- .1 Install wall hydrant with downward slope to exterior and isolation ball valves on interior supply line as well as a backflow preventer to prevent possible contamination of supply.

3.6 BACK FLOW PREVENTION DEVICES

- .1 Install and test to manufacturer's requirements, provincial plumbing code, and CSA B64.10.

3.7 PIPE AND FITTINGS

- .1 Follow pipe manufacturer's recommendations for the proper procedure for joints.

3.8 HOSE REELS

- .1 Mount reel(s) on wall 1 m from floor to centerline unless otherwise noted on the plans.
- .2 Connect hot and cold water supply c/w backflow preventers and shut-off ball valves to Y" mixing hose.

3.9 HOT WATER HEATER

- .1 Wall mount water heaters.
- .2 Gas connections and venting to meet all regulatory requirements. Field locate piping.

3.10 TESTING OF DRAINAGE OR VENTING SYSTEMS

- .1 All pipe in drainage system, except an external leader or fixture outlet pipe, must be tested to National Plumbing Code requirements below:
 - .1 Air pressure test at 35 kPa for at least 15 minutes without a drop in pressure.
 - .2 A water test of 3 m water column to all joints without visible leakage.
- .2 Departmental Representative reserves the right to request a Ball test to the National Plumbing Code.
- .3 Provide written description of system tests, record results and provide copies to Departmental Representative.

3.11 TESTING OF POTABLE WATER SYSTEMS

- .1 After a section of a potable water system has been completed, and before it is placed in operation, a water pressure test using potable water shall be conducted, except that an air pressure test may be done in freezing conditions.
- .2 Complete test in accordance with National Plumbing Code requirements below:

- .1 Air pressure test at 700 kPa for at least 2 hours without a drop in pressure.
- .2 A water test of 700 kPa for at least 2 hours without a drop in pressure.
- .3 Provide written description of system tests, record results and provide copies to Departmental Representative.

3.12 CLEAN UP

- .1 Polish and clean all fixtures prior to final inspection.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Pipe supports and hangers.

1.2 QUALIFICATIONS

- .1 Use qualified workmen who are fully familiar with this work and have a working knowledge of the system components.
- .2 Be thoroughly familiar with governing regulations applicable to this project.

1.3 ACCESSIBILITY

- .1 Install equipment and piping with headroom clearances for passage and operation.

Part 2 Products

2.1 HANGERS AND SUPPORTS

- .1 All pipe hangers, supports and brackets to be stainless steel.
- .2 Hangers for piping off walls and ceilings to be Anvil-Strut or Uni-Strut type.
- .3 Submit shop drawings for approval on all hangers and supports for piping and pumps.
- .4 Ensure all brackets and hangers used are constructed of rust proof materials.
 - .1 Use stainless steel in the wastewater trash removal building.

Part 3 Execution

3.1 HANGERS AND SUPPORTS

- .1 Install hangers to support all piping and equipment. If supporting a non rigid pipe on an exterior wall utilize supports as required to run pipe straight without "drooping".
- .2 Use sufficient hangers to restrain all piping and equipment from movement.
- .3 Ensure all brackets used are constructed of rust proof materials.
- .4 Do not support piping at excessively high elevations (as determined by Departmental Representative) above the plant floor. Minimize required support heights where ever possible.
- .5 Secure piping to the wall, floor and ceiling in a firm manner that results in "no movement" under all operating conditions.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Provide proposed and finalized list of mechanical and electrical lamacoid nameplates in electronic format MS Word, for review prior to engraving.
 - .2 Provide list of laminated plastic plate system/equipment tags in electronic format for review prior to engraving.
 - .3 Provide list of laminated plastic plate valve tags in electronic format for review prior to engraving.
 - .4 Provide type written panel directories to indicate equipment and location thereof by each circuit breaker.

1.2 REFERENCES

- .1 Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environment Managers (10 States Standards) - Recommended Standards for Wastewater Facilities (2014).

1.3 CLOSEOUT SUBMITTALS

- .1 Provide finalized valve tag list and neatly typed panel directories for incorporation into manual specified in 01 78 00 Closeout Submittals.

Part 2 Products

2.1 GENERAL

- .1 Refer to Correctional Service Canada - Technical Criteria Correctional Institutions for signage requirements in Correctional Institutions.

2.2 MANUFACTURER'S NAMEPLATES

- .1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
- .2 Provide Underwriter's Laboratories and CSA registration plates as required.
- .3 Manufacturer's nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.
- .4 Locate nameplates so that they are easily read. Do not paint over plates.

2.3 LAMACOID LABELS

- .1 All labels to be lamacoids.
- .2 Lamacoids to be 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws or adhesively attached. Dymo labels will not be accepted.
- .3 For shop drawing submission consider the following sizes and label on shop drawings.

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

- .4 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .5 Identification to be in English.
- .6 Securely fasten to equipment with screws or chains as required.

2.4 PIPING IDENTIFICATION

- .1 Identify medium in piping with markers showing name and service including temperature, pressure and directional flow arrows.
- .2 Paint pipe systems in conformance to CGS 1-GP0-60M for primary colour of paint. Selection of colours to be in accordance with 10 States Standards.
- .3 Complete painting in accordance with section 09 91 00.
- .4 Locate markers on piping so visible from floor, at start and end of runs and at each piece of equipment.
- .5 Table: Pipe and valve identification in accordance with the 10 States Standards. NOTE: For paint product numbers see Section 09 91 00.

Pipe Legend	Pipe Label	Colour
Fuel Oil	FUEL OIL	Medium Yellow
Vent Piping	VENT PIPING	Light Buff

- .6 Pipe Marking
 - .1 Provide custom pipe marker labels for the appropriate size pipes and number of labels identified in the table below. Adjust text sizes for different pipe sizes.

Label Name	Number Required	Pipe Size
FUEL OIL	2	25 mm
VENT PIPING	2	25 mm
DOMESTIC COLD WATER	7	25 mm
DOMESTIC HOT WATER	3	25 mm

- .7 Provide 3 rolls of pipe direction arrow markers.

2.5 SYSTEM LABELS GENERAL

- .1 Fasten labels securely and visibly providing standoffs where mounting not possible.
- .2 Identify equipment type and number using the identification system shown in the P&ID.

2.6 MECHANICAL SYSTEM IDENTIFICATION LABELS

- .1 Identify equipment type and number.
- .2 Legend Sample
 - .1 GAV = SLUICE GATE VALVE
 - .2 SOV = SOLENOID VALVE
- .3 Label all equipment, valves and process equipment as shown in the P&ID.
- .4 Prepare list of valves by grouping of valve type, with the headings Valve #, Valve Type, Size, Purpose and Normal Position.

2.7 ELECTRICAL SYSTEM IDENTIFICATION LABELS

- .1 To be completed by Division 26.
- .2 Install labels on electrical equipment with Lamacoid plastic engraving sheet.
- .3 Label each switch, switch unit, panelboard, receptacle, control panel, switchboard, motor starter, contactor, actuated valve, meter, etc. For disconnects, starters and contactors indicate equipment being controlled and voltage. Label all equipment as to identification including sequential numbering, descriptive purpose, circuit used and function or normal position.
- .4 Labels for terminal cabinets and junction boxes to indicate system and/or voltage.
- .5 Label terminal cabinets, splitters and pull boxes: indicate system and voltage.
- .6 Identify by Brady Markers neutrals in the panel and their associated circuit numbers.
- .7 Label all breakers with Lamacoid markers fastened with rivets.
- .8 Where multiple section panels are specified, number consecutively from one to the highest number. Two sets of identical numbers are not acceptable.
- .9 Provide typed panel directories indicating equipment and location of each circuit breaker. Securely mount directories, in transparent protective cover on inside of panel door.

2.8 VALVES, CONTROLLERS AND EQUIPMENT

- .1 Provide laminated plastic plate tags with 12 mm lettering and numbers. Secure directly to equipment and where not possible provide non-ferrous chains or "S" hooks.
- .2 Provide labels, for each type of chemical, on the spill tray and on bulk tanks.
- .3 Consecutively number valves in systems – incorporate tag descriptions.

Part 3 Execution

3.1 PREPARATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- .1 Tags:
 - .1 Install tags with corrosion resistant chains.
 - .2 Identify small devices with tags.

- .3 Tag automatic controls, instruments, and relays. Key to P&ID.
- .2 Pipe Markers:
 - .1 Install pipe markers to manufacturer's instructions.
 - .2 Identify piping. Include service, flow direction, and pressure.
 - .3 Identify piping 20 mm diameter and smaller with tags.
 - .4 Provide polyester self-adhesive pipe markers.
 - .5 Provide wrap-around polyester pipe markers as scheduled. Install wrap-around pipe markers completely around pipe.
 - .6 Install in clear view and align with axis of piping.
 - .7 Locate identification at maximum 6 m (20 feet) centers on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Manufacturer's catalogue literature related to installation and fabrication of insulation and PVC jackets for pipe, fittings, valves and jointing.
 - .2 Indicate proposed colours for the various pipe types.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for insulating materials with pertinent details and maintenance practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .2 ASTM C335/C335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
- .3 ASTM C411-19, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449-07(2019), Standard Specification for Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547-19, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics on Building Materials.
- .7 CGSB 51-GP-52MA (1989), Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .8 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .9 ULC 102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies (ULC S102).
- .10 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2021 Edition.
- .11 NFPA (Fire) 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 2021 Edition.
- .12 TIAC National Insulation Standards, Section 5: Commercial Piping (2013).

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store insulation in original packaging and protect from weather and construction damage.
- .2 Protect insulation from physical damage caused by dirt, water, snow, chemicals and mechanical.

1.5 QUALIFICATIONS

- .1 Applicator: Company specializing in performing the Work of this section with a minimum of three years of experience and a member of TIAC.

Part 2 Products

2.1 GENERAL

- .1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C411 and ASTM E 84.
- .3 Thermal Conductivity "k" shall not exceed 0.034 W/m. °C at 24°C mean temperature when tested in accordance with ASTM C335.
- .4 Thickness: 25 mm unless otherwise stated.

2.2 INSULATION

- .1 Formed fibrous glass or formed mineral fiber pipe insulation to ASTM C547 with factory applied vapour barrier jacket to CGSB 51-GP-52Ma.
 - .1 Factory molded to conform to piping.
 - .2 Thermal conductivity as stated above.
 - .3 Service temperature: 4°C to 150°C.
 - .4 Thickness: Minimum 25 mm thickness for nominal pipe sizes less than 25 mm diameter, minimum 50 mm thickness for nominal pipe sizes between 25 mm and 200 mm diameter.

2.3 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum 50 mm wide minimum.
- .2 Contact adhesive: Quick setting, washable.
- .3 Tie wire: 1.5 mm diameter stainless steel.
- .4 Bands: stainless steel, 20 mm wide, 0.5 mm thick.
- .5 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips. Length of pin to suit thickness of insulation.

2.4 INSULATION CEMENT

- .1 To ASTM C449/C449M.
- .2 Hydraulic setting or air drying on mineral wool, to ASTM C449.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

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

2.7 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CGSB 51-GP-53 with pre-formed shapes as required.
 - .2 Color of PVC pipe and fitting jacket, as manufactured:
 - .1 Domestic water piping – White
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.56 mm.
 - .7 Fastenings:
 - .1 Standard to manufacturer.
 - .8 Special requirements:
 - .1 Indoor: flame spread rating 25. Smoke developed 50.
 - .2 Outdoor: UV rated material at least 0.5 mm thick.
 - .9 Covering adhesive: Compatible with insulation.

Part 3 Execution

3.1 GENERAL

- .1 Install insulation and PVC jackets for all piping as follows:
 - .1 Domestic cold water above floor to hot water tank.
 - .2 Domestic hot and cold water to eyewash/shower.
 - .3 All piping above 2.1 m.
 - .4 Refer to P&ID for additional insulating locations.

3.2 APPLICATION

- .1 Apply insulation to pipe and fittings after pressure tests are completed and approved.
- .2 Complete work by licensed journeymen.
- .3 Surfaces shall be clean and dry during application of insulation and finishes.
 - .1 Do not install any insulation material if it becomes wet because of transit or job site exposure to moisture or water.
- .4 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified herein.
- .5 Install insulation and jackets with smooth and even surfaces.
- .6 Ensure all exposed surfaces are clean after installations.

3.3 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B and manufacturer's recommendations.

- .2 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering; with full length section and tight to insulated object.
- .3 Preformed: Sectional up to 300 mm, sectional or curved segmented above 300 mm.
- .4 Multi-layered: Staggered butt joint construction.
- .5 Vertical pipe over 75 mm: insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate 4.5 m centers.
- .6 Seal and finish exposed ends and other terminations with insulating cement.
- .7 Provide vapour retarder as recommended by manufacturer.
- .8 Finish joints so they will shed water and are completely sealed.
- .9 Do not apply PVC jacketing too tightly. Slide joints plus PVC thickness must work together to prevent cracks and puckering.
- .10 Use PVC cement sparingly as heavy application can cause puckering and cracks.
- .11 Use clear caulk/adhesive.
- .12 Maintain factory colour of jacket throughout.
- .13 Flanges and unions at equipment, valves, components requiring regular maintenance: install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.

3.4 FASTENINGS

- .1 Secure pipe insulation by tape at each end center of each section, but not greater than 900 mm on centers.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Manufacturer's catalogue literature related to installation and fabrication of insulation, accessories and jointing recommendations.
 - .2 Pipe fittings insulation.
 - .3 Pipe insulation protection shields.

1.2 REFERENCES

- .1 ASTM E84-21a; Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Manitoba Building Code – 2011.
- .3 National Building Code of Canada – 2015.
- .4 NFPA (Fire) 255; Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.
- .5 TIAC Mechanical Insulation Best Practices Guide (2013).
- .6 ULC 102; Standard Method of Test for Surface Burning Characteristics of Building Materials (ULC S102).

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for insulating materials with pertinent details and maintenance practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Perform work by Journeymen insulators skilled in this trade.
- .2 Apply insulation in a workmanlike manner so that the finished product is uniform in diameter, smooth in finish, pleasing to the eye with all longitudinal seams.
- .3 Apply insulation to piping and equipment only after all tests are successfully completed.
- .4 Ensure that sufficient space is provided to allow proper installation of insulation.
- .5 As applicable, use the TIAC Mechanical Insulation Best Practices Guide as the basis of determining material specification if not contained herein. Use materials with a flame spread rating of not more than 25 and a smoke developed rating of not more than 50 when determined in accordance with ASTM E84, ULC/CAN S102, or NFPA 255 and the Manitoba Building Code.
- .6 No materials containing asbestos shall be used.

1.5 SUBMISSION OF SAMPLES

- .1 Submit samples of the proposed insulation materials to the Departmental Representative for acceptance prior to commencement of the work.

1.6 CO-ORDINATION WITH OTHER TRADES

- .1 Supply all necessary instructions to other trades for sizing hangers, providing access and scheduling of work. Complete phases of the work as required to permit the work of other trades to continue without interruption and in accordance with the schedule.

Part 2 Products

2.1 GENERATOR EXHAUST PIPE INSULATION

- .1 Stand-by generator exhaust piping: From 150 mm off manifold connection including muffler and to 150 mm beyond roof or exterior wall surface.
- .2 Insulation shall be high temperature hydrous calcium silicate pipe insulation, molded to conform to piping. The insulation shall have a thermal conductivity of 0.090 W/m °C at 600 °C mean temperature.
- .3 Insulation thickness to be minimum 50 mm.

2.2 PIPE FITTINGS

- .1 Insulate pipe fittings with Mitred Sections or Built-up shapes of insulation.

2.3 ADHESIVES, COATINGS AND SEALERS

- .1 Adhesives, coatings and sealers shall be in strict accordance with the insulation manufacturer's recommendations, permanent in nature, waterproof when set, of approved smoke and flamespread ratings and be completely compatible and suitable for the finish to be applied.
- .2 Cover exposed pipe insulation with 0.25 mm aluminum jacket, complete with integral vapour barrier.

2.4 PIPE INSULATION PROTECTION SHIELDS

- .1 Use pipe insulation protection shields at supports for insulated pipe.

2.5 MUFLER/ETC.

- .1 See Division 23 for supply of muffler, wall thimble and exhaust piping. Be responsible for items not listed in Division 23.

Part 3 Execution

3.1 GENERATOR EXHAUST PIPE

- .1 Complete neat exhaust pipe opening through wall. Field locate height and co-ordinate with Division 4 and 13. Place opening on the exterior and extend piping horizontal 300 mm past the soffit and all other building components.
- .2 Apply insulation to clean, dry surfaces of straight run piping and firmly butting joints. Insulation to be securely fastened with 1.024 mm(18 gauge) stainless steel tie wire at no more than 300 mm centers. Fill any voids or openings in insulation with Manson Insulating cement.

- .3 Insulate all fittings except as specifically noted otherwise to a thickness equal and matching the pipe insulation with sections of mitered insulation or built-up shapes. Securely fasten with 1.024 mm (18 gauge) stainless steel tie wire.
- .4 Install stainless steel jacketing and vapour barrier, with all joints lapped a minimum of 50 mm and secured with 12 mm x 0.38 mm aluminum bands on 300 mm centers. Finish for fittings to match that of straight pipe.

END OF SECTION

DIVISION 23

HVAC

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Manufacturer's catalogue literature related to installation and fabrication of ductwork insulation and jointing recommendations.

1.2 REFERENCES

- .1 ASHRAE 90.1-2019 (I-P); Standard 90.1-2019 (I-P Edition) -- Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI Approved; IES Co-sponsored).
- .2 ASTM B209/B209M-21a; Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM C411-19; Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449-07(2019); Standard Specification for Mineral Fiber Hydraulic- Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C553-13(2019); Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .6 ASTM C921-10(2015); Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
- .7 ASTM E84-21a; Standard Test Method for Surface Burning Characteristics of Building.
- .8 ULC 102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies (ULC S102).
- .9 CGSB 51-GP-52Ma (1989); Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .10 TIAC National Insulation Standards, Section 6: Commercial Ductwork and Plenum (2013).

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for insulating materials with pertinent details and maintenance practices for incorporation into manual specified in 01 78 00 – Closeout Submittals.

1.4 QUALIFICATIONS

- .1 Applicator: Company specializing in performing the work of this section with a minimum of three years of experience and a member of TIAC.

Part 2 Products

2.1 GENERAL

- .1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C411 and ASTM E84.

2.2 MINERAL FIBER INSULATION

- .1 Insulate ductwork with rigid mineral fiberboard or flexible mineral fiber insulation to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
 - .1 Thickness: 50 mm with an installed RSI rating of 1.06.
 - .2 Maximum "k" factor: to ASTM C553.

2.3 ACCESSORIES

- .1 Vapour retarder lap adhesive to be water based, fire retardant, compatible with insulation.
- .2 Insulating Cement: Hydraulic setting on mineral wool, to ASTM C449.
- .3 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .4 Tape: Self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .5 Contact adhesive: Quick-setting.
- .6 Tie wire: 1.5 mm stainless steel.
- .7 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .8 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .9 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

2.4 JACKETS

- .1 Aluminum:
 - .1 To ASTM B209 with moisture barrier.
 - .2 Thickness: 0.40 mm sheet.
 - .3 Finish: Stucco embossed or corrugated.

Part 3 Execution

3.1 GENERAL

- .1 Install insulation for all ductwork as follows:
 - .1 Outside air inlet ductwork.
 - .2 Exhaust Fan exhaust air ductwork.
 - .3 Heat Pipe exhaust and intake ductwork.
 - .4 Genset intake and exhaust.

- .2 Refer to P&ID for additional insulating locations.

3.2 APPLICATION

- .1 Apply insulation to ductwork after tests have been completed and approved.
- .2 Surfaces shall be clean and dry during application of insulation and jackets.
 - .1 Do not install any insulation or jacket material if it becomes wet because of transit or job site exposure to moisture or water.

3.3 INSTALLATION

- .1 Complete work by licensed journeymen.
- .2 Install in accordance with TIAC National Standards.
- .3 Install insulation, accessories and jackets to manufacturer's recommendations.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Seal all tears, punctures and other penetrations of the vapour barrier facing.
- .6 Ensure installation of insulation allows for removal of intake bug screens.
- .7 Install insulation and jackets with smooth and even surfaces.
- .8 Ensure all exposed surfaces are clean after installations.
- .9 Install insulation with the foil backing as the finished surface. Finish corners with aluminum jacket material and tape.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Thermostats.
 - .2 Timers.
 - .3 Humidistat's.
 - .4 Starters and Control Panels.
 - .5 All related accessories and/or Spare Parts.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed operation and maintenance data and revised shop drawings for HVAC instrumentation and controls illustrating the operation of equipment and maintenance practices for incorporation into manual specified in 01 78 00 – Closeout Submittals.

1.3 QUALITY ASSURANCE

- .1 System control contractor shall have a minimum of five years business experience in the installation of heating, ventilation and air conditioning controls.

1.4 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
- .2 Manitoba Building Code.
- .3 Canadian Electric Code.
- .4 Canadian Standards Association (CSA).

1.5 COORDINATION

- .1 Coordinate Electrical work with Division 26.

1.6 INDOOR CONDITIONS

- .1 Controls in the process room to be Class I, Division 2 rated.

Part 2 Products

2.1 GENERAL

- .1 Provide all miscellaneous devices, hardware, software, control panel, temperature sensors and programming as required for a complete operating system according to the sequences of operation and points schedules. Refer to plans and specifications for additional details.

2.2 EXHAUST FAN THERMOSTAT

- .1 Line voltage, wall-mounted thermostat.
- .2 Full load rating: 16 A at 120 V.

- .3 Temperature setting range: 5°C to 30°C.
- .4 Markings in 5 degree increments.
- .5 Differential temperature fixed at 2 degrees C.
- .6 Switch type: To suit application.
- .7 Colour: White.
- .8 Provide accessories for wall mounting.

2.3 EXHAUST FAN TIMER

- .1 120 volt line voltage spring wound timer with "OFF" at end of selected time period.
- .2 Range: 0 – 2 hours with 20 minute increments.
- .3 Colour: White.

2.4 EXHAUST FAN HUMIDISTAT

- .1 120 volt line voltage humidistat.
- .2 Adjustable range: 20% to 80% relative humidity.
- .3 Colour: White.
- .4 Accessories for wall mounting.

2.5 STARTERS AND CONTROL PANELS

- .1 Provide starters and control panels as required.

2.6 GENSET

- .1 Provide genset HVAC control panel with NEMA 4X enclosure.
- .2 Panel will receive run signal from genset
- .3 Panel to include an electronic temperature controller c/w temperature sensor mounted in the electrical room, outside the panel. Controller to provide modulating control for the genset dampers.

2.7 GAS SENSORS

- .1 Supplied by Division 40.

Part 3 Execution

3.1 EXAMINATION

- .1 Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to a point where work may properly commence.
- .2 Notify Departmental Representative of conditions detrimental to the proper and timely completion of work.
- .3 Do not begin work until all unsatisfactory conditions are resolved.

3.2 SEQUENCE OF OPERATION

- .1 Process Room Inline Fans IF-1 & IF-2, and Duct Heater DH-1:
 - .1 Process Room inline fans IF-1 & IF-2 will energize and de-energize on a switch. The operation of IF-1 & IF-2 will be interlocked with intake dampers D-9 and exhaust damper D-8. Upon a call for IF-1 & IF-2 to operate, damper D-9 will open and damper D-8 will open. Damper D-9 and damper D-8 will close when IF-1 & IF-2 are not operating.
 - .2 Duct heater will be controlled by an adjustable duct mounted thermostat. When the duct outside air supply temperature falls below the adjustable set point, the duct heater will energize to heat the air.
- .2 Process Room Exhaust Fan EF-1:
 - .1 Process room exhaust fan EF-1 will operate at low speed when when BTH-101 is greater than a selectable set point in the PLC (approx. 10°C). The fan will also energize and de-energize on low speed by an adjustable timer switch. The fan will operate on high speed when any of gas sensors CH₄-101, CH₄-102, CH₄-103, H₂S-101, H₂S-102 or H₂S-103 reach their selectable setpoint input into the PLC. The operation of EF-1 will be interlocked with intake dampers D-7 and exhaust damper D-6. Upon a call for EF-1 to operate, damper D-7 will open and damper D-6 will open. Damper D-7 and damper D-6 will close when EF-1 is not operating. The main plant PLC will provide a contact advising when EF-1 is to run based on the gas sensors or the exterior temperature.
- .3 Electrical Room Exhaust Fan EF-2:
 - .1 Exhaust fan EF-2 will operate when the electrical room inside temperature is greater than a selectable high set point thermostat (approx. 23°C). The fan will also energize and de-energize by an adjustable timer switch. The adjustable timer switch will bypass the temperature logic. The operation of EF-2 will be interlocked with intake dampers D-1 and exhaust damper D-5. Upon a call for EF-2 to operate, damper D-1 will open and damper D-5 will open. Damper D-1 and damper D-5 will close when EF-2 is not operating.
- .4 Washroom Exhaust Fan EF-3:
 - .1 Exhaust fan to be energized and de-energized by the washroom light on/off switch.
- .5 Genset
 - .1 Genset Start up:
 - .1 Default positions: intake air damper D-1: – closed; exhaust air damper D-2– closed; return air damper(s) D-3 and D-4 – open. All dampers modulating type.
 - .2 On a signal from a Genset running relay to the damper controller, outside air intake damper D-1 opens to minimum adjustable position of 15 % open as set by adjustment potentiometer to allow for combustion air intake. Above 15% damper modulates with dampers D-2, D-3 and D-4 to maintain room temperature adjustable set point of 22° C. Damper D-1 to be spring return to open and power to close.
 - .3 Exhaust air damper D-2 initially closed shall modulate open upon genset start. Control is via a 4 - 20 mA signal according to adjustable space temperature. The damper is to be closed below the adjustable 22° C set

point providing the return air dampers D-3 and D-4 are open. Above 22° C on sensing an increase in space temperature from the electrical room control thermostat, damper D-2 to modulated open to maintain space temperature set point. Damper D-2 to have spring return to open and power to close.

- .4 Re-circulating air dampers D-3 and D-4 initially open upon genset start shall modulate from open to closed (open on low end of temperature scale, closed on high end of temperature scale) via a 4 - 20 mA signal in order to maintain building space temperature. Damper D-3 and D-4 to spring return to open and power to close
- .2 Controller and room thermostat to modulate outside air, re-circulating air and discharge air dampers to maintain set point of 22°C. Set point to be adjustable between 18° C and 30° C.
- .3 Genset shut down:
 - .1 Minimum position of D-1 to inactivate. Dampers D-1, D-2, D-3 and D-4 modulate to maintain the space set point temperature during the cool down period of the genset. Dampers D-1 and D-2 to close and dampers D-3 and D-4 to open upon reaching the set point.

3.3 INSTALLATION

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

3.4 INTERLOCKING AND CONTROL WIRING

- .1 Provide all interlocks and control wiring. All wiring shall be installed neatly and professionally, in accordance with specification Division 26 and all national, provincial and local codes.

3.5 TRAINING

- .1 Provide instrumentation/application technician to instruct in operation of systems and equipment.
- .2 Provide systems demonstration as per Section 01 79 00.
- .3 Provide training manual with trouble shooting guide.

3.6 COMMISSIONING

- .1 Provide systems commissioning as per Section 01 91 13.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Galvanized and flexible ductwork.
 - .2 Tape and sealants.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM A480/A480M-20a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .3 ASTM A635/A635M-15, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
- .4 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .5 ULC 110; Standard Methods of Test for Air Ducts (CAN/ULC S110-13).
- .6 NFPA (Fire) 90A; Installation of Air Conditioning and Ventilating Systems, 2021 Edition.
- .7 HVAC Duct Construction Standards - Metal and Flexible, 4th Edition (ANSI/SMACNA 006-2020).
- .8 HVAC Air Duct Leakage Test Manual, 2nd Edition.
- .9 UL 181; Factory-Made Air Ducts and Connectors.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data and revised shop drawings for ductwork and accessories with pertinent details and maintenance practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.4 LOCATION

- .1 Co-ordinate ductwork locations of with electrical trade to eliminate conflicts i.e. lights.
- .2 Provide minimum 2.2 m headroom above all floors, catwalks and platforms.
 - .1 For stairways, provide a minimum of 2.2 m headroom from the top of the stairway over the entire length of the stairway.

Part 2 Products

2.1 GALVANIZED DUCTWORK

- .1 Provide galvanized steel low pressure ductwork for supply and exhaust air systems as indicated on the drawings.

- .2 Construct ducts of galvanized steel, of lock forming quality and having zinc coating to ASTM A653/A653M designation for both sides.
- .3 Use sheet metal screws to secure joints.
- .4 Use water resistant, fire resistive duct sealants that are compatible with mating materials.
- .5 Provide angle iron, channels, rods and related supporting materials to support ductwork. All ductwork support material is to be galvanized.
- .6 Provide ductwork constructed of galvanized steel sheets as follows:

TYPE	MAXIMUM DIMENSION	GAUGE	JOINTS
Rectangular with Pittsburgh Longitudinal Seam	up to 300 mm	26	S & drive
	325 mm to 750 mm	24	S & drive
	775 mm to 1,275 mm	22	25 mm bar slip or standing T @ 1,500 mm O.C. maximum
	1,300 to 1,500 mm	20	As above with 40 mm bar slip or standing T.
	1,525 to 2,250 mm	18	As above, in addition provide 40 mm x 40 mm x 5 mm angle reinforcement at 750 mm on center

Note: Cross break all ductwork greater than 150 mm.

2.2 SEAL CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure (Pa)</u>	<u>SMACNA Seal Class</u>
500	C
250	C
125	C
125	Unsealed

- .2 Seal classification:
 - .1 Class A: Longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: Longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
 - .3 Class C: Transverse joints and connections made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed.
 - .4 Unsealed seams and joints.

2.3 FLEXIBLE DUCTWORK

- .1 Comply with requirements of CAN/ULC S110, UL181 and NFPA 90A.

- .2 Factory fabricated to CAN/ULC S110.
- .3 Flame spread rating not to exceed 25 and smoke developed rating not to exceed 50.
- .4 Metallic Uninsulated: spiral wound flexible aluminum.
 - .1 Performance:
 - .1 Factory tested to 1000 Pa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
- .5 Metallic Insulated: spiral wound flexible aluminum with factory applied, 25 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl or reinforced mylar/neoprene laminate jacket.
 - .1 Performance:
 - .1 Factory tested to 1000 Pa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Thermal loss/gain: $1.3 \text{ W/m}^2 \cdot ^\circ\text{C}$. mean.

2.4 FABRICATION

- .1 Where any dimension of duct exceeds 450 mm cross break all sides for rigidity. Open corners are not acceptable.
- .2 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.
- .3 Construct tees, bends and elbows with centerline radius of not less than 1.5 times width of duct in plane of rotation.
 - .1 Where not possible, and where square turn elbows are used, provide airfoil turning vanes.
 - .2 Where acoustical lining is required, provide turning vanes of perforated metal with internal mineral fiber cores.
- .4 Increase duct sizes gradually, not exceeding 15° divergence wherever possible.
 - .1 Maximum divergence upstream of equipment to be 30° to 45° convergence downstream.
 - .2 Angles are measured as total included angle (both sides).
- .5 Rigidly construct low pressure metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag.
 - .1 Caulk duct joints and connections with approved sealant.
- .6 Provide offsets where low pressure ductwork conflicts with piping and structure. Where offsets exceed 10% of duct area, split into two ducts maintaining original duct area.
- .7 Fabricate plenums and casings to configurations shown on drawings.
 - .1 Construct plenums of galvanized panels joined with standing seams on outside of casing riveted or bolted on approximately 300 mm on centers.
 - .2 Reinforce with suitable angles and provide diagonal bracing as required.
 - .3 Tightly fit at apparatus and caulk with sealant.

2.5 SEALANT

- .1 Sealant Oil resistant, polymer type flame resistant duct sealant. Temperature range of -30°C to 93°C.
- .2 Type shall be elastomer rubber.
- .3 For use with or without reinforcing tapes.
- .4 There shall be no effect from freezing.

2.6 TAPE

- .1 Tape: Polyvinyl treated, open weave fiberglass tape, 50 mm.
- .2 Suitable to seal joints of high and low pressure ducts.
- .3 Tape to resist chemical deterioration from application of a sealer compound.

2.7 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radius elbows:
 - .1 Rectangular: standard radius and/or short radius with single thickness turning vanes. Centerline radius: 1.5 times width of duct.
 - .2 Round: smooth radius 5 piece, centerline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45° entry on branch.
 - .2 Round main and branch: Enter main duct at 45° with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
- .5 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .6 Offsets:
 - .1 Short radius elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: As per Item 2.8.5 – Transitions.

2.8 HANGERS AND SUPPORTS

- .1 Strap hangers: Use same material as duct but next sheet metal thickness heavier than duct. A maximum 500 mm duct size to be supported by strap hanger.
- .2 Hanger configuration: to ASHRAE and SMACNA.
- .3 Hangers: black galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
Up to 750 mm	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10

- .4 Upper hanger attachments:
 - .1 For concrete: Manufactured concrete inserts.
 - .1 Rust -proof alloy
 - .2 Insert to lock as a machine bolt is tightened subsequently securely anchoring the bolt.
 - .2 For steel joist or beams:
 - .1 Standard beam clamp for normal use on wide flange or I beam
 - .2 Material to be carbon steel.

2.9 ACCESS DOORS

- .1 Fabricate rigid and close-fitting doors of galvanized steel. Use gaskets and quick fastening locking devices:
 - .1 Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.
 - .2 Doors shall be minimum 300 mm square, unless indicated otherwise on drawings, of the same gauge as duct, and larger doors 2 gauges heavier than duct.
- .2 Fabricate with two butt hinges fastened with:
 - .1 Two sash locks and outside handle for sizes up to 450 mm.
 - .2 Two hinges and two compression latches with outside and inside handles for sizes up to 600 x 1200.
 - .3 An additional hinge for larger sizes.

2.10 SINGLE BLADE VOLUME DAMPERS

- .1 Limit low velocity system single blade volume dampers to maximum duct depths of 300 mm and maximum duct widths of 1.2 metres.
- .2 Minimum 0.76 mm (22 gauge) thick steel for duct widths up to 450 mm and 1.52 mm thick steel for widths in excess of 450 mm.
- .3 Die formed damper blades for reinforcement, with center grooved and edges bent.
 - .1 Center groove to hold mounting pins and rod.
 - .2 Damper frame: Mild steel channel with backstops at top and bottom.
 - .3 Bearings iolite bronze press-fit into frame.
- .4 Manual dampers with a locking quadrant to hold dampers in fixed position without vibration. Complete assembly shall have a galvanized finish.

2.11 FLEXIBLE CONNECTIONS

- .1 Flexible connections for fans, air handling units and generator, to be neoprene coated and flame proof, minimum density 1.22 kg/m² (0.25 lb/ft²), factory fabricated, not more than

150 mm long between metal parts and installed with sufficient slack to prevent vibration transmission. Allow 50 mm movement on low-pressure fans.

2.12 INSTRUMENT TEST PORTS

- .1 Zinc plated steel.
- .2 Camlock handles with neoprene expansion plug and handle chain.
- .3 28 mm (1 1/8") minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.13 GRILLES – HEAT PIPE SUPPLY AND RETURN DUCTING

- .1 General: High capacity return or exhaust outlet with high free area and low sound and pressure drop.
 - .1 Provide aluminum grid core with a grid of 13 mm x 13 mm x 13 mm.
 - .2 White powder coat finish.
 - .3 Maximum noise criterion of NC30.
 - .4 Any grilles located in process room to be constructed of PVC materials.
 - .5 Provide opposed blade damper for each grille.
 - .6 Size, border style and mounting accessories as required.
 - .1 Each supply and return grille to have a minimum core area of 830 square centimeters.

Part 3 Execution

3.1 INSTALLATION

- .1 Install ductwork in accordance with SMACNA duct construction standards.
- .2 Seal all traverse joints in supply and return ductwork with high velocity duct sealer – maximum leakage 5%.
- .3 Flexible Connections:
 - .1 Install as indicated in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .4 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.

- .2 Control dampers.
- .3 Devices requiring maintenance.
- .4 Required by code.
- .5 Reheat coils.
- .6 Elsewhere as indicated.
- .5 Instrument Test Ports:
 - .1 Locate to permit easy manipulation of instruments.
 - .2 Install insulation port extensions as required.
 - .3 Locations as indicated:
 - .1 For traverse readings:
 - .1 At all fresh air and exhaust air inlet and outlet to HRV.
- .6 Clean duct systems.
 - .1 Force air at high velocity through ducts to remove accumulated dust.
 - .2 Alternatively, clean duct systems with high power vacuum machines.
 - .3 Provide adequate access into ductwork for cleaning purposes.
 - .4 Replace filters at total completion of work.
- .7 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- .8 During installation, protect open ends of ducts to prevent debris and dirt from entering.
- .9 Connect ceiling diffusers to low-pressure ducts with a maximum 1,500 mm length of flexible duct. Hold in place with caulking compound, screws and strap or clamp.
- .10 Install balancing dampers at all branch ducts and as indicated.
- .11 Support flexible ducts at 1,200 mm centers.
 - .1 Ensure bends are not tighter radius than standard 1½ times duct width.
 - .2 Use pipe shields to support duct at hanger without sagging or compression.
- .12 Do not break continuity of insulation vapour barrier with hangers or rods.

3.2 HANGERS

- .1 Hangers: Galvanized steel angle with supports rods, locking nuts and washers to the following table. For ducts up to 750 mm the largest dimension, 25 mm x 0.9 mm (20 gauge) strap hangers may be substituted. Strap hangers to be screw fastened at 100 mm o.c. along sides and at least one screw through duct bottom. Space strap hangers at 2.5 m o.c.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE and SMACNA as follows:

<u>CIRCULAR DUCT SIZE* (mm)</u>	<u>ANGLE SIZE (mm)</u>
up to 750	25 x 25 x 3
755 to 1,000	40 x 40 x 3
1,005 to 1,500	40 x 40 x 3
<u>ROD SIZE (mm)</u>	<u>SPACING (mm)</u>
6	3,000

6	3,000
10	3,000
10	2,300

*Equivalent Rectangular Maximum Dimension

3.3 SEALING AND TAPING

- .1 Apply sealant to joint exterior per manufacturer's recommendations for specified pressure and seal class.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturer's recommendations for specified pressure and seal class.

3.4 APPLICATION

- .1 Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers and elsewhere as indicated. Review locations prior to fabrication.
- .2 Provide 100 x 100 mm quick opening access doors for inspection at balancing dampers on all rectangular ducts and on all round ducts over 250 mm diameter.
- .3 At each point where ducts pass through partitions, seal the joints around the duct with non-combustible material.
- .4 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct and as required for proper air balancing.
- .5 Install flexible connections in ducts connected to fans and equipment subject to forced vibration, immediately adjacent to equipment and where indicated on the drawings.
- .6 Install all accessories in accordance with manufacturer's recommendations.

3.5 VIBRATION AND OBJECTIONABLE NOISES

- .1 Install ductwork free from pulsation, chatter, vibration or objectionable noises. Should any of these defects appear after the system is in operation, correct same by either removing, replacing or reinforcing the work as directed by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Exhaust and Intake Louvers.
 - .2 Exhaust and Intake Powered Dampers.
 - .3 Powered Damper Actuators. Provide calculations of required torque for each damper/louver.
 - .4 Screens, Wall Caps and Brick Vents.
 - .5 All related Accessories and Spare Parts.
 - .6 Clearly indicate each type and finish around opening.

1.2 REFERENCES

- .1 ASTM E90-09(2016); Standard Test Method for Laboratory Testing of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 AMCA 500-D-18; Laboratory Methods of Testing Dampers for Rating.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .4 Society of Automotive Engineers (SAE).

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data and revised shop drawings for louvers, dampers and accessories containing all relevant information and maintenance practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.4 CERTIFICATION OF RATINGS

- .1 Cataloged or published ratings shall be those obtained from independent laboratory substantiating air performance and water penetration. Louvers to bear the Air Movement and Control Association (AMCA) label.

1.5 POWERED ACTUATED DAMPER TORQUE

- .1 Coordinate and be responsible to ensure all powered actuators provide sufficient torque to operate all louvers and dampers.
- .2 Provide calculations of required torque for each damper/louver. Indicate safety factor used- minimum 10%.

1.6 BUG SCREEN

- .1 Provide a bug screen that is removable for cleaning on all intake assemblies provided.
- .2 Mesh size 18x4.
- .3 Insulate all ducting inside of building between bldg wall and damper/fan.

1.7 COORDINATION

- .1 Coordinate equipment wall openings with Divisions 4, 6 and 13.

Part 2 Products

2.1 POWERED DAMPERS

- .1 Parallel blade type.
- .2 Frame: Heavy gauge extruded aluminum damper frame.
 - .1 Silicone frame seals.
 - .2 Type: flanged to duct.
 - .3 Thermally broken with high density polyurethane resin pockets.
- .3 Blades: Extruded aluminum with internal insulation.
 - .1 Silicone blade seal.
 - .2 Thermally broken with high density polyurethane.
 - .3 Blade and frame seals to be extruded from formulated silicone for reduced air leakage at extreme cold temperatures
 - .4 Flange to duct interlocking blades.
- .4 Celcon inner bearing within a polycarbonate outer bearing.
- .5 Air leakage per Class 1A at 0.25 kpa static pressure differential to be per standard as certified under the AMCA Certified Ratings Program.
- .6 Dampers to operate in extreme cold temperatures, temperature range -73°C to 100°C.
- .7 Linkage: Plated steel tie and control rods, brass pivots and plated steel brackets.
- .8 Materials
 - .1 All dampers to be thermally insulated, except for Genset dampers
 - .2 Process room dampers to be spark resistant.
- .9 Operator: Refer to Damper Schedule below.

2.2 RETURN AIR DAMPERS

- .1 Dampers
 - .1 Parallel blade type.
 - .2 Dampers to operate in temperature range from -40°C to 100°C.
- .2 Frame: Heavy gauge extruded aluminum damper frame.
 - .1 Silicone frame seals.
 - .2 Type: Flanged to duct.
- .3 Blades: Extruded aluminum with internal insulation.
 - .1 Silicone blade seal.
 - .2 Flange to duct interlocking blades.
- .4 Celcon inner bearing within a polycarbonate outer bearing.
- .5 Air leakage per Class 1A at 0.25 kpa static pressure differential to be per standard as certified under the AMC Certified Ratings Program.
- .6 Linkage: Plated steel tie and control rods, brass pivots and plated steel brackets.
- .7 Location: Refer to damper schedule in this section.

- .8 Operator: Refer to Damper Schedule in this section.

2.3 DYNAMIC FIRE DAMPERS

- .1 Fire Resistance: Dampers shall have a UL 555 fire resistance rating of 1.5 hours.
- .2 Fire Closure Temperature: Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches 74° C.
- .3 Differential Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 1000 Pa.
- .4 Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 fpm.
- .5 Frame: Roll-formed 1 mm galvanized steel, with 406 mm long integral sleeve.
- .6 Blades: Double thickness galvanized steel, 2 mm with welded channel reinforcement.
- .7 Linkage: Jackshaft to blade.
- .8 Axles: Minimum 10 mm plated steel.
- .9 Retaining Plates: Two 1 mm galvanized steel complete with angle clips.
- .10 Bearings: Bronze Oilite press-fit into frame.

2.4 POWERED DAMPER ACTUATORS

- .1 Operator:
 - .1 Two position type
 - .1 Power open, spring close with 120 VAC power supply.
 - .2 Overload protection throughout rotation.
 - .3 Control to be on/off.
 - .4 Select torque requirement based on damper size, minimum 10 Nm.
 - .5 Motor running time less than 75 seconds, spring 20 sec @ -20 to 50°C and less than 60 seconds @ -30°C.
 - .6 Spring return to be reversible.
 - .7 Visual position indicator 0° to 95°.
 - .8 Manual override with 5 mm hex crank.
 - .9 Zinc coated and plastic casing housing to be Nema 2, IP54, Enclosure Type 2.
 - .2 Modulating type
 - .1 Power Supply 24 VAC ± 20%, 24 VDC ± 10%.
 - .2 2 - 10 VDC (4 - 20 mA) modulating input with 2 - 20 VDC feedback.
 - .3 Overload protection throughout rotation.
 - .4 Motor running time less than 95 seconds, spring 20 sec @ -20 to 50°C and less than 60 seconds @ -30°C.
 - .5 Spring return to be reversible.
 - .6 Visual position indicator 0° to 95°.
 - .7 Manual override with 5 mm hex crank.
 - .8 Zinc coated and plastic casing housing to be Nema 2, IP54, Enclosure Type 2.

- .9 Power close, spring open with 120 VAC power supply.
- .10 Select torque requirement based on damper size, minimum 20 Nm.
- .2 Provide necessary connectors, brackets, clamps, linkage and adaptors to mount actuator to damper.
- .3 Provide actuator size, capacity and number suitable for the opening and closing torque requirements of the damper as recommended by damper manufacturer.
- .4 For the Process Room, provide either an explosion proof damper or a NEMA 7 enclosure. Overall assembly to be Class I, Division 2 rated.

2.5 EXHAUST AND INTAKE LOUVERS

- .1 Construction: Welded with exposed joints ground flush and smooth.
- .2 Material: Extruded aluminum alloy.
- .3 Blade
 - .1 Stormproof pattern with centre watershed in blade.
 - .2 Reinforcing bosses and maximum blade length of 1,500 mm
 - .3 Blade angle 43°.
- .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 2 mm thick with integral perimeter caulking stop.
- .5 Performance rating standard AMCA 500-D.
- .6 Percent free area: Minimum 50.6%.
- .7 Free area velocity at beginning point of water penetration to be minimum of 196 m/min.
- .8 Air volume delivered at start of water penetration to be minimum of 147 m³/min.
- .9 Pressure drop at beginning point of water penetration 18 Pa.
- .10 Mullions: At 1,500 mm maximum centers.
- .11 Fastenings: Stainless steel nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, stainless steel washer and aluminum body.
- .12 Finish: Factory applied enamel. Color: to match exterior finish.

2.6 SCREENS

- .1 Bird Screen: 12 mm mesh, 2 mm diameter wire aluminum bird screen with a minimum open area of 80%. Provide a formed U-frame to support the mesh.
- .2 Removable Bug Screen: 457 mm x406 mm aluminum mesh with 0.279 mm wire diameter and minimum open area of 66%. Provide formed U-frame to support screen.

2.7 AIR FILTERS

- .1 Provide 50 mm air filter with MERV 8 rating on inside of air intakes as noted in item 2.9. Minimum 15 pleats per linear foot. Size and number of filters to match intake.
- .2 Provide access door to allow for removal of air filter.
- .3 Filters to be installed inside of the bug screen

2.8 BRICK VENTS

- .1 Provide aluminum wall brick vent design for masonry walls as shown in the table below.
- .2 Vent to have built in aluminum mesh insect screen.
- .3 Paint wall cap with epoxy paint. Colour to match louvres.

2.9 LOUVER SUMMARY TABLE

Louver I. D.	Size (mm) width x height	Material	Function	Accessories
Wastewater Trash Removal Building				
L-1	1800 x 1800	aluminum	intake	bird screen, removable bug screen downstream of damper and removable air filter downstream of bug screen.
L-2	1000 x 1500	aluminum	exhaust	bird screen
L-3	500 x 500	aluminum	exhaust	bird screen
L-4	1500 x 1500	aluminum	intake	bird screen, removable bug screen downstream of damper and removable air filter downstream of bug screen.

2.10 DAMPER SUMMARY TABLE

Damper I. D.	Size (mm) width x height	Model	Mounting	Function	Configuration	Actuator Type
Wastewater Trash Removal Building						
D-1	1800 x 1800	Insulated	Flanged	Intake	parallel blade - single section	Modulating
D-2	1000 x 1500	Insulated	Flanged	Exhaust	parallel blade - single section	Modulating
D-3	600 x 800	Non-Insulated	Flanged	Exhaust	parallel blade - single section	Modulating
D-4	600 x 800	Non-Insulated	Flanged	Exhaust	parallel blade - single section	Modulating
D-5	500 x 500	Insulated	Flanged	Exhaust	parallel blade - single section	Two Position
D-6	900 x 900	Insulated	Flanged	Exhaust	parallel blade - single section	Two-Position
D-7	1500 x 1500	Insulated	Flanged	Intake	parallel blade - single section	Two Position
D-8	600 x 600	Insulated	Flanged	Exhaust	parallel blade - single section	Two Position
D-9	600 x 600	Insulated	Flanged	Intake	parallel blade - single section	Two Position
D-10	200 dia	-	-	Fire Damper	dynamic	-
D-11	300 dia	-	-	Fire Damper	dynamic	-
D-12	200 dia	-	-	Fire Damper	dynamic	-

Damper I. D.	Size (mm) width x height	Model	Mounting	Function	Configuration	Actuator Type
D-13	200 dia	-	-	Fire Damper	dynamic	-
D-14	250 dia	-	-	Fire Damper	dynamic	-
D-15	150 dia	-	-	Fire Damper	dynamic	-

2.11 WALL CAP SUMMARY TABLE

Louver I. D.	Size (mm) width x height	Duct Connection (mm)	Material	Accessories
WC-1	200 x 200	150	aluminum	Built-in bird screen and damper

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with manufacturers and SMACNA recommendations.
- .2 Provide framing for unit.
- .3 Install ductwork between equipment and motors to exterior openings in a neat manner. Ensure wall openings line up on the same plane in all directions with equipment to be connected with ductwork to the exterior. Obtain and confirm dimensions of all equipment to be serviced prior to cutting or placing wall openings to ensure proper alignment and placement of openings.
- .4 Anchor securely into wall opening. Seal with flashings and caulking to ensure weather tightness.
- .5 Reinforce and brace air vents, intakes and goosenecks to withstand local wind speeds.
- .6 Upon system start-up, ensure that dampers operate smoothly without sticking.
- .7 Wire damper motors to start upon signals as outlined in Section 23 09 00 HVAC Instrumentation and Controls. These include humidistat, thermostat, genset driver start up, etc.
- .8 Install louvers in the location as indicated on the plans.

3.2 DAMPERS

- .1 In accordance with manufacturers and SMACNA recommendations.
- .2 Extend wall opening with galvanized sleeve.
- .3 Ensure that damper blades are not binding.
- .4 Locate damper so that damper motor, linkage and operator have sufficient clearance to wall and other equipment.

- .5 Ensure that damper motors are not inducing stress in the damper blades due to over driving in the open or closed position.

3.3 DAMPER ACTUATOR MOTOR

- .1 Provide power to damper motor.
- .2 Provide necessary connectors, brackets, clamps, linkage and adaptors to mount actuator to damper.
- .3 Coordinate damper motor control requirements with Division 26.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Exhaust Fans (all sizes).
 - .2 All related Accessories and Spare Parts.
 - .3 Exhaust Fan Controls.
 - .4 Include material data sheets, dimensional and layout data of all equipment.
 - .5 Clearly indicate each type of fan and proposed finish around opening.
 - .6 Clearly indicate each type of fan horsepower, voltage, wattage, phase and hertz.
 - .7 Provide shop drawing of proposed exterior wall mounting of louvers and hoods.

1.2 REFERENCES

- .1 Associated Air Balancing Council (AABC) National Standards for Total System Balance 7th Edition (2016).
- .2 AMCA 99-16; Standards Handbook.
- .3 AMCA 210-16; Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .4 AMCA 300-14, Reverberant Room Method for Sound Testing of Fans.
- .5 AMCA 301-14, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.4 CERTIFICATION OF RATINGS

- .1 Published ratings shall be those from tests carried out by manufacturer or from independent testing agency signifying adherence to codes and standards.

1.5 TESTING AND BALANCING

- .1 Test all fans for air flow rate to the Associated Air Balancing Council (AABC).

Part 2 Products

2.1 GENERAL

- .1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
- .2 Capacity: flow rate, pressure, efficiency, revolutions per minute, power, model, size, sound power data and as indicated.
- .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA 99.
 - .1 Balance Process Room inline fans to maintain a negative 25 Pa pressure differential between the Process Room and Vestibule.
- .4 Sound ratings: comply with ANSI/AMCA 301, tested to ANSI/AMCA 300.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210.

2.2 PROCESS ROOM INLINE FANS – IF-1 & IF-2

- .1 Inline Centrifugal Sidewall direct drive propeller fan to exhaust 2,500 cfm @ 159 Pa, at a maximum 64 dBA, fan speed 1,265 rpm.
- .2 Construction level to be AMCA spark B.
- .3 Continuously welded steel or aluminum housing, with flanges ends to attach to ductwork.
- .4 Fan propeller to be aluminum. Shafts to be polished, solid steel. Fan wheel to be balanced in accordance with AMCA standards.
- .5 Motor with class B or greater insulation and aluminum cover. heavy duty permanently lubricated bearings with oil retaining, dust excluding seals.
- .6 Provide mounting rails and spring hanging isolators to mount to the ceiling.
- .7 Motor to explosion proof, CSA labeled, UL/cUL-705 rated 575 V, 60 Hz, 3 phase, 1 HP motor. Motor to be mounted to the bottom of the fan.
- .8 Refer to plans for location. Be responsible to configure motor so that it does not interfere with other equipment in the building.
- .9 Provide 2 units.

2.3 PROCESS ROOM EXHAUST FAN – EF-1

- .1 Belt driven upblast centrifugal roof exhaust fan to exhaust 4,855 cfm @ 180 Pa, at a maximum 70 dBA, fan speed 1,725 rpm.
- .2 Fan to be configured for sidewall mounting.
- .3 Construction level to be AMCA spark B.
- .4 Continuously welded steel or aluminum housing.
- .5 Backward inclined aluminum wheel. Shafts to be polished, solid steel. Fan wheel to be balanced in accordance with AMCA standards.
- .6 Motor with class B or greater insulation and aluminum cover, heavy duty permanently lubricated bearings with oil retaining, dust excluding seals.
- .7 Motor to be CSA labeled, UL/cUL-705 rated, explosion proof, 575 V, 60 Hz, 3 phase, 2 HP motor.
- .8 Refer to plans for location. Be responsible to configure motor so that it does not interfere with other equipment in the building.

- .9 Provide VFD to control fan.

2.4 ELECTRICAL ROOM EXHAUST FAN – EF-2

- .1 Sidewall direct drive propeller fan to exhaust 1,269 cfm @ 115 Pa at a maximum of 14.1 sones sound level, 1,725 rpm.
- .2 Fan propeller to be riveted to steel hub. Fan wheel to be balanced in accordance with AMCA standards and bear the AMCA Certified Ratings seals for sound and air performance.
- .3 Fan and fan motor support to be constructed of galvanized steel and located in a wall housing with protective welded steel wire guards.
- .4 Fabricated galvanized sheet metal collar to mount fan panel to ductwork. Ensure adequate clearance to damper blades.
- .5 Motor with heavy duty permanently lubricated bearings with oil retaining, dust excluding seals.
- .6 Motor to be CSA labeled, UL/cUL-705 rated, TEFC, 115 V, single phase, 60 Hz, 0.5 hp. Provide factory-mounted and wired, preprogrammed variable frequency drive.
 - .1 Set low speed to 800 cfm.
 - .2 Set High speed to full fan speed (approx. 1300 cfm).

2.5 WASHROOM EXHAUST FAN – EF-3

- .1 Ceiling mounted exhaust fan, per location on plans, to be centrifugal direct drive type.
- .2 Ceiling mounted exhaust fan to provide 106 cfm @ 0.125 in H₂O S.P. Housing interior to be lined with 13 mm of acoustical insulation for a maximum 1.0 sones sound level.
- .3 Housing to be fabricated with embossed galvanized steel complete with a positive seal automatic spring loaded back draft damper, mounting brackets, disconnect, electrical junction box and inlet grill with white enamel finish.
- .4 Ceiling support rods to be galvanized with galvanized nuts and washers.
- .5 Provide spring isolator type vibration isolation. Provide galvanized steel channel supports between roof purlins to support hangers.
- .6 Motor to be single phase, 120 V, 49W.

Part 3 Execution

3.1 EXHAUST FANS

- .1 Install at locations per plans, to manufacturers and SMACNA recommendations.
- .2 Provide framing for unit(s), reinforce and brace to withstand local wind speeds.
- .3 Install fans in the location as indicated on the plans.
- .4 Provide flashing to have a watertight seal for connection of fan and louver unit to wall.
- .5 Exterior Unit: Install unit on wall with 6 mm neoprene gasket around perimeter, bolted through to back plates.
- .6 Tightly fit insulation in the wall to the fan housing and seal the vapor barrier by taping and acoustical sealant.

- .7 Ensure all openings through wall are neat and complete with flashings and caulking.
- .8 Support rods and vibration isolation are to be mounted vertically. Vibration isolation to have freedom of vertical movement.
- .9 Sidewall fans installed up to 1.5 m from ceiling can be hung from the ceiling with vertical rods. Sidewall fans lower than 1.5 m from ceiling to be installed using wall mount brackets. All inline fans to be hung from the ceiling.
- .10 Provide air flow report.
- .11 Coordinate electrical work with Division 26.

3.2 VIBRATION AND OBJECTIONABLE NOISES

- .1 Install ductwork free from pulsation, chatter, vibration or objectionable noises. Should any of these defects appear after the system is in operation, correct same by either removing, replacing or reinforcing the work as directed by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASME B16.44-2012 (R2017); Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi.
- .2 ASTM A53/A53M-20; Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .3 CSA B139 Series:19; Installation code for oil-burning equipment, Includes Errata (2021).
- .4 National Plumbing Code of Canada – 2010.
- .5 NFPA (Fire) 91; Standard for Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids, 2020 Edition.

1.2 REGULATORY AGENCIES

- .1 Construct a piping system to the requirements of the National Plumbing Code and all of its amendments, NFPA Fire Code, CSA B139, and the authority having jurisdiction.

1.3 WORK DESCRIPTION

- .1 Provide all piping, fittings, valves, hangers, fixtures, tanks, traps, drains, filters, flexible connections and other components shown including:
 - .1 Connections to exhaust, ventilation and heating equipment to make a completely operable system for all piping components of the project.
 - .2 Co-ordinate supply of muffler with other sections as required.
 - .3 Extend genset fuel fill piping outside building to an accessible location or as shown on the plans.

1.4 QUALITY ASSURANCE

- .1 Perform all work by journeymen skilled in this trade.
- .2 All pipe, fittings, valves, tanks, fixtures and equipment shall be approved for the pressure and temperature for their designated use.
- .3 All piping, fittings, valves, tanks, fixtures and equipment shall be installed, neat and parallel to general building lines and fully accessible for future maintenance.
 - .1 Install fuel fill lines parallel and alongside engine exhaust ducting unless otherwise indicated on the drawings.

1.5 DELIVERY AND STORAGE

- .1 Deliver fixtures, trim and other manufactured equipment to the job site and store indoors in original intact factory packaging and protect from damage.

1.6 CO-ORDINATION WITH OTHER TRADES

- .1 Supply necessary instructions to other trades for access and for scheduling of work.
- .2 Complete phases of the work permitting other trades to continue work without interruption and in accordance with the schedule.
 - .1 Frame wall thimble in wall prior to building cladding installation.

Part 2 Products

2.1 PIPE AND FITTINGS

- .1 Fuel fill and stand-by generator exhaust piping:
 - .1 Pipe sizes 50 mm or smaller.
 - .1 Schedule 40 steel black pipe with standard black malleable screwed fittings rated at 860 kPa (125 psi) in accordance with ASTM A53.
 - .2 Pipe sizes 60 mm or larger.
 - .1 Schedule 40 wrought steel black pipe with standard black steel welding fittings in accordance with ASTM A53.
- .2 Equipment connections:
 - .1 All fittings 50 mm and smaller connecting to equipment: Use unions, extra heavy duty pattern, having ground joints, brass seats and diagonal screw.
 - .2 Connections to equipment 60 mm and above: Flanged, standard weight provided with ring gaskets.

2.2 BALL VALVES

- .1 Full port two piece body with threaded ends.
- .2 Forged brass/bronze construction rated for minimum 1,000 kPa working pressure.
- .3 Steel plated operating lever with vinyl insulator sleeve, handle stop and PTFE stem packing and washers.
- .4 Ball to be brass with PTFE seats.
- .5 CSA approved.

2.3 MUFFLER AND RELATED ACCESSORIES

- .1 See Section 26 32 13 for supply of muffler, wall thimble and exhaust piping. Be responsible to provide required items not provided for in Division 26.

2.4 FILL LINE SPILL CONTAINMENT

- .1 Provide remote fill container to be mounted on the building exterior for containment of small spills that may occur during filling operations.
- .2 Minimum 15 gallon capacity.
- .3 Gas spring to hold lid in open position during filling.
- .4 Lid to be lockable.
- .5 Provide 25 mm NPT drain with locking ball valve.
 - .1 Ball valve to be Brass with Teflon gasket
- .6 Provide pedestal mount to be attached to the exterior grade beam as shown on the plans.

Part 3 Execution

3.1 INSTALLATION

- .1 Install as per manufacturer's requirements and applicable NFPA and Department of Labour codes.

3.2 FIXTURE INSTALLATION

- .1 Provide supports, required to set square and level.

3.3 PIPE AND MUFFLER INSTALLATION

- .1 General: Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.
- .2 Run 50 mm fill and 50 mm vent piping to exterior maintaining minimum 910 mm from any intake grills or source of ignition. Co-ordinate wall openings and methods of sealing openings with building Contractor to ensure integrity of vapour barrier is maintained.
 - .1 Supply and install whistle vent alarm audible at fill location during filling.
 - .2 Vent piping to be within 600 mm of fill piping.
- .3 Install piping to CSA B139 and in a manner as to conserve space.
- .4 Obtain Engineer's approval for pipe run prior to installation. Ensure tank fill lines are located on the exterior at an elevation that allows easy filling of the tank.
- .5 Arrange valving to permit the isolation of each fixture and each piece of equipment to facilitate servicing.
- .6 Maintain access to all valves.
- .7 Install groups of piping parallel to each other.
- .8 Install eccentric (where required) reducers in horizontal piping to permit drainage and eliminate air pockets.
- .9 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .10 Use non toxic lubricant or teflon tape applied to male thread. Use of hemp or similar materials on threaded joints will not be permitted.
- .11 Install flanges or unions to permit removal of equipment without disturbing pipe systems.
- .12 Use ULC rated "wall thimble" through building wall for muffler piping. Obtain from Division 26.
 - .1 Frame wall thimble in wall prior to building cladding installation.
- .13 Muffler:
 - .1 Provide low points in horizontal runs of piping with condensation traps, as well as condensation drains.
 - .2 Provide a flexible length of exhaust pipe between the engine exhaust manifold and rigid exhaust piping.
 - .3 Provide a clearance of at least 250mm between exhaust piping and any combustible material.
 - .4 Properly support all muffler components and piping against movement and connect all runs.

- .5 Keep exhaust piping well clear of fuel tanks, fuel lines, etc.
- .14 Securely cap all pipes and plug all openings which are temporarily not connected during construction.
- .15 Install systems so that they can be thoroughly drained and all air eliminated.

3.4 TESTING AND TURNOVER

- .1 Tests on piping systems to consist of pressure tests.

3.5 CLEAN UP

- .1 Leave systems operating with work areas clean to satisfaction of Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 23 – Shop Drawings, Product Data, and Samples Submittals to include but not limited to:
 - .1 Size and Free Areas
 - .2 Capacity
 - .3 Throw and terminal velocity
 - .4 Noise criteria
 - .5 Pressure drop
 - .6 Neck velocity
 - .7 Necksize and panel size
 - .8 Mounting
 - .9 Finish
 - .10 Accessories.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.
- .3 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.3 MANUFACTURED ITEMS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogued or publish ratings obtained from tests carried out by manufacturer or those or those ordered by him from independent testing agency signifying adherence to codes and standards.

Part 2 PRODUCTS

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Air outlets shall have a maximum noise criterion of NC 30 unless otherwise specified.
- .3 Frames:
 - .1 Full Perimeter gaskets.

- .2 Concealed fasteners.
- .4 Concealed operators.

2.2 RETURN GRILLES

- .1 Round, aluminum, painted white
- .2 Factory tolerance 0.76 mm.
- .3 Frame to suit ceiling or wall installation. Provide foam gasket as required
- .4 Sizes as per Item 2.4.

2.3 DIFFUSERS

- .1 Round, steel, painted white.
- .2 2-position, adjustable to provide both horizontal and vertical patterns.
- .3 Factory tolerance 0.76 mm.
- .4 Provide 150 mm and 200 mm nominal sized as indicated in Item 2.4.

2.4 SUMMARY

Supply Air					
I.D.	Size mm	Air Flow Rate, L/s	Material	Finish	Border
S-1	200 dia	90	steel	White	-
S-2	200 dia	90	steel	White	-
S-3	150 dia	46	steel	White	T-bar
S-4	150 dia	44	steel	White	T-bar
S-5	150 dia	56	steel	White	T-bar
S-6	200 dia	92	steel	White	T-bar
Return Air					
R-1	300 dia	180	aluminum	White	Wall
R-2	150 dia	46	aluminum	White	T-bar
R-3	150 dia	44	aluminum	White	T-bar
R-4	200 dia	92	aluminum	White	T-bar
R-5	150 dia	56	aluminum	White	T-bar

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Manufacturer's instruction
- .2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible
- .3 Provide balancing damper on duct take-off to each diffuser at main branch take-off, even when volume dampers are specified as part of grille assembly.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA C22.2 No. 24:21. Temperature-indicating and -Regulating Equipment.

1.2 SHOP DRAWINGS

- .1 Submit product data in accordance with Section 01 33 23 – Shop Drawings, Product Data, and Samples Submittals to include but not limited to:
 - .1 Equipment, capacity and piping connections
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed support, sizes and location of mounting bolt holes.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.4 COORDINATION

- .1 Coordinate control and power supply with Division 26.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Provide CSA/ approved, packaged factory assembled unit consisting of cabinet, fan, fan motor, heat exchanger, combustion system, controls, filter section
- .2 Suitable for addition of air conditioning.
- .3 Aluminized steel heat exchanger.
- .4 Sealed combustion system.
- .5 Disposal type filter.

2.2 NATURAL GAS FURNACE

- .1 Provide CSA approved, packaged factory assembled unit consisting of cabinet, fan, fan motor, heat exchanger, combustion system, controls and filter section for vertical installation.
- .2 Casing: 0.75 mm thick cold rolled steel, gloss enamel finish. Hinged bottom panel for access to element and fan compartment.
- .3 Capacity :
 - .1 Heating output 11.6 kW
 - .2 Blower air flow rate: 415 L/s

- .4 Time delay sequences to turn on burners.
- .5 Sealed combustion system
- .6 24 kW, 3 phase, 208 Volts, 70 amps.
- .7 Fan motor to be multi speed with permanently lubricated bearings. Motor and blower assembly to be have rubber vibration isolation mounts.
- .8 Minimum 95% AFUE
- .9 Provide filter section with 508 mm x 508 mm x 25 mm disposable filter. Provide 3 spare filters after commissioning.

2.3 CONTROLS

- .1 General: conform to CSA C22.2 No. 24.
- .2 Provide a digital auto change over 7 day programmable heating / cooling thermostat with LCD display, outdoor ambient temperature sensor and mounting kit.
- .3 Manual summer / winter switch.

2.4 CARBON MONOXIDE DETECTOR

- .1 See Section 28 16 00.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide housekeeping pad to elevate furnace unit 100 mm above floor.
- .3 Provide drain.
- .4 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's directive.
- .5 Mount thermostat on wall 1.5 m above floor in vestibule: mount thermostat in office: wiring by Division 26.
- .6 Before acceptance, balance air flows and set discharge patterns and fan speeds to suit requirements.
- .7 Seal all exterior wall penetrations with silicon sealant to match building colour. Seal interior wall penetrations with silicon.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Heat Pipe Unit.
 - .2 Supply of all related accessories and spare parts.
 - .3 Include material data sheets, dimensional and layout data of all equipment.
 - .4 Clearly identify material and options with an identification arrow.
 - .5 Provide information on condensate drain.
 - .6 Supply air duct heater.

1.2 REFERENCES

- .1 AHRI 1060-2013, Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment (I-P) (AHRI).
- .2 ANSI B9.1-00, Safety Code for Mechanical Refrigeration.
- .3 ASHRAE 52.1-92, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .4 ASHRAE 52.2-2017, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by particle Size (ANSI Approved).
- .5 ASTM B117-19, Standard Practice for Operating Salt Spray (Fog) Apparatus.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of the heat pipe equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.4 CERTIFICATION OF RATINGS

- .1 Published ratings shall be those from tests carried out by manufacturer or from independent testing agency signifying adherence to codes and standards.

1.5 CODE REGULATION

- .1 Install equipment according to the Manitoba Building Code.

1.6 EXTRA MATERIALS

- .1 Provide one spare set of filters.
- .2 Provide list, in operating manual, of manufacturer's recommended spare parts (i.e. bearings, seals), supplier addresses and special tools for adjusting, repairing or replacing.

- .3 Spare filters: In addition to filters installed for start-up and commissioning and prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

Part 2 Products

2.1 HEAT PIPE

- .1 Provide self contained, air-to-air heat pipe heat exchanger, with sealed partition between intake and exhaust streams and no moving parts.
- .2 Unit casing to be minimum 1.3 mm thick satin coated galvanized metal sheet with 0.74 mm solid internal liner. Epoxy coating by factory.
- .3 All joints to be screwed or riveted, and caulked with a water resistant sealant.
- .4 Provide hinged access doors with fully lined neoprene gasket.
- .5 Suitable for outdoor installation with minimum 50 mm of internal, neoprene coated fiberglass thermal insulation. Provide sheet metal break to prevent erosion of exposed ends.
- .6 Heat exchanger core shall be 16 mm seamless aluminum tubing permanently expanded into fins. Each tube to be individually sealed heat pipe filled with a working fluid conforming to Group 1 in ANSI B9.1.
- .7 Secondary surface to be continuous plate aluminum fins of corrugated design. Spiral fins will not be accepted.
- .8 Design heat pipe with capillary wicking behavior to provide a completely wetted surface.
- .9 Provide an integrated tilt package for frost control.
- .10 Drain pan to be integral to floor paneling and minimum 50 mm deep. Provide 38 mm stainless steel MPT drain connection.
 - .1 Contractor to provide heat traced drain.
- .11 Provide pure pure phenolic with plasticizers thermosetting resinous on coils suitable for exposure to hydrogen sulfide and methane gas. Spray salt tested to ASTM B117.
- .12 Provide filter sections with formed metal track, sized for 50 mm pleated panel disposable filters.
- .13 Provide UL listed filter. Filter media shall have minimum efficiency of 30-35% as per ASHRAE 52.1 and minimum MERV 8 as per ASHRAE 52.2
- .14 Suitable for 1,180 L/s with minimum ASHRAE effectiveness of 70%.
- .15 Maximum intake pressure loss 75 Pa. Maximum exhaust pressure loss 100 Pa.
- .16 Maximum 1.5 m wide, 2.2 m long and 1.3 m high with a maximum weight of 700 kg.

2.2 SUPPLY AIR ELECTRIC DUCT HEATER

- .1 Supply and install:
 - .1 One 20 kW, 600 V, 3 phase flanged style tubular incolil element duct heater.
 - .2 Mercury contactors to power individual stages of heating.

- .3 Solid state relay controller (SCR) that modulates the heater and supplies the exact amount of power to match the heat demand.
- .4 Airflow switch to prevent heater from operating if there is no air flow.
- .5 Proportional thermistor duct mounted thermostat to control SCR
- .6 Built in disconnect.
- .7 Automatic reset cut-out.
- .8 Pilot lights mounted on control box to indicate heater functions or failure and fuses to protect individual stages.
- .2 All electrical components of heater to bear the CSA label. Suitable for Class I, Division 2 environment.
- .3 Duct heater to be flanged open coil.

Part 3 Execution

3.1 HEAT PIPE

- .1 Install on heat pipe support pad outside building. Be responsible to size support pad as required.
- .2 In accordance with manufacturers and SMACNA recommendations.
- .3 Ensure openings through wall are exact, neat, have flashings and are caulked.
- .4 Install condensation drain line complete with heat trace.
- .5 Insulate outside air supply ductwork and exhaust air ductwork.
- .6 Provide outside air supply and inside air exhaust filters that fit tight inside unit and do not allow insects to enter the room.

3.2 SUPPLY AIR ELECTRIC DUCT HEATER

- .1 Mount flanged electric pre-heat coil in outside supply air ductwork from heat pipe according to manufacturer's recommendations.
- .2 Install duct discharge temperature control thermostat downstream of heater according to manufacturer's recommendations. Wiring by Division 26.

3.3 TESTING AND BALANCING

- .1 Adjust and balance unit air flow delivery rate to manufacturer's balancing procedure. Coordinate with Section 23 34 00.
- .2 Lock balancing dampers after completion of balancing.
- .3 Test all fans for air flow rate to the Associated Air Balancing Council (AABC).

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples. Submittals to include but not limited to
 - .1 Product data sheets, product characteristics and limitations.
 - .2 Performance criteria.
 - .3 Physical size and mounting methods.
 - .4 kW rating, voltage, phase.
 - .5 Cabinet material thicknesses, colour and finish.
 - .6 Manufacturer's Instructions on handling, installation and cleaning procedures.

1.2 REFERENCES

- .1 CSA C22.2 No.46-13 (R2018); Electric Air-Heaters.
- .2 NFPA (Fire) 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems, 2021 Edition.
- .3 UL 2021, Fixed and Location-Dedicated Electric Room Heaters.
- .4 National Building Code of Canada, 2015.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.4 CERTIFICATION OF RATINGS

- .1 Cataloged or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 EXPLOSION PROOF SUSPENDED UNIT HEATERS

- .1 CSA/UL listed, horizontal discharge complete with adjustable louvers. Approved for use in a Class I, Division 2 Environment.
- .2 Three phase 600 V forced air heater units as indicated on heater schedule.
- .3 Fan type unit heaters with built-in high-heat limit protection to provide automatic and manual reset.
- .4 Fan motor: Explosion proof, permanently lubricated ball bearing with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
- .5 Hangers: Provide hangers/brackets to hang units from ceiling or wall.

- .6 Cabinet: Steel, 14 gauge, fitted with brackets for rod or wall mounting.
 - .1 Baked epoxy/polyester finish.
- .7 Provide remote thermostat and disconnect switch options. Thermostat control voltage 24V, single phase. Accessories as per heating schedule on the plans.

Part 3 Execution

3.1 INSTALLATION

- .1 Connect power and control.
- .2 Wall mount unit heaters in position as indicated on layout drawings.
 - .1 Provide mounting brackets as required.
- .3 Install thermostats in locations indicated or as stated by Departmental Representative.
- .4 Perform tests as per other Sections.

3.2 MOUNTING HEIGHTS

- .1 Install devices at following heights above finished floor:
 - .1 Heaters: 2.6 m for suspended unit heaters. Coordinate with duct placement.
 - .2 Thermostats controls: Maximum 1.5 m above finished floor.

END OF SECTION

DIVISION 25

INTEGRATED AUTOMATION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures.
 - .1 Each plan/drawing shall contain a drawing description.
 - .2 Provide an overall index of all plans and general descriptions such that specific plan numbers for specific devices/equipment can be located.
 - .3 Provide an overall index that shows each PLC slot and provides a detailed description of the function/device wired/connected to each the terminal of the slot.
- .2 Shop drawings to include all wiring details, panel layout and wording for all labels. Panel to have sticker indicating it has been approved by CSA and/or Manitoba Hydro.
- .3 Shop drawings to include listing of all materials to be used including manufacturer's descriptive literature, all wiring details, charts of all relays that indicate their function, chart of all panel labeling and proposed wording and panel layout.
- .4 Diagrams of control panel, instrument loop, and PLC (not typical) are required. Loop diagrams to show all device terminal numbers and wiring connections (point to point).

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of all control equipment for incorporation into manual specified in 01 78 00 – Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 CSA C22.2 No. 52-17, Underground Secondary and Service-Entrance Cables.
- .2 Electrical Equipment Manufacturers Association of Canada (EEMAC).
- .3 Manitoba Electrical Code (2018).
- .4 ANSI/NEMA MG 1-2016, with 2021 Revisions; Motors and Generators, Includes 2021 updates to Parts 0, 1, 7, 12, 30, and 31.

1.4 OTHER SECTIONS

- .1 Control system for the building heat and ventilation systems – see section 23 09 00. Instrumentation, monitoring and accessories is in Division 40. Co-ordinate supply with other Divisions. For a fully functioning system install, wire and program electrical devices and equipment to provide monitoring and control of all equipment and processes.
- .2 Building heat and ventilation systems: Control system, to control the building heat and ventilation systems, is in Section 23 09 00. Co-ordinate supply with other Divisions. For a fully functioning system install, wire and program electrical devices and equipment.

1.5 GENERAL DESCRIPTION OF PROCESS

- .1 General description of wastewater trash removal process operations:
 - .1 Wastewater flows by gravity to the Wastewater Trash Removal building. Wastewater enters the building through a 300 mm diameter pipe to a concrete channel on the basement level.
 - .2 There are two trash removal channels, each with a grinder, auger and sluice gate valves. The upstream sluice gate valve is equipped with an electric actuator.
 - .3 Under normal operation one channel is open with all waste being processed by one pair of grinder and auger. Under high flow conditions, both grinders and augers will run. If both pairs of grinders and augers are offline, sewage will pass through an overflow channel.
 - .4 The control system in the wastewater trash removal building will record and alarm various parameters including the operation of the grinders, augers, and alarms for building temperature, genset alarms etc.

1.6 QUALIFICATIONS

- .1 Use qualified workers knowledgeable with this work and of the system components.
- .2 Be thoroughly familiar with governing regulations having jurisdiction on this project.

1.7 EXISTING CONDITIONS

- .1 Examine specifications and drawings relating to work of other trades which may affect installation of this Work.
- .2 Where contradictions in specifications and drawings are implied, obtain ruling from Departmental Representative. Where ruling is not obtained, include the item or arrangement of better quality, greater quantity, or higher cost.
- .3 Work or expenses arising by default of not having examined existing conditions prior to submitting bid shall be borne under this contract at no additional cost to the Departmental Representative.

1.8 ACCESSIBILITY

- .1 Install equipment and piping with adequate head room, operation and service clearances.

1.9 TESTS

- .1 Provide tests on equipment, systems and materials as may be requested by the Departmental Representative.
- .2 Carry out tests for such reasonable lengths of time and at such a time as determined by Departmental Representative before final completion and acceptance of work to verify performance requirements.
- .3 Completion of tests is not evidence of acceptance of tested part of contract.
- .4 No claim for damage will be made for injury or breakage of parts due to tests.

1.10 ELECTRICAL

- .1 Electrical equipment supplied under this section shall be CSA approved and bear CSA labels. Motors shall be tested to NEMA MG1 standards or CSA C22.2 No. 52 and shall conform to insulation and dielectric strength.

- .2 Motors shall have conduit terminal boxes and adequate starting protective equipment defined by local power utility and applicable sections of the Manitoba Electrical Code.

1.11 START UP

- .1 Retain fully qualified operators to start up all systems as may be required by the Departmental Representative.
- .2 Cycle all components of the complete system to duplicate normal operating conditions and test all level control system components.
- .3 Where adjustment devices, throttling devices, and gauges are installed, mark clearly and indelibly, the readings required for the intended performance of the system.

1.12 POWER FAILURE

- .1 Provide equipment and operations to automatically start up and properly operate after an electrical power failure without the attendance of the plant operator.
- .2 Protect PLC with a surge suppressor.
- .3 Provide an uninterruptable power supply (UPS) as per Section 26 33 53.
 - .1 Connect Ethernet switch to UPS system.

1.13 CSA APPROVAL

- .1 Panel assembly, subcomponents and internal components shall be CSA approved. Cabinet construction to be performed by a panel manufacturer complying with building codes, factory and labour regulations and has CSA approval as manufacturer for all components of the work including control panels, MCC's, service entrance, etc. Local approvals for panel construction including local CSA will not be accepted.

1.14 TRAINING

- .1 Review Section 01 79 00 and include training as outlined in the scope of work.

Part 2 Products

2.1 SURGE SUPPRESSERS

- .1 Protect service entrance installed surge arrestors to protect all electrical components.
- .2 Protect all control circuits from AC power line disturbances with Aegis HW series.
- .3 Protect all control circuits from under voltage by use of an under voltage relay.

2.2 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- .1 Provide programmable logic relay controller or PLC unit according to the following:
 - .1 Provide inputs and outputs as required.
 - .2 Complete programming in ladder/function block.
 - .3 Flash programming storage media.
 - .4 Power off retention: minimum 240 hours.

- .5 Program to remain in last state after power failure and continue from last point of process with retention of all timer values and bit status.
- .6 Provide required programming, communication cables and software to program messages by personal computer.
- .7 Provide a spare program cartridge, load with latest program.
- .8 Provide details in O&M manual on how to use keypad to view status of devices and registers in use and access process parameters on HMI.
 - .1 Include method to display and view analogue signal value being received from hydrostatic transmitter on HMI.

2.3 HUMAN MACHINE INTERFACE (HMI)

- .1 Provide human/machine interface and data base software package.
- .2 Tailoring/customizing of data base software package to include but not be limited to:
 - .1 Downloading data to obtain instantaneous, daily, monthly and yearly values for:
 - .1 Equipment run time (elapsed time) and daily run times.
 - .2 Listing of all alarms that occur.
 - .2 Recognize and advise of alarm conditions as they occur.
 - .3 Screens include but are not limited to the following:
 - .1 All critical Alarm conditions.
 - .2 All non-critical Alarm conditions.
 - .3 Others as implied in various sections of these specifications.
 - .4 Others as field directed by Departmental Representative.
 - .4 Screen displays to be set up to be easily legible (i.e. choice of fonts, type styles, colours) and logically laid-out (i.e. tables are to follow a sequential order rather than random summarization of data).
 - .5 Real Time analogue displays: Screens to display in real time all analog (4-20 mA) input and output signals with associated labels and descriptions (instrument number and descriptive heading).

2.4 AUTO DIALER

- .1 Set up system for auto dialer.
- .2 Dialer to be capable of sending critical alarm messages over combination of mobile radio, telephone, cellular (GSM, HSPA), paging or electronically as SMS text or Email.
- .3 Unit will be capable of advising by phone or dialer a minimum of 3 alarm priorities.
- .4 Complete with sim card for use with a cellular network. Confirm cell provider with Departmental Representative to provide appropriate sim card with voice plan.

Part 3 Execution

3.1 INSTALLATION

- .1 Furnish manufacturer's drawings and instructions for installation of equipment. Install equipment and piping to manufacturers' recommendations. Ensure all equipment is properly aligned and plumb.

- .2 Install all temperature control systems as specified. Refer to Section 23 09 00.
- .3 Install and calibrate level monitoring assemblies.
- .4 Make all mechanical and electrical connections between components, noted or implied.
- .5 Design overall electrical conduit and junction box system to allow easy removal of equipment for servicing.
- .6 Coordinate between the different manufacturers in the assembly of components.
- .7 Provide receptacles, cables and process control for all fractional horsepower motors.
- .8 Provide receptacles not related to any specific motor listed as shown on the plans and at a minimum spacing not to exceed 6 m or as determined by Departmental Representative.
- .9 Provide misc 120 V circuits as required for instrumentation, etc.
- .10 Integrate and calibrate all panels and controls with all related components.

3.2 START UP AND ADJUSTMENT

- .1 Upon completion of installation, test, adjust and regulate controls or safety equipment provided under this and other sections.
- .2 Adjust and place in operating condition.

3.3 IDENTIFICATION

- .1 Provide lamicoid identification labels as specified in Section 22 05 54.

3.4 AUGER AND GRINDER OPERATION

- .1 Review Section 46 21 39 for Control Panel provided by equipment manufacturer.
- .2 Be responsible to coordinate with manufacturer and receive all run signals, run times alarms to display in SCADA. Use auto dialer to notify of alarms as required.

3.5 HVAC INSTRUMENTATION AND CONTROL

- .1 Coordinate HVAC control and run control signals with Section 23 09 00.

3.6 MONITORING INSTRUMENTS

- .1 Provide power to all instrument devices.
- .2 Accept data signals from all devices.
- .3 When process related to instrument is not operational, do not record signals from device.

3.7 CONTROL COMPONENT SET POINTS

- .1 The following table summarizes the operator set points, acceptable input range, initial startup values and control action. Minor adjustments will be completed during commissioning.
- .2 Input values to the following decimal:
 - .1 Days to 0 decimal place
 - .2 Pressure to 0 decimal place
 - .3 Elevation to 3 decimal places

Device	Description	Operator Set Points	Action	Start up set point Values	Acceptable Range of set point
BFS-101	Overflow Channel Flood Switch	N/A	N/A		
BFS-102	Basement Flood Switch	N/A	N/A		
BTH-101	Exterior Temperature & Humidity	Exterior temperature	Run EF-1 when temperature is above setpoint	10 C	5 C – 20 C
CH4-101	Methane Gas Sensor (Basement area)	Methane Level that starts Process Room exhaust fan	Energize Fan EF-1 and turn on alarm lights	0.5%	0.1% - 0.5%
CH4-102	Methane Gas Sensor (Main Level – floor level)	Methane Level that starts Process Room exhaust fan	Energize Fan EF-1 and turn on alarm lights	0.5%	0.1% - 0.5%
CH4-103	Methane Gas Sensor (Main Level – ceiling level)	Methane Level that starts Process Room exhaust fan	Energize Fan EF-1 and turn on alarm lights	0.5%	0.1% - 0.5%
DPG-101	Process Room Pressure Differential	N/A	N/A		
GENSET		N/A	N/A		
GRINDER 1 & AUGER 1	Inline Sewage Grinder and In-channel Screw Screen	Grinder & Auger runtime between Grinder & Auger alternation.	When Grinder 1 or Auger 1 stop in faults, activate Grinder 2 and Auger 2. Cycle equipment for equal usage.	4 days	1-10 days
GRINDER 2 & AUGER 2	Inline Sewage Grinder and In-channel Screw Screen	Grinder & Auger runtime between Grinder & Auger alternation.	When Grinder 2 or Auger 2 stop in faults, activate Grinder 1 and Auger 1. Cycle equipment for equal usage.	4 days	1-10 days

Device	Description	Operator Set Points	Action	Start up set point Values	Acceptable Range of set point
H2S-101	Hydrogen Sulfide Gas Sensor (Basement area)	Hydrogen Sulfide Level that starts Process Room exhaust fan	Energize Fan EF-1 and turn on alarm lights	10 ppm	5-20 ppm
H2S-102	Hydrogen Sulfide Gas Sensor (Main Level – floor level)	Hydrogen Sulfide Level that starts Process Room exhaust fan	Energize Fan EF-1 and turn on alarm lights	10 ppm	5-20 ppm
H2S-103	Hydrogen Sulfide Gas Sensor (Main Level – ceiling level)	Hydrogen Sulfide Level that starts Process Room exhaust fan	Energize Fan EF-1 and turn on alarm lights	10 ppm	5-20 ppm
MOD-101	Grinder 1 & Auger 1 upstream sluice gate valve	N/A	Open when Grinder 1 & Auger 1 are running		
MOD-102	Grinder 2 & Auger 2 upstream sluice gate valve	N/A	Open when Grinder 2 & Auger 2 are running		
US-101	Sewage Level – Building Entrance	N/A	N/A		

Device	Description	Operator Set Points	Action	Start up set point Values	Acceptable Range of set point
US-102	Sewage Level – Upstream of Grinder 1	High level Return to normal Operation	High level - Start Grinder 2 & Auger 2 while keeping Grinder and Auger 1 running. Return to normal Operation – Return to one Grinder and Auger running	0.50 m 0.40 m	0.40-0.55 0.30-0.50 *do not permit high level setpoint to be set less than the return to normal operation setpoint
US-103	Sewage Level – Upstream of Grinder 2	High level Return to normal Operation	High level - Start Grinder 2 & Auger 2 while keeping Grinder and Auger 1 running. Return to one Grinder and Auger running	0.50 m 0.40 m	0.40-0.55 0.30-0.50 *do not permit high level setpoint to be set less than the return to normal operation setpoint
US-104	Sewage Level – Between Grinder 1 and Auger 1	N/A	N/A		
US-105	Sewage Level – Between Grinder 2 and Auger 2	N/A	N/A		

Device	Description	Operator Set Points	Action	Start up set point Values	Acceptable Range of set point
US-106	Sewage Level – After Auger 1	N/A	N/A		
US-107	Sewage Level – After Auger 2	N/A	N/A		

3.8 ALARM CONTROLS

- .1 Section 25 91 00 identifies various alarm conditions. Some alarm conditions have control functions associated with the alarms.
- .2 Complete all controls as required to enable alarms.

3.9 VOICE AUTO DIALER

- .1 Mount unit and install SIM card.
- .2 Program for “alarm dialing” as required.

3.10 DIFFERENTIAL PRESSURE GAUGE

- .1 Refer to Section 40 73 00.
- .2 Complete all wiring as required to control system.

3.11 TESTING

- .1 Once all systems are permanently connected testing will be required.
- .2 The Departmental Representative must be present to witness the start up test.
- .3 Test all electrical components to confirm acceptable working performance.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The following list generally describes the scope of Work under this section. In general provide screens and information displays that the address and indicate the following:
 - .1 Data acquisition PLC, modem and enclosure panel.
 - .2 Pressure monitoring.
 - .3 Level monitoring.
 - .4 Equipment operation and status monitoring.
 - .5 Intrusion alarm.
 - .6 Genset operation monitoring.
 - .7 Surge suppressor monitoring.
 - .8 Digital power meter monitoring.
 - .9 Communications modem.
 - .10 Alarm and change of status condition alert.
 - .11 Start-up, customizing and commissioning of monitoring program.
 - .12 Provide/Develop Historian c/w Reporting.
 - .13 Configure and develop daily, weekly, and monthly reports using both historical and real-time data
 - .14 Initial training on use of SCADA system and follow up training after commissioning.
 - .15 Supply of SCADA/PLC programming software.
- .2 General description of monitoring operations wastewater trash removal building Operation is described in Section 25 51 00. Monitoring and control to include:
 - .1 Grinders and Augers.
 - .2 Pressures.
 - .3 Levels.
- .3 Provide a supervisory control and data acquisition system (SCADA) and related communication instrumentation to facilitate the monitoring of the control system of the wastewater trash removal building. Provide, install, custom program, test and start-up all monitoring software
- .4 Data acquisition, processing and communication to be accomplished through PLC design/build format.
- .5 Provide central computer station and monitoring software required to call-up, display and document all monitored data including P.I.D. of overall sewage treatment system, plant floors, alarm conditions, change of status conditions and historical trending. Computer station to also be compatible with remote access through the internet.
- .6 Major components of this system shall include the specified software, materials, equipment, and installation required to implement a complete and operational SCADA system along with any associated panel or field mounted instrumentation.
- .7 Incorporate ability for a remote computer station and monitoring software as required to call-up, display and document all monitored data including P.I.D. of overall process, plant floor, alarm conditions, change of status conditions and historical trending.

- .1 Use internet for call up. Also set up system for future telephone call up (future telephone line and dialer).
- .8 A description of the number and type of inputs at each location are outlined in various sections of the plans and specifications.
- .9 A partial description of the number and type of inputs and outputs are outlined in the loop diagrams.
 - .1 Review all sections of the specifications and the plans to determine the complete listing of inputs and outputs. The loop diagrams are to be considered as a partial listing.
- .10 Provide a complete Historian to log all digital and analog points. Resolution of the stored values shall be within the resolution of the device.
- .11 Configure and develop daily, weekly, and monthly reports using a SQL data base for both historical and real-time data. Reports will include calculations and manipulations of stored values. Allow for a minimum of 30 reports each report consisting of at least 120 tags and 75 calculations, some to include total and min/max/averages.
 - .1 Hard copies of individual reports to be completed by entering a "date range" for data to be displayed.
 - .2 Provide a method to "combine" the various individual report sheets into one file for ease of opening, viewing, copying, printing and electronic transfer. Thus provide software and written instruction as required (as part of the O&M manual) to allow the operator to have or make one overall file for all hard copy reports of a particular or selectable date range.
- .12 Wherever software or hardware is referenced provide latest version.
- .13 Use a programmable logic controllers (PLC) to provide remote terminal unit (RTU) functions for use in the SCADA and telemetry applications. NOTE: The term PLC and RTU is used interchangeably in the specifications.
- .14 Real time: Real time refers to events simulated by a computer at the same speed that they would occur in real life. In graphics animation, for example, a real-time program displays objects moving across the screen at the same speed that they would actually move (ie trend screen). Direct historical and real time data transfer or real time data transfer to data base file formats with diagnostic alarming on PC, suitable for input into hard copy printable spreadsheets.
- .15 Data Recording when motor, device, instrument or monitor is not operating: When a motor, device, instrument or monitor is not operating then data generation is to be off, off status to be clearly identified on trending screens and tab delimited files which use the data such as reporting functions. For devices that take time to stabilize (i.e. turbidity monitor) provide operator selectable time delay at start up where data is also not to be collected.
 - .1 Recoding of "0" or the value generated at 4 mA is not acceptable when data from a motor, device, instrument or monitor is not being recorded under operating conditions and a stabilization period where applicable.
 - .2 Do not power off device, instrument or monitors for the sole purposes of not recoding data unless approved by Departmental Representative.
 - .3 For hard copy report only use data that is generated when the device, instrument or monitor is fully operational and the applicable process being monitored is

active and in operation. Ensure time delays are utilized to ignore data during process start up.

- .16 Power or flow to Instruments: When instruments or similar devices that record or monitor data are on piping that is monitoring a process that cycles on/off do not power off the instrument when data is not being generated unless otherwise directed by Departmental Representative.
 - .1 Provide field adjustable time delays as required to discount data being recorded by SCADA at start up of the process.
- .17 Time delay countdown: Provide a time delay countdown whenever a process or other operation or control sequence that is occurring which has a start/stop cycle which may invalidate real time data being monitored and collected. Provide a clear countdown display to advise the operator that the device is in a time delay mode which does not monitor or collect data for the period as displayed. Do not collect or display data during the countdown and off period.
 - .1 Place all time delay field adjustable set points and countdown/up time displays on a separate SCADA screen. Clearly label all devices.
- .18 Customizing, testing and confirmation of the monitoring software package operation to be demonstrated at the JR Cousin Consultants Ltd (JRCC) office in Winnipeg.
 - .1

1.2 REFERENCES

- .1 IEEE C62.41.1-2002, IEEE Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
- .2 IEEE C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits.

1.3 QUALIFICATIONS

- .1 Use qualified workmen who are fully familiar with this Work and have a working knowledge of the system components.
- .2 Be thoroughly familiar with governing regulations having jurisdiction on this project.
- .3 SCADA integrators shall have successfully completed a minimum of five (5) water and or sewage treatment plant projects of a similar scope and complexity in the past 36 months. SCADA integrators shall have current licensed development copies of all required software. The Departmental Representative may request copies of the licenses at any time. Licenses of all runtime and development software supplied for this contract shall be transferred to the Departmental Representative after commissioning.

1.4 ACCESSIBILITY

- .1 Install equipment and conduits with adequate clearances for head room, passage, operation and service.

1.5 TESTS

- .1 Provide tests on equipment, systems and materials as may be requested by the Departmental Representative.

- .2 Carry out tests for such reasonable lengths of time and at such a time as determined by Departmental Representative before final completion and acceptance of Work to verify performance requirements.
- .3 Completion of tests is not evidence of acceptance of tested part of contract.
- .4 No claim for damage will be made for injury or breakage of parts due to tests.

1.6 ELECTRICAL

- .1 Electrical equipment supplied under this section shall be CSA approved and bear CSA labels.
- .2 Cabinet construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory and Department of Labour regulations and has CSA approval as manufacturer for all components of the Work including control panels, MCCs, service entrance etc. Local approvals for panel construction including local CSA will not be accepted.
- .3 Submit for Departmental Representative's review schematic diagrams outlining all proposed connections between equipment control and display panels and the PLC as deemed necessary by the contractor to achieve the desired monitoring results. Label the wiring configurations for clear interpretation of drawings and intent.
- .4 In accordance with Section 25 51 00.

1.7 DATA RECORDING FAILURE

- .1 Provide a highly visual on screen notification if the data recording features of the SCADA system are turned off in any manner.
- .2 Maintain reminder "on top" (with screen minimizing features disabled) until data recording features are re-established.
- .3 Provide "pop up" screen that confirms whether a daily back up of all data being recorded has been made to the second hard drive. Operator to click "acknowledge" button that back up has occurred before "pop up" disappears.

1.8 MODEM ACCESS

- .1 PC and PLC shall be capable of being viewed and controlled directly by modem through future telephone access.
- .2 Complete terminations in building and at 50 bed complex. Stony Mountain Institution will establish connectivity.

1.9 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Submit hard copy reporting columns and headings.
- .3 Submit for review prior to any software programming. Detailed FRD (Functional Requirements Document. The FRD shall contain at a minimum all proposed graphics screens, control philosophy, function blocks, program architecture, operator interface, alarming, interlocks and permissives, and simulation. Once programming is complete the system shall be simulated using an acceptable method of simulation. All functionality to be tested and validated during a Factory Acceptance Test witnessed by the Departmental Representative prior to site installation and commissioning. All third party interfaces will

also be tested (i.e. aeration and treatment system, VFD's, Power Meters, Remote Access, genset monitoring and others as may be required).

- .4 Include index and outline descriptions
- .5 Include index and typicals of hard copy reports. List each heading to be monitored and reported.
- .6 Suggested detailed format and configuration of all log reports, alarm summaries, printer outputs, screen displays and graphics.
- .7 Detailed block diagram showing system hardware configuration and identifying model numbers of system components.
- .8 Format, protocol and procedures for data highway communications and local communications with input/ output modules and peripheral devices.
- .9 Data base of all proposed full scale settings for all analogue devices.
- .10 Data base configuration and description on how program polls only the data registers that are required.
- .11 Explanations on how overall software modules complete automatic backups of all data base values being recorded from all analytical and discrete devices and how software visually displays and confirms that data backup is occurring on a daily basis
- .12 PLC I/O card layout including screen being used for graphical display of all input/output points including required information to be displayed in real time. Include proposed wording. Ensure there is enough spare I/O space for future equipment.
- .13 On-line configuration.
- .14 Layout drawings to include:
 - .1 Front, rear, and internal panel views to scale.
 - .2 Dimensional information.
 - .3 Tag number and functional name of components mounted in and on panel, console or cabinet.
 - .4 Mounting and installation details.
 - .5 Installation requirements, instructions and/or recommendations.
- .15 Provide Individual loop diagrams for each process instrument system, the use of typicals is not permitted. Loop diagrams shall show all device numbers and actual wiring connections (point to point). Instrument loop diagrams for all analog display, control and I/O loops to include:
 - .1 Instrument tag numbers from Contract Documents.
 - .2 Functional name of each item.
 - .3 Location of each item.
 - .4 Signal type and calibrated range, scale, and set point for each item, as applicable. Allow Departmental Representative to make changes at a later date.
 - .5 Identification of all loop and instrument energy sources.
- .16 SCADA I/O Loop Wiring Diagrams: Prepare drawings on a module-by-module basis and include the following information:
 - .1 Rack numbers, slot number, module type and module terminal point numbers. Also, include location and identification of all intermediate panel terminal block

and strip numbers to which I/O wiring and power supply wiring is connected.
Identify all power supply circuit numbers and ratings.

- .2 Wiring sizes, types, wire numbers and color-coding
- .3 Location, functional name, tag numbers and manufacturer model numbers of panel and field devices and instruments to which I/O wiring is connected

1.10 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of all control and monitoring equipment for incorporation into manual specified in 01 78 00 – Closeout Submittals.
- .2 Provide the following:
 - .1 Overall index.
 - .2 A separate listing of all software and hardware supplied c/w serial numbers and registration numbers. Include all CDs supplied in listings.
 - .1 Binder for all CDs supplied as part of manufacturer's equipment.
 - .2 Separate sheet for all passwords used.
 - .3 Completed bill of materials list of all suppliers of equipment provided.
 - .4 Listing of all manuals provided with all software and hardware. Bind all hardcopy manuals into sets. Provide instructions on digital manuals included on CD for all software and hardware supplied.
 - .5 Process Control Narrative (PCN) describing how the control philosophy has been implemented on a given project. Identify the equipment to be controlled on a process-by-process basis. For each process clearly define all available modes of control. Define how control software is to function, provide a clear description of how operators interface with the system, and define process indicators to be monitored to ensure that the process is operating efficiently. Use short bullet point phrases, tables, and diagrams in order to keep the document as concise as possible. The PCN shall be generated by the System Integrator as the first stage of system integration before commencing on any programming or configuration.
 - .6 Introductorily description of how all hardware and software is interfaced.
 - .7 Description of how automatic back up and back up confirmation occurs and procedures to use backed up data if and when required.
 - .8 Written description on function and operational features of each screen including explanation of data displayed.
 - .9 Written description and listing of all potential operator entered values and settings.
 - .10 Written description and listing of all program entered values and settings at the time of final commissioning.
 - .11 Descriptions of how automatic hard copy spreadsheets for plant monitoring and water balance are produced.
 - .12 Copy of shop drawings revised to as constructed including instrumentation loop diagrams and electrical schematics.
 - .13 Functional Requirements Document and Reporting. Include colored copies of hard copy reports.
 - .14 Functional descriptions on the use of SCADA system and methods to produce hard copy reports.

- .15 Description of values and inputs used for control as related to modulating motors such as valve actuators, pumps, etc.
 - .16 Screen shots of all screens used with a detailed written description on the operation and values that are used for each screen. Provide color hard copies of all screens used as part of the descriptive process ensuring screen shots have “realistic” numbers and related displays that are specific for this project. If changes are made provide the most recent in the final O&M manual.
 - .17 All reporting from each training trip including print outs of hard copy reports available since the last training report.
 - .18 Digital copy of O&M manual(s) of all project components and Divisions on the hard drive.
- .3 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.11 POWER TO INSTRUMENTS

- .1 When instruments or similar devices that record data are on piping that is monitoring a process that cycles on/off do not power off the instrument when data is not being generated unless otherwise directed by Departmental Representative.
- .2 Provide field adjustable time delays as required to discount data being recorded by SCADA at start up of process.

1.12 SCADA INSTRUMENT LABELING

- .1 Labeling of all instrument/valve/equipment on a SCADA screen, at a minimum, shall consist of the following.
 - .1 Tag # (i.e. US-101).
 - .2 Item Description (i.e.: Sewage Level – Building Entrance).
- .2 Match all Instrument/valve/equipment labeling tag numbers used on SCADA displays to the tag numbers listed on the drawings. Allow Departmental Representative to make wording and description changes.
- .3 Coordinate with all trades to ensure all alterations to wording that are incorporated into the SCADA screens and displays are identified on the red-line/as-built drawings.

1.13 PROGRAM CHANGES

- .1 The Contractor is advised that there will be changes and alterations to the program logic as described herein and as directed by the Departmental Representative as may be related to process and clarity. This is in addition to items as may be identified as deficiencies and faults.
- .2 Complete remote changes to the program as required and identified by the Departmental Representative until overall project warranty period has elapsed. Include an allowance to make remote changes throughout the warranty period; in addition to typical program corrections and fine tuning to meet specifications and process conditions; as may be directed by the Departmental Representative.
- .3 Additional Trips to Site: Provide an allowance for a minimum of 3 additional trips to site, minimum 8 hours onsite, (do not include in this allowance time and expenses for program changes that can be completed remotely or completed during training sessions). This allowance is in addition to typical program corrections and fine tuning as may be required to make the program fully functional in accordance to the specifications.

- .4 Track and submit (upon request) dates and time onsite of training and completing program changes in addition to the specifications as outlined above.

1.14 TRAINING

- .1 Do not schedule start up and initial training until hard copy reporting, trending, all SCADA screens, remote web access, etc are deemed 95% complete by Departmental Representative. Provide coloured paper copies of all reports, screens, trends, etc for approval.
- .2 Be responsible to review Section 01 78 00 and 01 79 00; include training requirements as outlined in Section 01 78 00 and 01 79 00 in scope of Work. Provide written reports as outlined.
- .3 Coordinate with Section 01 79 00 for training requirements. Check calibration of supplied equipment, switch operation, review O&M manuals, print hard copy reports, review alarms and input set points, SCADA operation, etc.
- .4 Complete any requested changes to SCADA screens or operation or information supplied in addition to site training time. Do not count time to complete trouble-shooting or program updates or changes as part of training.
- .5 Confirm backups and train operator on loading data from backups.
- .6 During training trip be prepared to adjust calibration and train operators on procedures.
- .7 Review hard copy reports to ensure data of “real” zeros, averages, totals and other math is without errors and reading from day to day are reasonable in terms of variance and values obtained.

1.15 PERSONAL INSTRUCTIONS TO OPERATOR

- .1 Upon completion of Work (including system start up) provide by phone contact a fully qualified operator (familiar with all systems) for a time period of warranty, as necessary, to instruct the Operator(s) on the operation and maintenance of SCADA systems and equipment.

Part 2 Products

2.1 GENERAL

- .1 Use control equipment of one manufacturer wherever possible.

2.2 HARDWARE AND SOFTWARE – WASTEWATER TRASH REMOVAL BUILDING

- .1 Provide PC with minimum Intel i9, 32GB DDR3 SDRAM, two internal 7200 RPM 1,000 GB hard drives, 16X DVD burner (DVD+RW), minimum 2 GB dedicated video card with dual DVI+VGA, DVI video cables, stereo speakers, media card reader and ethernet cards as required.
 - .1 Software to be suitable for use with pagers and internet/email notifications.
 - .1 Also compatible with SMS text messages.
 - .2 Provide 25 dual layer DVD RW and 25 CD RW.
 - .3 Provide software to backup data for hard copy reports, trending screens and motor usage, etc to second internal hard drive and third external hard drive on a

- daily automatic basis. Provide instructions on using second and third hard drive as startup for a computer in case of main computer hard drive failure.
- .4 Provide 2 - 16 GB USB drives.
 - .5 Built in 15 in 1 card reader.
 - .6 Provide a 101 key multimedia keyboard, speakers, laser mouse and required video drivers.
 - .7 Provide Microsoft operating system latest edition Professional version 64 bit with latest service pack operating system. Ensure compatibility with SCADA software.
 - .8 Provide "Microsoft Office Business" current edition full version (not upgrade or yearly subscription type) software package. Software to be registered to client - supply registration name for approval prior to registration.
 - .9 Provide an external hard drive with a 1,000 GB minimum storage capacity. Locate the external hard drive in a separate lockable and secure cabinet above the office ceiling tile. Provide and set up software to clone hard drive (latest edition of Symantec System Recovery Desktop Edition or equivalent) on a daily basis. Provide instructions on using external hard drive as startup for a computer in case of main computer hard drive failure. Provide cables as required to connect external hard drive to main computer (inside conduit).
- .2 Provide one 27" LCD flat wide screen colour monitor: contrast ration 1000:1 static contrast ratio, 178° viewing angle, resolution 1920 x 1080
 - .3 Provide all data base reporting provide software as required to produce suitable reports.
 - .4 Register software to client - supply registration name for approval prior to registration.
 - .5 Provide continuous, subscription-free, on-line antivirus, anti malware/adware program.
 - .6 Provide all necessary connecting and power supply cables required to set up and operate entire system including all extension cords and cables required to properly set up the systems.
 - .7 Provide isolated ground receptacle as power supply for computer terminal and accessories.
 - .8 Provide software c/w 2 site licenses suitable for 2 remote computers to access the site.
 - .9 Supply a multifunction colour laser printer, scanner, copier, fax and PC-FAX suitable for paper sizes up to 279 mm x 432 mm (11" x 17") c/w 2,000 sheets of 216 mm x 280 mm (8 ½" x 11"), 1,000 sheets of 216 mm x 432 mm (8 ½" x 17") and 1,000 sheets of 279 mm x 432 mm (11"x17") replacement paper and two sets of replacement toner cartridge (black plus 3 colors) as part of the overall Works.
 - .10 Provide surge suppresser for PC, printer, video hard drives, PC monitor, etc. as required for protection from power supply surges.
 - .1 Surge suppression rated at minimum 3,840 joules / 92,000 amps.
 - .2 Meets IEEE C62.41 category A & B specifications.
 - .3 Eight outlet with 3.6 m cord and all-metal housing.
 - .4 Pair of RJ11 jacks.
 - .5 Full lifetime guarantee to \$50,000 of equipment.
 - .11 Provide uninterruptable power supply (UPS) unit or system to automatically shut down PC unit upon an extended power failure.

- .1 Minimum 1,500 VA/900 watts
- .2 Rate unit as “on line” upon failure with a minimum surge voltage rating of 2,000 volts.
- .12 Provide CPU stand and stand for computer UPS to keep CPU and UPS units off of the floor. Provide minimum 2.4 m (8’) length for computer/UPS cables to allow CPU and UPS to be located under the computer desk.

2.3 SCADA, DATABASE AND REPORTING SOFTWARE

- .1 Provide human/machine interface SCADA, data base and reporting software as an integrated package. Tailoring/customizing of SCADA, data base and reporting software package to include but not be limited to:
 - .1 SCADA system to archive data into electronic records that may be recalled and reviewed at a later time. Historical records are to be able to be exported in a suitable format that can be exported to .xlsx format or other suitable format for formatting into printable reports that list and manage the available data.
 - .1 Be responsible to develop and format reports for printing.
 - .2 Allow operator to view and print reports based upon daily, monthly and yearly data, as well using an operator defined time frame or both.
 - .2 The hard copy reports in general are to report data at a specific time such as midnight each day and provide applicable math to generate data such as run times, min/max/averages, list number of points sampled to obtain totals, min/max/averages and other parameters as applicable.
 - .1 Provide a “button” on the bottom of each sheet that lists the available months/year for which data is available to allow the operator to instantly review the data for any particular month. Provide space for at least 16 buttons for individual months.
 - .2 Zero values: Do not print or record data as a zero value unless it is a “true zero” based on a process being operational. Thus ignore zero values in min/max/average and other related displays that are not “true” due to an operating process being “off”. Zero values in general are to generate an empty cell. An example of a true zero is temperature as it changes from a positive to a negative value.

Examples of zero values that are to be ignored due to a process being off is a mag meter that is displaying zero as the process feed to it is not operating or a water quality analyzer that is not receiving a flow from an operating process. If the process does not operate for an entire day display the word “nil” or some other applicable term in the cell.

Zero values that are not “true” shall not be used in determining the minimum, maximum, averages or any other calculation. For averages and minimums only use data which is not a zero and data that is recorded due to an operating process, as zero means there is no process action occurring. In general for min and maximum values use the smallest number that is greater than zero, ensure that a time delay is used on the start of a process and related data reporting to ignore data generated during “start up”.

In general “true” zeros are mostly applicable to digital data and not analogue data.
 - .3 Report headings to display the equipment/device, tag descriptions and numbers, full scale calibration setting, unit and values being displayed.

- .3 Downloaded data to be automatically entered and summarized onto printable forms, tables and charts that provide an overview of plant operation and process functions in a hard copy format. Data base and applicable software used to generate reports to be backed up onto the second internal hard drive and remote hard drive on an automatic basis.
- .4 Report categories. In general group reports into the following categories and number the pages.
 - .1 Equipment run time.
 - .2 Gas Levels.
 - .3 Differential Pressure
 - .4 Liquid levels.
- .5 Reports: Provide for review as part of shop drawing submission overall headings and columns to be utilized including headings and columns for calculated values. "Fine-tuning" as detailed by Departmental Representative during start-up and program customizing. Provide an index. Assume as a minimum that downloading data as required to obtain instantaneous, daily, monthly and yearly values for:
 - .1 Daily run times and number of starts of all equipment using electrical motors that are monitored and controlled by SCADA. Include a column for number of starts per day and a column for hr:min for each piece of equipment. Provide totals and averages on a monthly basis. ("true" zeros are applicable for this data)
 - .2 Levels as monitored with liquid level devices.
 - .3 Listing of all alarms that occur.
 - .4 Change of set points to SCADA interface.
 - .5 Genset operation.
 - .6 Generator run time and starts ("true" zeros are applicable for this data.)
 - .7 Surge suppressor occurrences.
 - .8 Daily Min/Max and Averages for stored values as directed by Departmental Representative.
 - .1 Include all instantaneous read results.
 - .9 Locations for manual entry of operator, notes and comments.
- .6 Downloading of data for printing a hard copy to occur automatically at a prescribed programmed time and interval as inputted by operator – ie daily, monthly, yearly or other.
- .7 Program to interpret position status of monitored valves and display the valve position by color change.
- .8 Recognize and advise of an alarm conditions as they occur. Alarm conditions to be programmed as directed by the Departmental Representative.
- .9 Program to advise remote computer station or email address (as chosen by the Departmental Representative) "change of status" condition immediately as it occurs. Allow items to be grouped into 3 priorities.
- .10 Provide real time historical trending of all analogue equipment, meters and monitors. A partial listing is levels, pressures, on line instrumentation and meter readouts and elapsed time readings by means of "spot reading polls" in time intervals as determined by Departmental Representative (typically every 15 minutes into data base locations). Back up data to second hard drive daily.

- .1 Provide method to “easily” scroll back in time by both arrow buttons and direct entry of a date and time. Provide on screen written instructions for scrolling to specific dates and times.
- .11 Instantaneously update ‘on-screen’ status and displays throughout duration of manual dial-up and viewing from Host Computer.
- .12 Directly display treatment process to second monitor and allow changes to process PLC to be made through data highway from SCADA station.
- .13 Display approximately 30 ‘screens’ as directed by the Departmental Representative. Screens include but are not limited to the following:
 - .1 Process and Information Diagram (P.I.D.) of entire treatment plant floor while indicating current status of all pumps and equipment being monitored including flows, precipitation, liquid levels and pressures.
 - .1 Include a visual representation of actual plant layout.
 - .2 Use “pop-up” screens to obtain detailed information based on clicking on applicable area on overall screen.
 - .2 All critical Alarm conditions.
 - .3 All non-critical Alarm conditions.
 - .4 Screen displaying P.I.D. detailing wastewater treatment process operation and status.
 - .5 Others as stated or implied in various sections of these specifications.
 - .6 Others as field directed by Departmental Representative.
- .14 Screens displays to be set up to be easily legible (i.e. choice of fonts, type styles, colours) and logically laid-out (i.e. tables are to follow a sequential order rather than random summarization of data).
- .15 Real Time analogue displays: Screens to display in real time all analog (4-20 mA) input and output signals with associated labels and descriptions (instrument number and descriptive heading).
- .16 Full scale settings for all analogue devices, sensors and equipment and display of all I/O card analogue and digital inputs to PLC:
 - .1 Review specification sections where applicable for calibration range for full scale settings. Submit listing of all instruments and full scale ranges in a chart as part of shop drawing submission. Allow Departmental Representative to make changes.
 - .1 Set requirement of password level security 1 on changes to settings (operator cannot make changes). Provide password to Departmental Representative.
 - .2 For any equipment or device where ranges, scales and set points may not have been specified, submit a logical recommendation to Departmental Representative for review during shop drawing stage.
 - .3 Once approval from Departmental Representative has been obtained for full scale setting ranges to be used, be responsible to co-ordinate with personnel completing start up of the related instrument or device to implement a proper and stable process as systems are placed into operation.
 - .4 Use wording and descriptions for all digital and analogue devices, sensors and equipment that include a device number as well as a device name. The integrator may use their own device number however each

- such display show also include the JRCC assigned tag as well as a descriptive name.
- .5 Provide a separate SCADA screen that lists the full scale settings used for calibration of all instruments, sensors and other analogue equipment being monitored or controlled. Protect screen from unauthorized changes.
 - .1 Confirm that all instruments and devices have be calibrated to full scale ranges as they exist in the SCADA system.
 - .6 Provide a separate screen that displays the actual analogue or digital output of each instrument, sensor or device as being received by the PLC with associated labels and descriptions. Display information based on a graphical representation of the cards in the PLC.
 - .1 Scaling as displayed on the screen may be in a 4-20 mA or 0-10V format. Regardless of format used provide clear examples on the screen as an explanation to allow an operator to use the full scale analogue settings and the inputs as displayed on the screen to calculate the actual reading as displayed on the instrument for comparison purposes. Include such information in the O&M manual.
 - .7 Provide a separate screen based on a graphical representation of the cards in the PLC that clearly shows the location of each analogue and digital device in respect to its connection to PLC I/O cards. For wording see item .4 above.
 - .8 Include full scale setting in headings of hard copy reports as applicable.
 - .9 Summary: Provide screens that show each device using the integrator's numbering system, JRCC tag and descriptive name. Screens to indicate approved full scale calibration ranges which have been verified to match device settings. Screens to display digital and analogue inputs being received in a manner that allows comparison to actual device readings being displayed.
 - .17 Registers of the SCADA system that provide totals or instantaneous values shall match exactly to the instruments generating the data.
 - .18 Screens to display all operator set points. Each and every change to a set point is to be permanently logged on a single set point log screen with a date stamp. The log shall include a description of the set point, the past and new set point.
 - .19 Service time interval Screen: Provide a service time interval screen to display service interval times for items such as equipment oil changes and other re-occurring events as identified. Provide a pop up display when the service time has been reached and print pop up display on alarm page. To reset pop up ensure a "password" is required. Display on the screen for each piece of equipment:
 - .1 Obtain Manufacturers recommended service frequency and obtain Departmental Representative's approval of items of service and service frequency.
 - .2 Equipment and Work required with a box that displays the Manufacturers recommended service frequency (with applicable units).
 - .3 Date that last service timer pop-up was reset.
 - .4 A running summary that provides an overall listing of when service times were reset. Ensure values cannot be altered or erased.
 - .5 Count down timer that shows remaining time until service is required.

- .6 Separate password protected file to allow Manufacturer's service time interval to be altered.
- .20 Screens to display animation, as a minimum
 - .1 Indicate motors are operating.
 - .2 Show position of valves by change in color.
 - .3 Show position of valve if it is modulating.
 - .4 Show instrument as being in either "active" mode where data is being generated and used in programming or hard copy reporting or "inactive" where data is not being used in programming or hard copy reporting.
- .21 Program to distinguish between 'manual' and 'automatic' dial-up (via web) activation to Plant from remote station.
 - .1 Automatic dial-up will initiate a polling of the entire site for data logging and data base (used to compile spreadsheet charts and hard copy print-outs) updates only.
 - .2 Manual dial-up is not to poll for data logging and data base updates but is to function for "on-line" viewing of the system components only.
- .22 Program to provide for the setting of various levels of access security.
- .2 Shall be FCC and DOC approved.

2.4 PRESSURE, HUMIDITY AND TEMPERATURE TRANSMITTERS

- .1 Provide a trend screen that tracks pressure, humidity and temperature (as applicable) on units.
- .2 Provide operator enterable alarm set points.

2.5 DATA DOWNLOADING SEQUENCE

- .1 Program the PLC such that the treatment plant is on line to the SCADA station.
 - .1 To be immediately initiated by the activation of conditions including, but not limited to, the following:
 - .1 Alarm condition
 - .2 Change of status
 - .3 Other parameters as field determined by Departmental Representative.
 - .2 Treatment plant PLC to compile historic trending data for all monitored functions.
 - .3 Historical trending hard copies to be automatically completed by compiling "spot readings" at regular intervals as directed by Departmental Representative.
 - .4 Provide software to allow an automatic remote call from the host computer is to initiate downloading and printouts of historical trending data only.

2.6 VALVE LIMIT SWITCHES

- .1 Account for the position of each actuated valve.

2.7 PLC ENCLOSURE PANEL

- .1 The PLC hardware enclosure panel shall be complete with all items indicated on the drawings and shall be complete with the following:

- .1 Wall mount or floor mount panel in one grouping c/w appropriate lightning arrestor to protect equipment from induced line surge.
- .2 All wiring is to have wire markers. All field wiring is to be made to terminal bars that have been clearly labeled in the shop drawings.
- .3 PLC hardware including CPU, EEPROM, chassis, racks, cartridges, cables, termination blocks, etc.
- .4 System to allow for custom alarm messages and remote alarm acknowledgement via internet/email.
- .5 PLC to have a master option to provide the ability to dial out upon exception.
- .6 Supply spare fuses equal to the number used.
- .7 Identification nameplates on all components.
- .8 Shop drawings to include listing of all materials to be used including manufacturer's descriptive literature, all wiring details, charts of all I/O's and their function, chart of all panel labeling and proposed wording and panel layout.
- .9 CSA approved, front accessible, dead-front type with flush panel-mounted equipment having back connection terminals.
- .10 Panel to be sized as small as comfortably possible to house its components. Available mounting space near existing control panels may be limited in some locations. Location of panel to be approved by Departmental Representative prior to mounting.

2.8 MOTOR STATUS

- .1 Monitor electric motors for operation status including elapsed time (resettable and non resettable), number of starts (resettable and non resettable), run indication and control (H-O-A) switches position. Provide communications as required.
 - .1 Grinders
 - .2 Augers
- .2 Provide conduits, wiring and connections as necessary to supply appropriate input signal to PLC/computer station.
- .3 Motor status signals provided in the form of digital inputs and 4-20 mA as required.
- .4 Pumps in chambers: Provide low level shut down for all pumps in chambers.
- .5 Provide trending of run time and alarms status.

2.9 PLC

- .1 Use a programmable logic controllers (PLC) to provide remote terminal functions for use in the SCADA and telemetry applications.
- .2 PLC to be supplied equipped in accordance Section 25 51 00 "Control Components".

2.10 LIQUID LEVEL

- .1 Level transmitters and pressure transmitters provide 4-20mA output signals to be utilized for SCADA.
- .2 Transmitters in accordance with Section 40 72 00. Display all values.
- .3 Allow operator to enter set point values on SCADA input screen.

- .1 Provide a method for operator to input all alarm set points where applicable. Alarm conditions demanding PLC to dial-out based on priority shall include but not be limited to the following:
 - .1 PLC failure - Alarm 2.
 - .2 Control panel power switch to “OFF” - Alarm 2.
 - .3 Building intrusion - Alarm 2
 - .4 Additional conditions as directed by Departmental Representative which become evident during the project installation Works and warranty period.
- .2 Alarms shall include but not be limited to the following:
 - .1 **One** – Immediate dial out and notify remote computer – requires operator attention at site.
 - .2 **Two** – Notify remote computer
 - .3 **Three** – No dial out- Operator notified when plant is inspected.
 - .4 **Four** – Notify remote computer and Energize alarm lights.
- .3 The following table identifies the Analogue Alarms. The initial alarm numbers and set points are identified below. The operator shall have full access to change alarm numbers and set points.

[illegible]

- .4 The following table identifies the Digital Alarms. The initial alarm numbers are identified below. The operator shall have full access to change alarm numbers.

Device	Alarm Name	Alarm #	Description
BFS-101	Flow in overflow channel	1	
BFS-102	Building Flood (Basement)	1	
GRINDER 1	General Fault	2	
GRINDER 2	General Fault	2	
AUGER 1	General Fault	2	
AUGER 2	General Fault	2	
GENSET	Common Fault	3	
GENSET	Low Fuel	2	
MOD-101	Monitor Relay Alarm	3	
MOD-101	Valve Position	2	Valve does not reach desired location in 30 seconds
MOD-102	Monitor Relay Alarm	3	
MOD-102	Valve Position	2	Valve does not reach desired location in 30 seconds
Spare			
Spare			
Spare			
Spare			
Spare			
Spare			
Spare			
Spare			
Spare			
Spare			
Spare			

2.12 CHANGE OF STATUS

- .1 A change of status shall be defined as the altering of a control parameter to a status which is deemed to inhibit the intended operation of the sewage treatment facility.
- .2 Change of status conditions which shall notify the host computer include but are not limited to those identified as follows:
- .1 "HAND" or "OFF" position of the following control switches.
 - .1 Grinders
 - .2 Augers
 - .3 Valves
 - .2 Additional conditions as directed by Departmental Representative which become evident during the project installation Works and warranty period.

2.13 FIELD ADJUSTABLE INPUTS/OUTPUTS

- .1 Provide field adjustable input for all process variables such as time delays on motor start stop cycles, time delays on alarm notification, high/low pressures, high/low readings of all online instrumentation and meters, high/low levels and other parameters as directed by Departmental Representative.

- .2 Provide an overall chart of last inputted values to allow to see description, date and time of last change of any and all values. Set up chart to allow printing of change of settings and related data.

2.14 FIELD TROUBLESHOOTING OF EQUIPMENT

- .1 Provide a means to troubleshoot failure of equipment such as valves causing the program to “freeze”. Troubleshooting the cause of the freeze can be very difficult (ie PLC is waiting for a certain input from a valve closing or opening to go on to the next step but never gets the confirmation of valve status and thus “freezes”).
- .2 Provide operator with method to troubleshooting equipment failures by highlighting equipment failures by a change in color for example – ie. PLC is waiting for valve to close but does not get the input in 30 seconds thus valve failed and changes to color red and indicates an alarm.
- .3 Show all values obtained from all 4-20 mA inputs on a screen.

2.15 PRESSURES

- .1 Display and chart differential pressure between Process Room and Vestibule.

2.16 IDENTIFICATION

- .1 Provide lamicoid identification labels as specified in Section 22 05 54 "Identification".

2.17 GENSET

- .1 Provide ethernet between SCADA system and genset and discrete output from SCADA system to ensure that only 1 of the 3 blowers can be operated by the genset at any one time.
 - .1 Ensure SCADA system and PLC is on genset power.
- .2 Interface genset running and all genset alarms with SCADA system. Use hard wire(s) or software interface as described in section 26 32 13.
 - .1 “Engine Run”.
 - .2 ‘Engine shut down condition’.
 - .3 “Common failure”.
- .3 Interface genset running and all genset alarms with PLC. Use hard wire(s).
- .4 Disengage/engage thermostats for heaters on emergency bus.
- .5 Provide UPS power supply to hardware used in genset panel to communicate with PC.
- .6 Provide SCADA programming as required so that all process and motors automatically operate after a power loss and genset start without manual resetting of any equipment.
- .7 Complete wiring as required for genset software to PC. Set up genset monitoring software on PC. See Section 26 32 13.

2.18 SURGE SUPPRESSOR

- .1 Monitor counts as recorded by Surge Suppressor unit – see Section 26 43 13.
- .2 Provide settable and non resettable screen.

2.19 AUGER AND GRINDER EXERCISE

- .1 Provide switch to allow duty blower exercise based on weekly or daily blower alteration.

2.20 INTRUSION ALARM

- .1 See Section 28 16 00.
- .2 Integrate intrusion alarm with SCADA system.
- .3 Provide listing and zones of all alarms in hard copy and electronic format.

2.21 SUPERVISION RELAY ASSEMBLY FOR CONDITION MONITORING

- .1 Review Submersible Pump specification sections and other electrical sections to determine the use of supervision relays for condition monitoring of submersible pump systems.
- .2 Connect supervision monitoring alarms to SCADA monitoring system.

2.22 AUGER AND GRINDER SERVICE

- .1 Units require service such as oil changes, etc. Obtain Manufacturer's recommended data to provide listing.
- .2 Provide a pop up window (operator entered time) to indicate service is required.

2.23 INSTRUMENTATION

- .1 Control all online instrumentation operation by PLC. Review Section 25 51 00.01 for a listing of instrumentation.
 - .1 Include power to related online instrumentation.
- .2 Set SCADA to ignore online instrumentation for operator enter period of time after pump start.
 - .1 Set SCADA to ignore online instrumentation for operator enter period of time after start up.

2.24 TREND SCREENS

- .1 Group the trending information in the following trend screens. Minor adjustments of the trend screens will be completed during commissioning.

Trend Page 1 – Levels			
Device	Range	Units	Description
US-101	0-1	m	Sewage Level – Building Entrance
US-102	0-1	m	Sewage Level – Upstream of Grinder 1
US-103	0-1	m	Sewage Level – Upstream of Grinder 2
US-104	0-1	m	Sewage Level – Between Grinder 1 and Auger 1
US-105	0-1	m	Sewage Level – Between Grinder 2 and Auger 2
US-106	0-1	m	Sewage Level – After Auger 1
US-107	0-1	m	Sewage Level – After Auger 2

Trend Page 2 – Wastewater Trash Removal Process			
Device	Range	Units	Description
Grinder 1	0-1	Off/On	Pump run status
Grinder 2	0-1	Off/On	Pump run status
Auger 1	0-1	Off/On	Treated Discharge Flow Rate
Auger 2	0-1	Off/On	Treated Discharge Pressure
MOD-101	0-1	Off/On	Valve Position
MOD-102	0-1	Off/On	Valve Position

Trend Page 3 – Air Quality			
Device	Range	Units	Description
CH-101	0-5	%	Methane Gas Concentration (Basement area)
CH-102	0-5	%	Methane Gas Concentration (Main Level – floor level)
CH-103	0-5	%	Methane Gas Concentration (Main Level – ceiling level)
H2S-101	0-50	Ppm	Hydrogen Sulfide Gas Concentration (Basement area)
H2S-102	0-50	Ppm	Hydrogen Sulfide Gas Concentration (Main Level – floor level)
H2S-103	0-50	ppm	Hydrogen Sulfide Gas Concentration (Main Level – ceiling level)

Trend Page 4 – Building Power			
Device	Range	Units	Description
Genset	0-1	Off/On	Genset run status
Energy Meter	550-650	Voltage	(Future)
Energy Meter	0-300	Amps	(Future) Building Amp usage

2.25

POWER FAILURE

- .1 Provide equipment and operations to automatically start up and properly operate after an electrical power failure without the attendance of the plant operator.
- .2 Operate analyzers only when flow is occurring.
- .3 Provide a highly visual on screen notification if the data recording features of the SCADA system are turned off in any manner.
- .4 Maintain reminder until data recording features are re-established..

Part 3

Execution

3.1

INSTALLATION

- .1 Furnish manufacturer's drawings and instructions for the installation of the equipment.
- .2 Mount equipment and enclosure panels as described in the specifications.
- .3 Install and calibrate level monitoring and pressure monitoring assemblies as directed by the Departmental Representative.

- .4 Make all mechanical and electrical connections between the various components, noted or implied.
- .5 Coordinate between the different manufacturers in the assembly of components.
- .6 Mount/place CPU/ UPS /printer and other related hardware on stands or attached to the desk in a manner that does not utilize the working area of the desktop. Ensure switches and CD tray is accessible.
- .7 Co-operate to produce a video tape of operation, maintenance and training provided for all equipment. See Section 01 79 00.
 - .1 Ensure required video drivers and codecs/decoders are loaded onto the PC as may be required to view the DVD's as produced by the Company hired.
- .8 Integrate and calibrate all panels and controls with all related components.

3.2 START UP AND ADJUSTMENT

- .1 Upon completion of remote monitor package installation, test, adjust and place in operating condition.
- .2 Upon finalization of remote monitor package operation, test, adjust and place in operating condition at JRCC office.
- .3 Testing of the remote monitor system shall confirm the desired operation of the system including, but not limited to the following:
 - .1 Dial-up functioning of the entire system.
 - .1 Alarm and change of status notification.
 - .2 Systems to be "on hook" continuously during manual dial-up of Plant.
 - .3 Daily automatic dialing from host computer to Plant.
- .4 Alarm condition automatic notification to the host computer.
- .5 Dial in to all PLC's from remote computer.
- .6 All historical trending operations as programmed during start up.
- .7 Provide folders with backup copies of all data suitable for copy to DVD for a 2 month period after commissioning. Dial in and make files as required on a weekly basis.
- .8 Produce historic trending, hard copy reporting and water balance from developers package using Excel and any required add on modules (based on daily downloaded results) including monthly hard copy reporting for a minimum three month period after commissioning. Import all digital recording devices onto daily hardcopy printouts as directed by Departmental Representative.
 - .1 Review hard copy reports to ensure there are no "zero" values that are recorded when the process is not operational and that data as printed for min/max/averages or totals is representative and reasonable. Ensure values do not "swing" greatly for a stable process or measurement variable and that values are not different on a day to day period without reason. In general review reports for a minimum three month period to ensure values are reasonable and reporting is stable without errors. Investigate (including review of trend screens as applicable), report and repair as required

3.3 MONITORING SOFTWARE

- .1 Customize monitoring software package at JRCC offices in presence of Departmental Representative. Ensure all monitored devices and equipment is connected and logged as required.
 - .1 Tailor program to provide all functions as outlined in “Part 2 - PRODUCTS” and as field directed by Departmental Representative.
 - .2 ‘Fine tune’ program functions, operation and screen displays as site directed by Departmental Representative.
 - .3 Confirm and program all automatic dial-up and download procedures.
- .2 Install monitoring software program onto computer station located at the JRCC office after finalization of its operation at JRCC.
 - .1 Confirm and program all automatic upload and download procedures.

3.4 PLC ENCLOSURE PANEL

- .1 Locate PLC enclosure panel in control room together with all other control and electrical panels.
- .2 Mount on backing boards in accordance with Section 26 05 00 "Common Work Results for Electrical". For floor mounted units, install housekeeping pad.
- .3 Obtain Departmental Representative’s approval of mounting location prior to final installation and hook-up.

3.5 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- .1 Locate PLC and related components inside its own enclosure panel or as approved by Departmental Representative.

END OF SECTION

DIVISION 26

ELECTRICAL

Part 1 General

1.1 GENERAL

- .1 This section covers items common to Sections of Division 26. This section supplements requirements of Division 1.
- .2 Supply of various electrical components are included in Divisions other than Division 26. Be responsible to review all specifications sections and all related shop drawings as prepared by the various project sub contractors pertaining to electrical works.
- .3 Supply materials and complete works to make all electrical components operational and fully integrated even if not specifically itemized in other Divisions.
- .4 Complete electrical work as required, as stated and as implied to make electrical components supplied in other divisions fully operational. A partial listing of electrical works that may include equipment supply with electrical implications is:
 - .1 Trash Grinding and Screen Equipment Section 46 33 66
 - .2 Process Equipment Division 40
 - .3 Integrated Automation Division 25
 - .4 Mechanical Division 22 and 23
 - .5 Material Processing and Handling Equipment Division 41

1.2 REFERENCES

- .1 CSA C235:19; Preferred Voltage Levels for AC Systems up to 50,000 V.
- .2 CSA C22.1:21; Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .3 CSA C22.3 No. 1:20; Overhead Systems, Includes Administrative Update (2021) and Update No. 1 (2022).
- .4 CSA Z85 (1983), Abbreviations for Scientific and Engineering Terms
- .5 EEMAC 2Y-1-1958; Light Grey Colour for Indoor Switch Gear.
- .6 EEMAC Y1-2-1979; Performance Specification for Finishing Systems for Outdoor Electrical Equipment.

1.3 SCOPE

- .1 The works shall include the furnishing of labour, material, equipment and services necessary for to the complete installation of the electrical work as shown on the drawings and as hereinafter specified.
 - .1 See Section 46 43 66 Trash Grinding and Screening Equipment for electrical scope and co-ordination for chemical feed equipment.
 - .2 See Division 40 for electrical scope and co-ordination for instrumentation and monitoring equipment and accessories.
 - .3 A new underground electrical service from the existing customer owned distribution network is required for the electrical supply to the wastewater trash removal building.
 - .4 Provide temporary power supply as required in the construction phase at wastewater trash removal building.

- .5 Co-ordinate all electrical service to site works with the Departmental Representative.
- .2 The specifications shall be considered as an integral part of the drawings which accompany them. Neither the drawings nor the specifications shall be used alone and all services, materials or apparatus, etc., omitted from one but mentioned, shown or reasonably implied in the other shall be considered as properly and sufficiently specified and shall therefore be supplied and installed by the Electrical Trade.
- .3 Unless otherwise specified in this section of the specifications, the Electrical Trade shall supply and install all devices required for the complete approved system, operating to the complete satisfaction of the Departmental Representative.
- .4 Electrical service supply – Co-ordinate with the Departmental Representative all outside works and connections between customer owned distribution and supplied works and this contract.
- .5 Telephone service supply – Co-ordinate with the Departmental Representative all outside works and connections between owner supplied infrastructure and works within this contract.

1.4 ELECTRICAL SUPPLY

- .1 Provide and install 225A, 600V, 3 phase, underground service from customer owned distribution to new trash building. Coordinate all requirements with Departmental Representative.
- .2 Provide conduit and wire as required.

1.5 PLANT COMMUNICATIONS PROTOCOLS

- .1 The specifications may or may not specify a specific make/manufacturer as a sole source thus the communication protocols required for equipment with communication protocols will depend upon the PLC type/system chosen by the Contractor.
 - .1 The specifications and plans also may indicate specific communication protocols as being required for specific equipment.
- .2 Be responsible to co-ordinate connectivity protocols for all equipment supplied by Contractor, pre-selected supplier or by others and ensure communication protocols for all equipment are compatible throughout.
 - .1 For network speed consider 100 Mbps as minimum.

1.6 SHOP DRAWINGS

- .1 Refer to Section 01 33 23 Shop Drawings, Product Data and Samples for shop drawing submission details and requirements. Prepare all required shop drawings in accordance with Section 01 33 23 and as requested within Division 26.
- .2 Submit for approval all equipment such as main distribution, sub-distribution, transformers, lighting fixtures, heating equipment, auxiliary systems, transducers, genset, and all associated devices as outlined in Division 26.
- .3 Control diagrams: Provide drawings that are circuit specific and include a reference (drawing name/number and/or Specification reference) to the associated item in the contract documents. Include logic diagrams identifying system control logic. Provide specific equipment service names and loop tag numbers consistent with the Drawings on each respective diagram.

- .4 Items to be submitted for controls and SCADA- See Sections 25 51 00 and 25 91 00.

1.7 CARE, OPERATION AND START-UP

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

1.8 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .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 Post instructions where directed.
 - .4 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .5 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.
- .3 Project Record Drawings:
 - .1 Before commencing work, obtain a set of white prints of all drawings pertinent to the work. Keep drawings on site and continuously update drawings to accurately record in colored pencil, all items such as change orders, alterations or additions, runs of conduit, numbers and locations or outlets, motors, panels and luminaires that may occur during progress of the work. Transpose this information onto a set of the latest issue prints. All conduit runs must be shown on the record drawings, complete with size and wire count. Dimension buried conduit and cables from permanent datum points such as buildings.
 - .2 Before requesting substantial performance certificate, make necessary final corrections, sign and date prints as accuracy certification and deliver to Departmental Representative.
 - .3 Provide written programming values entered into all electronic equipment whether factory or field programmed.

1.9 COMMISSIONING AND TRAINING

- .1 Review Sections 01 91 13 and 01 79 00 and include commissioning and training.

1.10 POWER TO INSTRUMENTS

- .1 When instruments are on piping that is monitoring a process that cycles on/off do not power off the instrument unless otherwise directed by Departmental Representative.

1.11 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3 C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions without damage.

1.12 CODES AND STANDARDS

- .1 Complete installation to CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems to CSA C22.3 No. 1-15 except where specified otherwise.
- .3 Maintain the integrity of the fire rating where openings are required in fire separations for pipes, cables, etc.
- .4 Abbreviations for electrical terms: to CSA Z85.

1.13 INTERNET

- .1 System to be configured to accept internet signal from a 3rd party internet supplier. See other sections for internet requirements. Division 26 includes a supply and installation building Ethernet and network communication system.

1.14 LAWS, RULES AND ORDINANCES

- .1 The installation of the electrical systems shall comply with requirements of Canadian Electrical Code latest edition, AHJ inspection department, and all provincial and municipal laws, rules and ordinances and to the satisfaction of the Departmental Representative.
- .2 In conflict between Electrical Code and plans and specifications the most stringent governs but the minimum requirements of the Electrical Code must be met or exceeded.
- .3 In conflict between the Electrical Code, the Electrical Authority having jurisdiction and this document the most stringent shall govern but the minimum requirements of the Electrical Code and Electrical Authority must be met or exceeded.
- .4 Verify point of service attachment with the power supply authority. Forward any construction charges from the power supply authority to the Departmental Representative for direct payment. Charges for temporary power are the responsibility of the Contractor.

1.15 PERMITS, FEES AND INSPECTION

- .1 Confirm service entrance location with Departmental Representative.
- .2 Obtain all necessary permits and pay all fees.
- .3 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.

- .1 Pay associated permit and inspection fees.
- .4 Arrange inspection of the work by Electrical Authority having jurisdiction.
- .5 Notify Departmental Representative in writing of changes required by Electrical Inspection Department.
- .6 Request AHJ to provide copies of all inspection reports, written comments and Acceptance Certificate and provide directly to Departmental Representative. Certify that there are no outstanding issues not shown on the Acceptance Certificate.

1.16 SITE INSPECTION

- .1 Examine the site and local conditions affecting the Work under this Contract. Carefully examine the drawings to be certain that the Work under this Contract can be satisfactorily carried out without changes to the building as shown on these drawings and before commencing the Work, examine the Work of the other Divisions and report at once any defect or interference affecting the Work of this section or the guarantee of the same.

1.17 WORK OF OTHER TRADES

- .1 Refer to drawings and specifications for electrical work in connection herewith. Where such work is included in any section of the specifications, install such equipment as specified and in accordance with the manufacturer's approved shop drawings.

1.18 RESPONSIBILITY

- .1 Install all work promptly in advance of concrete pouring or similar work. Provide and set sleeves as required. Should there be cutting and repairing of unfinished or finished work, employ the particular subcontractor whose work it is to do such cutting and repairing. Before being undertaken such work shall be laid out for the Departmental Representative's approval.
- .2 Co-ordinate openings in chambers where required to neatly run conduit and wiring to pumps, level controls and related appurtenances, conduit to the general area of the chambers to be cast in place. Before being undertaken such work shall be laid out for the Departmental Representative's approval.
 - .1 Provide water tight seals as per Section 03 15 00.
- .3 Arrange work in co-operation with other trades to not interfere with other work. In places where other pipes or ducts must be installed along with conduits, co-operate with other subcontractors so all pipes and ducts are installed in best arrangement.
- .4 Protect finished and unfinished work from damage due to the carrying out of the work.
- .5 Ensure sealing fittings are utilized where required to restrict the passage of gases or vapors from one portion of the electrical installation to the other at atmospheric pressure and normal ambient temperatures.
- .6 Remove all tools, surplus and waste material and leave the premises in a clean and satisfactory condition after completion of the electrical work.

1.19 GUARANTEE

- .1 Guarantee the satisfactory operation of all work and apparatus included and installed under this section of the specifications. Replace forthwith at no additional cost to the Departmental Representative, any part which may fail or prove defective within a period of twelve calendar months after final acceptance of completed installation provided that

such failure is not due to ordinary wear and tear. No certificate given, payment or partial use of equipment by Departmental Representative shall be interpreted as acceptance of defective work. This guarantee shall not act as a waiver of any specified guarantee for any greater length of time.

1.20 WORKMANSHIP

- .1 Execute all work in a professional and workmanlike manner to all applicable standards.
- .2 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act governing vocational training and qualification.
 - .1 Employees registered in provincial apprentice programs are permitted under the direct supervision of a qualified licensed electrician to perform specific tasks.
- .3 Ensure all supports, hangers and securing devices are solid and substantial.
- .4 Neatly lay out all work in its mechanical appearance and logically arrange for simplicity of installation, accessibility and electrical efficiency.
- .5 Provide to other trades and obtain from other trades all dimensional information as may be required to install and locate openings, piping and conduit for all electrical related equipment or material supplied under this section. Ensure openings, conduit and piping line up on the same plane in all directions with equipment to be connected. Obtain and confirm dimensions of all equipment to be serviced prior to cutting or placing openings or conduit to ensure proper alignment and placement of openings or conduit.
- .6 Rigidly attach panelboards, other cabinets, switch boxes, etc., to the structure by means of lag bolts, unistrut with suitable clips/hangers or other approved means of support.

1.21 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance Section 01 61 00 – Common Product Requirements.
- .2 Electrical equipment and materials to carry CSA, ULC or cUL approval and conform with applicable standards, **no exceptions or alternatives**.
- .3 Factory assemble control panels and component assemblies. Panel assembly, subcomponents and all internal components shall be CSA approved. Cabinet construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory and labour regulations and CSA certification for this type of work. Local approvals for panel construction including CSA will not be accepted.
- .4 Use stainless steel fasteners for all appurtenances for all works.

1.22 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Control wiring and conduit is specified in Divisions 25, 26 and 40.

1.23 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" to finish EEMAC Y1-2.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

- .2 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

1.24 GROUNDING

- .1 Supply and install a grounding conductor so arranged that under operating conditions, no injurious amount of current will flow in any grounding conductor.
- .2 Connect conductor to Code grounding regulations to the main distribution and other service switches including the service neutral conductor.
- .3 Protect grounding conductors where exposed to mechanical injury by means of rigid galvanized steel conduit or other approved means.
- .4 Ground the entire electrical system in accordance with the Canadian Electrical Code.

1.25 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, using Electrovert Type Z cable markers or coloured plastic tapes on both ends of phase conductors of feeders and branch circuit wiring. See Section 22 05 54 – Identification.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code to CSA C22.1 and Canadian Electrical Code use:
 - .1 Colour coded wires in communication cables, matched throughout system.
 - .2 Number coded wires in control cables, matched throughout system. Identify conductors with permanent indelible markings, numbered on both ends.
 - .3 Number coded pairs in instrument cables, matched throughout system. Pairs shall also be colour coded black and white for polarity indication. Identify conductor pairs with permanent identifying markings at both ends.

1.26 EQUIPMENT BASES

- .1 Provide bases as housekeeping pad to raise all equipment off floor minimum 100 mm. Do not install any mechanical or electrical equipment directly on floor.
- .2 Provide concrete bases (non shrink grout or concrete per Section 03 30 00) to equipment manufacturer's recommendations and as shown on the drawings.
- .3 Ensure new concrete is “tied” to existing concrete with drilled in place dowels.
- .4 Provide 10M or wire mesh as reinforcing steel to prevent shrinkage cracking.
- .5 Provide a chamfered edge.
- .6 Do not restrict future equipment servicing.
- .7 Size base as required for footprint of equipment plus 100 mm all around. Provide drains through bases if overall floor drainage is affected.
- .8 Provide shop drawings and obtain Departmental Representative's approval.

1.27 CONDUIT AND CABLE IDENTIFICATION

- .1 Color code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colors: 25 mm wide prime color and 20 mm wide auxiliary color as follows.

Type	Primary Colour	Auxiliary Colour
Up to 250 V	Yellow	-
Up to 600 V	Yellow	Green
Telephone	Green	-
Other Communication Systems	Green	Blue
Fire Alarm	Red	-
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

1.28 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for copper or aluminum conductors.

1.29 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible after equipment is installed.

1.30 WARNING SIGNS

- .1 In accordance with requirements of Electrical Inspection Department and Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

1.31 CONDUIT LOCATIONS

- .1 The Contract Drawings shall be considered as diagrammatic, actual locations of the conduit, ducts, cables, etc., indicated in the plans and specifications and as required to complete works to be located for best layout to the Canadian Electrical Code.
- .2 Contract Drawings do not show all the structural details. Accurate dimensions shall be taken from the figured dimensions of the Drawings or by site measurements. The Electrical trade shall make, without additional charge, necessary changes or additions to conduit runs to accommodate as built structural conditions.
- .3 The drawings indicate the general locations and route to be followed by the conduit and duct installed under this Contract. Suspended conduits, ducts and boxes to be installed to conserve the maximum head room above the floor unless otherwise shown on the drawings or approved by the Departmental Representative. Strap all conduits to the floor, wall or ceiling.
- .4 If electrical servicing of equipment must be completed where a cast in the floor conduit cannot be used, service equipment with aluminum cable or ladder trays suspended a minimum of 2.3 m above the floor.
- .5 To service the augers, grinders, motors, instrumentation, etc placed in the "open floor area" of the plant cast conduits in building floor. Ensure conduit connections are watertight. Provide record drawings.
 - .1 Be responsible to review shop drawings of manufacturer's equipment prior to casting of building floor to best locate all required conduits in the building floor to service the actual equipment being provided.
- .6 Provide two additional 50 mm diameter conduits from the Office, to the building exterior, buried 1 m deep and 1 m away past the exterior wall for future use.

1.32 TOP SLAB CAST IN PLACE CONDUITS

- .1 Utilize cast in place conduits in building floor wherever possible to service all motors, on line monitors, genset and related accessories, devices and accessories, ultrasonic sensing devices, actuated valves and all control panels.
- .2 Be responsible for finished location of conduits. Locations shown on plans are approximate only. Co-ordinate installation with other trades.
- .3 Locate outlet boxes and fixtures with reference to the final floor, wall or ceiling finish and so secured that they will not be displaced by concrete placing.
- .4 Ensure other Divisions review all shop drawings and required works to provide a complete listing of required cast in place piping.
- .5 Consider dimensions shown for locations of cast in place piping as a guide only. Other Divisions to confirm required location of all cast in place piping based on their shop drawing review.
- .6 Provide shop drawings of intended conduit to be cast in place.
- .7 See Section 03 15 00 for cast in place conduit.
- .8 Provide record drawings.
- .9 A partial listing of required cast in place conduit works are (Note: more than one conduit may be required as electrical supply and SCADA input/output must be considered):
 - .1 Genset and transfer switch.
 - .2 To all pressure transducers.
 - .3 Level measurement devices.
 - .4 Valves with position indicators.
 - .5 600 V service entrance.
 - .6 Telephone and internet servicing.
 - .7 Between MCC and:
 - .1 Various motors.
 - .2 Related wiring connection locations.
 - .3 Related instrumentation.
 - .4 SCADA and related control systems.
 - .8 To provide electrical supply to interior wall plugs, etc.

1.33 CONDUITS TO SERVICE MOTORS

- .1 Be responsible for finished location of conduits. Locations shown on plans are approximate only.
- .2 To service the equipment placed in the "open floor area" of the building cast conduits in building floor. Ensure conduit connections are watertight. Provide record drawings.
 - .1 Be responsible to review equipment shop drawings prior to casting of building floor to best locate all required conduits in the building floor to service the actual equipment being provided.

1.34 ADDITIONS TO OR DELETIONS FROM WORK

- .1 Should the Departmental Representative desire to make changes whereby certain work is deleted, or added, submit an itemized estimate.

1.35 TESTING

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report indicating phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00.
 - .1 Power generation and 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 Communication systems.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation.
- .5 Supply written record of relay settings, test times and currents.
- .6 Carry out all tests and furnish all equipment required to demonstrate safe and proper completion of the work, without cost to the Departmental Representative.

1.36 RIGHT TO CHANGE LOCATIONS

- .1 The right to change locations of outlets, switches, etc., to within 3.0 m of points shown is reserved by the Departmental Representative provided change is requested prior to roughing-in. These changes do not include major items such as panelboards, motor control centers, etc.

1.37 TEMPORARY POWER

- .1 Temporary electrical power costs until project completion to be paid by Contractor.

1.38 MOUNTING LOCATIONS

- .1 Install devices at following heights (to C/L) above finished floor:

- .1 Wall switches - 1,200 mm – floor to center of switch.
- .2 Convenience receptacles - 355 mm above floor or 200 mm when located above workbenches or desks.
 - .1 Wall thermostats and humidistats - 1,500 mm.
 - .2 Heaters - minimum 2,600 mm for suspended unit heaters.
- .3 Where outlets are located in party walls on opposite sides of the wall, separate by 400 mm wherever possible.
- .4 Arrange outlets to accommodate mechanical installation. Do not install outlets in areas until the mechanical work is laid out. Final arrangement of light fixtures, as approved by Departmental Representative, shall provide best possible lighting for the mechanical equipment.
- .5 Surface mount all conduits, receptacles, switches, etc. except:
 - .1 Receptacles, switches, etc inside a washroom or office. In these locations mount such devices and equipment flush in the wall. Ensure trim is used to make a neat finish.

1.39 MECHANICAL EQUIPMENT

- .1 Refer to Divisions 22, 23, 40, 44 and 46 of the specification as well as to Mechanical drawings.
- .2 Supply and install line and control voltage wiring, provide indicated control equipment.

1.40 VAPOUR BARRIER

- .1 Ensure all screws used to fasten equipment to the walls and ceiling provide a “seal” that maintains the vapor barrier rating.
 - .1 Conduits to ceilings. Use screws (matching those used for ceiling panels) into structural member with washers to preserve vapour barrier.
- .2 When using screws into plywood behind panels ensure screw length does not puncture vapour barrier.
- .3 Provide samples of screws, gaskets and materials to be used to fasten equipment and maintain vapour barrier as per Section 01 33 23.

1.41 TRENCHING AND BACKFILLING

- .1 All trenching and backfilling as necessary for installation of underground cables between wastewater trash removal building and the lift stations and the motorized gate shall be the responsibility of the Electrical Trade.

1.42 SERVICE ENTRANCE

- .1 Underground service entrance is by building contractor.
- .2 Provide service entrance wiring (as shown on the single line diagram). Make all arrangements to provide connection to Stony Mountain Institute’s distribution system.

1.43 MOUNTING

- .1 There are two general types of wall systems being utilized.

- .1 For wall with plywood backing behind the liner panels, attach panels with stainless steel screws. Ensure screws extend to the full depth of the plywood.
- .2 For wall system with concrete block, use concrete screws or anchors.
- .2 Where the protective coating of U-channel support material is disturbed or bare metal is exposed due to drilling, filing, sawing or by other means, restore the protective coating by applying appropriate primer prior to painting.

1.44 DRAWINGS AND SPECIFICATIONS

- .1 The intent of the drawings and specifications is to include all labour, products and services necessary for complete work, tested and ready for operation.
- .2 The drawings and specifications compliment each other and what is required by one shall be as binding as if required by all.
- .3 The plans are largely schematic and do not show all the structural, architectural, equipment, etc., details. Examine all drawings and specifications before beginning the work to ensure that the equipment may be installed as specified and indicated. Report to the Departmental Representative any discrepancies or interferences which may occur.
- .4 Control and instrumentation system layouts shown on the plans are generally diagrammatic and equipment location is approximate hence routing of conduits, cables, wiring, and tubing to be governed by prevailing structural and architectural conditions.
- .5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the work. Review mechanical drawings and specifications and provide wiring and controls for all electrical motors and controls shown or specified in the Mechanical Divisions.
- .6 Responsibility to determine which division provides various products and work rests with the Contractor. Additional compensation will not be considered because of the difference in interpretation of specifications.

1.45 INSTALLATION REQUIREMENTS

- .1 Install all instrumentation and control devices according to details provided in specification and on associated drawings (i.e. P & ID, location drawings, schematics, vendor prints, mounting details, etc.). Where details are not provided, follow good industry practice and ISA installation requirements.
- .2 Installation of all instrument and control field hardware (unless otherwise specified), is required. This includes all requirements for mounting the sensing devices and transmitters for the detection of process conditions. This shall include, but not be limited to, the installation of all couplings or nipples, flanges, etc., on process lines, vessels, tanks for temperature measurement (gauges), and for pressure measurements (gauges and transmitters). Isolation valves, sensing lines, raceways as well as the instrument mountings shall be included.
- .3 Installation of all materials for transmitters and mounts, associated electronics, wiring, cabinets and mountings.
- .4 Installation of all final control devices (except motorized valves). This includes the installation of all accessories.
- .5 Installation of all 120 V power supply to operate the instrumentation and controls is specified under Division 26.
- .6 Installation of field wiring shall include, but not be limited to:

- .1 All wiring and trays, conduit, brackets, wiring between the primary sensing devices and the transmitters, local panels, etc.
- .2 All wiring between the transmitters, switches and the PLC components.
- .3 All wiring between the PLC components and the MCC's and central control panel.
- .4 All wiring for local indication and alarms.
- .5 All wiring between the local panels and the MCC and central panel.
- .6 All other field wiring required to make the instrumentation and control system fully operational.
- .7 Check all wiring for continuity and circuit prior to start-up to detect any errors made during installation.
- .8 Ensure wheels of carts or other lifting and moving devices have rubber tires and that method of moving heavy equipment does not mark the floor.
- .9 Where surface mounted, mount all conduits, cabinets, sensing lines, and control and field devices on stainless steel or fiberglass strut U channel section with stainless steel bolts and anchors. Use a minimum of two channels per cabinet and maximum of 1.5 m on center for conduits and sensors. Conceal conduit work in finished areas.

1.46 CO-ORDINATION WITH OTHER DIVISIONS

- .1 Examine the drawings and specifications of all divisions. Before commencing work, obtain a ruling from the Departmental Representative if any conflict exists.
- .2 Install anchors, bolts, pipe sleeves, hanger inserts, etc., in ample time to prevent delays.
- .3 Lay out the work and equipment with due regard to architectural, structural and mechanical features. Refer to architectural and structural drawings regarding location of walls, doors and equipment.

1.47 SEPARATION OF SERVICES

- .1 Maintain separation between electrical wiring system and building piping, ductwork, etc., so that wiring system is isolated (except at approved connections to such systems) to prevent noise transfer and galvanic corrosion.
- .2 In particular, contact between dissimilar metals such as copper and aluminum, in damp or wet locations, is not permitted.
- .3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Departmental Representative and ceiling installer, and approved clips or hangers are used.

1.48 BURIED CABLE

- .1 Complete supply and installation of buried cable (wire) between:
 - .1 Customer owned distribution and MCC service entrance.
 - .2 MTS to service building.
- .2 Place cable in PVC conduit buried as per electrical code.
- .3 Each conductor to be without splices or joints.
- .4 Connections to be watertight and neat.

1.49 HVAC SYSTEMS

- .1 The building(s) are heated by electric units.
- .2 The building(s) have ventilation system(s).
- .3 Be responsible for wiring all fans, dampers, heater motors, thermostats, humidistats, ceiling fans and all other HVAC components and controls. Refer to Division 40 and 23 for complete listing of HVAC controls and components.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- .2 IEEE 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.
- .3 IEEE 241-1990, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.
- .4 IEEE 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).
- .5 IEEE 399-1997, IEEE Recommended Practice for Industrial and Commercial Power System Analysis (Brown Book).
- .6 IEEE 1015-2006, IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems [BLUE BOOK].
- .7 IEEE 1584-2018, IEEE Guide for Performing Arc-Flash Hazard Calculations.
- .8 IEEE 1584.1-2013, IEEE Guide for the Specification of Scope and Deliverable Requirements for an Arc-Flash Hazard Calculation Study in Accordance with IEEE Std 1584(TM).
- .9 IEEE C37.13-2015, IEEE Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
- .10 IEEE C37.41-2016, IEEE Standard Design Tests for High Voltage (>1000V) Fuses and Accessories.
- .11 IEEE C37.010-2016, IEEE Approved Draft Application Guide for AC High Voltage Circuit Breakers > 100 VAC Rated on a Symmetrical Current Basis.
- .12 IEEE C57.12.00-2021, IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- .13 NFPA (Fire) 70, National Electrical Code (NEC), 2020 Edition.
- .14 NFPA (Fire) 70E, Standard for Electrical Safety in the Workplace.

1.2 SUBMITTALS FOR REVIEW/APPROVAL

- .1 The short-circuit and protective device coordination studies shall be submitted to the Departmental Representative prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Departmental Representative may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.3 SUBMITTALS FOR CONSTRUCTION

- .1 The results of the short-circuit protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies

of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.

- .2 The report shall include the following sections:
 - .1 One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations.
 - .2 Descriptions, purpose, basis and scope of the study.
 - .3 Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
 - .4 Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
 - .5 Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.
 - .6 Incident energy and flash protection boundary calculations.
 - .7 Comments and recommendations for system improvements, where needed.
 - .8 Executive Summary including source of information and assumptions made.

1.4 QUALIFICATIONS

- .1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be licensed to practice in the Province of Manitoba and be a full-time employee of the Engineering Services Organization.

Part 2 Products

2.1 STUDIES

- .1 Furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. Submit under seal from and engineer licensed to practice in the Province of Manitoba.
- .2 Contractor / supplier to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 600 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.

- .3 Furnish an Arc Flash Hazard Analysis Study per NFPA 70E, reference Article 130.3 and Annex D.

2.2 DATA COLLECTION

- .1 Furnish all field data as required by the power system studies. The Engineer performing the short-circuit protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination may include present and future utility supplies, motors, and generators.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- .1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE 141.
- .2 Use transformer design impedances and standard X/R ratios when test values are not available.
- .3 Provide the following:
 - .1 Calculation methods and assumptions.
 - .2 Selected base per unit quantities.
 - .3 One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.
 - .4 Source impedance data, including electric utility system and motor fault contribution characteristics.
 - .5 Typical calculations.
 - .6 Tabulations of calculated quantities.
 - .7 Results, conclusions, and recommendations.
- .4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - .1 Electric utility's supply termination point.
 - .2 Incoming switchgear.
 - .3 Unit substation primary and secondary terminals.
 - .4 Low voltage switchgear.
 - .5 Motor control centers.
 - .6 Standby generators and automatic transfer switches.
 - .7 Branch circuit panelboards.
 - .8 Other significant locations throughout the system.
- .5 For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- .6 Protective Device Evaluation:

- .1 Evaluate equipment and protective devices and compare to short circuit ratings.
- .2 Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses.
- .3 Adequacy of transformer windings to withstand short-circuit stresses.
- .4 Cable and busway sizes for ability to withstand short-circuit heating.
- .5 Notify Departmental Representative in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- .1 Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- .2 Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- .3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- .4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- .5 Plot the following characteristics on the curve sheets, where applicable:
 - .1 Electric utility's protective device.
 - .2 Medium voltage equipment relays.
 - .3 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - .4 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
 - .5 Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters.
 - .6 Conductor damage curves.
 - .7 Ground fault protective devices, as applicable.
 - .8 Pertinent motor starting characteristics and motor damage points.
 - .9 Pertinent generator short-circuit decrement curve and generator damage point.
 - .10 Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center.
- .6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

- .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70, Annex D.
- .2 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

- .3 Calculate the flash protection boundary and the incident energy at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- .4 The Arc-Flash Hazard Analysis shall include all MV, 575v, & 600v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 75 kVA.
- .5 Specify safe working distances for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- .6 The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- .7 Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- .8 Base Arc Flash calculations on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2.

2.6 REPORT SECTIONS

- .1 Input Data:
 - .1 Utility three-phase and line-to-ground available contribution with associated X/R ratios.
 - .2 Short-circuit reactance of rotating machines with associated X/R ratios.
 - .3 Cable type, construction, size, # per phase, length, impedance and conduit type.
 - .4 Bus duct type, size, length, and impedance.
 - .5 Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
 - .6 Reactor inductance and continuous ampere rating.
 - .7 Aerial line type, construction, conductor spacing, size, # per phase, and length.
- .2 Short-Circuit Data:
 - .1 Source fault impedance and generator contributions.
 - .2 X to R ratios.
 - .3 Asymmetry factors.
 - .4 Motor contributions.
 - .5 Short circuit kVA.
 - .6 Symmetrical and asymmetrical fault currents.
- .3 Recommended Protective Device Settings:
 - .1 Phase and Ground Relays.
 - .2 Current transformer ratio.
 - .3 Current setting.
 - .4 Time setting.
 - .5 Instantaneous setting.

- .6 Specialty non-overcurrent device settings.
- .7 Recommendations on improved relaying systems, if applicable.
- .4 Circuit Breakers:
 - .1 Adjustable pickups and time delays (long time, short time, ground).
 - .2 Adjustable time-current characteristic.
 - .3 Adjustable instantaneous pickup.
 - .4 Recommendations on improved trip systems, if applicable.
- .5 Incident energy and flash protection boundary calculations.
 - .1 Arcing fault magnitude
 - .2 Device clearing time
 - .3 Duration of arc
 - .4 Arc flash boundary
 - .5 Working distance
 - .6 Incident energy
 - .7 Hazard Risk Category
 - .8 Recommendations for arc flash energy reduction

Part 3 Execution

3.1 FIELD ADJUSTMENT

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the arc flash coordination study. Field adjustments to be completed by the engineering service division of the agency that completed the arc flash study and the Electrical Contractor.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Insure closest device to fault opens in the least amount of time and prior to any other protective device i.e. a VFD short circuit should trip the related VFD breaker before the main breaker is affected.
- .4 Notify Departmental Representative in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

- .1 Provide an 89 mm x 125 mm thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD", and shall include the following information:
 - .1 Location designation.
 - .2 Nominal voltage.
 - .3 Flash protection boundary.
 - .4 Hazard risk category.

- .5 Incident energy.
- .6 Working distance.
- .7 Engineering report number, revision number and issue date.
- .3 Labels shall be machine printed, with no field markings.
- .4 Provide arc flash labels in the following manner and all labels shall be based on recommended overcurrent device settings.
 - .1 For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided.
 - .2 For each motor control center, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.
- .5 Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

- .1 The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA C22.2 No.18.1-13 (R2018); Metallic outlet boxes (Tri-national standard, with ANCE NMX- J-023/1 and UL 514A), Includes Update No. 1 (2015), Update No. 2 (2107).
 - .2 CSA C22.2 No. 18.2-06 (R2016); Nonmetallic Outlet Boxes, Includes Update No. 1 (2013) and Update No. 2 (2019).
 - .3 CSA C22.2 No. 18.3-12 (R2017); Conduit, Tubing, and Cable Fittings (Tri-national standard, with ANCE NMX-J-017 and UL 514B), Includes Update No. 1 (2014 and Update No. 2 (2020).
 - .4 CSA C22.2 No. 18.4-15 (R2019); Hardware for the Support of Conduit, Tubing, and Cable (Bi-National standard, with UL 2239), Includes Update No. 1 (2019) and Update No. 2 (2022).
 - .5 CSA C22.2 No. 18.5-13 (R2018); Positioning devices (Bi-national standard, with UL 1565).
 - .6 CAN/CSA C22.2 No. 65-18; Wire connectors (Tri- national standard with NMX-J-543-ANCE and UL 486A-486B), Includes Update No.1 (2019) and Update No.2 (2021).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):
 - .1 EEMAC 1Y-2 (1961), Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for copper bar.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper bar.
 - .5 Sized for conductors and bars as indicated.

- .4 Clamps or connectors for armoured cable, Teck cable, aluminum sheathed cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and perform work in accordance to the following:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.2 REFERENCES

- .1 CSA C22.1:21; Canadian Electrical Code, part 1 (24th edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .2 CSA C22.2 No. 38-18; Thermoset-Insulated Wires and Cables (Tri-National Standard, with UL 44 and ANCE NMJ-J-451).
- .3 CSA C22.2 No. 123-16 (2021); Metal Sheathed Cables.
- .4 CSA C22.2 No. 131-17; Type TECK 90 Cables.
- .5 CSA C22.2 No. 174-18; Cables and Cable Glands for Use in Hazardous Locations.
- .6 CSA C22.2 No. 239:21; Control & Instrumentation Cables.

Part 2 Products

2.1 LOW VOLTAGE WIRE (< 1000 V)

- .1 All wire to be stranded annealed copper conductors with cross-linked thermosetting polyethylene RW90 rated (XPLE) insulation, rated for 600 V, installation in wet environments and 90°C maximum conductor temperature.
- .2 Minimum insulation rating shall be greater than or equal to the highest voltage in which the insulation may be exposed to.
 - .1 Minimum insulation rating of 300 V in all cases.
- .3 Minimum conductor size of #12 AWG unless otherwise specified or a heavier gauge is required for application.
 - .1 Luminaire drops can be #14 AWG if fed from 15A circuits.
- .4 Cables directly buried or installed in underground raceways shall be cross-linked moisture resistant polyethylene XLPE, RWU90 rated.
- .5 Insulated conductors shall be colour coded as follows:

Wire	Colour	Single Phase	Three Phase
Phase A	Red	yes	yes
Phase B	Black	yes	yes
Phase C	Blue	-	yes
Neutral	White	yes	yes
Ground	Green	yes	yes

2.2 TECK/ACWU90 CABLE

- .1 CSA C22.2 No. 131.

- .1 Conductors:
 - .1 Grounding conductor: stranded copper as indicated.
 - .2 Circuit conductors: stranded copper, size as indicated.
- .2 Insulation:
 - .1 Cross-linked polyethylene XLPE rated to 600 V.
 - .1 RW90 for normal/wet applications and RWU90 for buried applications.
- .3 Inner jacket: polyvinyl chloride (PVC) flame and moisture resistant material.
- .4 Armor: Aluminum interlocking armor.
- .5 Overall jacket: Black PVC flame retardant material, FT4 or better rated.
- .6 Fastenings:
 - .1 One hole straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm diameter or larger to support suspended channels/unistrut/cable trays for loads as per manufacturer's guidelines.
- .7 Connectors: Watertight approved for TECK/ACWU90 cable.

2.3 ARMORED CABLE (BX)

- .1 Copper conductors with RW90 cross-link polyethylene insulated for 600 volts, rated not less than 90°C, and bare copper grounding conductor wrapped with bare interlocked aluminum armor.
- .2 All conductors #12 AWG or larger shall be stranded, Type RW90 cross-link polyethylene insulated for 1000 volts and rated for not less than 90°C .
- .3 Use armoured cable (BX) for lighting tails (maximum 3 m).

2.4 VFD POWER CABLE

- .1 1 kV rated VFD cable designed and shielded to reduce magnetic fields outside the cable so induced voltage from the cable to other power and control cables is eliminated.
- .2 CSA C22.2 No. 123 and CSA C22.2 No. 174 rated.
- .3 Three (3) bare soft copper grounding conductors.
- .4 RW90 rated XPLE insulated stranded copper main conductors.
- .5 Continuously corrugated impervious aluminum sheath shielding.
- .6 FT4 rated PVC jacket.
- .7 Use VFD cable for end connections at motors.

2.5 ETHERNET CABLE

- .1 Ethernet/data/voice cabling: Use augmented Cat 6 or 6a cables that meet or exceed the EIA/TIA 568B performance requirements.
 - .1 CSA Type CMG.
 - .2 22 or 24 AWG conductors.
 - .3 CSA rated 8P8C connectors.
 - .4 Provide center spline or separator.

- .1 LDPE or PP.
- .5 Sequential foot markers on jacket.
- .6 T568B termination ends.
- .2 For field-terminated end connections, contact type to match conductor type. Mixing of solid or stranded conductors with the opposite (solid or stranded) contact is not acceptable.
- .3 Factory or field-terminated T568B ends shall be colour coded as follows:

Pin	T568B Colour	Pair
1	white/orange stripe	2
2	orange solid	2
3	white/green stripe	3
4	blue solid	1
5	white/blue stripe	1
6	green solid	3
7	white/brown stripe	4
8	brown solid	4

2.6 FIBER OPTIC CABLE

- .1 All-dielectric OM1 multimode fiber cable.
 - .1 National Electric Code (NEC) OFNR, CSA FT-4 listed and tested to ICEA S-104-696.
 - .2 Fibers: 62.5 µm (OM1), minimum 6 count.
 - .3 Dielectric central strength member, tight buffered fiber.
 - .4 Black flame retardant and UV resistant outer jacket material, c/w a single ripcord.
 - .5 Single-mode ITU-T G.652D, ITU657.A compliant.

2.7 CANOPEN BUS CABLE

- .1 3107A Multi-conductor – EIA Industrial RS-485 PLTC/CM cable.
 - .1 NEC/UL CM, PLTC OIL RES II listed and FT1 CSA flamed tested.
 - .2 22 AWG stranded tinned copper conductors (2 pairs, 4 conductors).
 - .3 Datalene® foam high density polyethylene (FHDPE) insulation.
 - .4 Beldfoil® aluminum foil-polyester tape outer shield.
 - .5 22 AWG tinned copper outer shield drain wire.
 - .6 PVC outer jacket.
- .2 Insulated conductors shall be colour coded as follows:

Pair	Colour
1	white/blue stripe & blue/white stripe
2	white/orange stripe & orange/white stripe
- .4 VFD unit(s) wire connection ends: Provide a CANopen bus cable to RJ45 drop- cable- 300 mm long. For Schneider VFD part number is VW3CANCARR03.

2.8 CONTROL CABLES

- .1 Analog instrumentation single or multiple pair cable rated to CSA C22.2 No. 239, Control & Instrumentation Cables (Type ACIC).
 - .1 7 strand tinned copper conductors, individually and overall shielded pairs. Minimum 16 AWG or as noted on plans.
 - .2 Pairs: black & white, colour code and number code for each pair.
 - .3 XLPE (RW90 rated) insulated conductors rated for 600 V.
 - .4 Polypropylene fillers and polyester separator tape.
 - .5 Overall aluminum /mylar shield with tinned copper drain wire.
 - .6 PVC inner protective jacket.
 - .7 Aluminum interlocking armor.
 - .8 Black flame retardant rated outer PVC jacket.

Part 3 Execution

3.1 INSTALLATION

- .1 Install wiring according to plans and conceal all wiring as much as possible.
- .2 Use conduit or Teck cables for all wiring unless otherwise indicated in the specifications. Wiring is to be located in the concrete slab wherever possible, with surface mounted wiring to be used only when cast in place conduits are not possible. All devices shall be surface mounted types except as shown.
- .3 Install wire and cable into ducts, cable trays and conduits in accordance to the specification sections herein and manufacturer's recommendations.
- .4 Support conductors at intervals not exceeding 1.5m. Where cables are run in close proximity to each other, they shall be grouped and installed in a neat and workman-like manner. Tie wire or perforated strap will not be accepted.
- .5 Do not pull wire or cable into conduit until rough building operations are complete.
- .6 Do not pass wire or cables through structural members.
- .7 When pulling conductors into conduit, do not use any lubricant which is harmful to the conduit or to the insulation of the conductors.
- .8 No splices in any wiring or cable run shall be permitted without the permission of the Departmental Representative delivered in writing.
- .9 Installation of control cables: Install control cables in conduit or cable troughs. Ground control cable shield at one end only. Shields to be continuous over entire run.
- .10 All exposed wiring shall be in conduit with appropriate fittings. Conduit in contact with earth shall be rigid PVC.
- .11 Equip boxes for outlets other than lighting fixture outlets switches suitable coverplates to accommodate the specified switch, convenience receptacle, etc.
- .12 Exterior outlet boxes to be weatherproof of the types shown or noted on the drawings and be complete with weatherproof covers.
- .13 Ground the entire electrical system in accordance with the Canadian Electrical Code.

- .14 Identification of all wiring and cable in accordance with Section 26 05 00.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Products listed above in Item 1.1.1.
 - .2 Printed product literature, specifications and datasheet, performance criteria, physical size, finish and limitations.
 - .3 Dimensional and layout data of all equipment.

1.2 REFERENCES

- .1 IEEE 837-2014, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

Part 2 Products

2.1 MATERIALS

- .1 Ground rods: Copper clad steel, 20 mm diameter x 3,000 mm long.
- .2 Grounding conductors: Bare stranded soft annealed copper wire, size as indicated.
- .3 Insulated grounding conductors: Green, type RW90.
- .4 Accessories: Non-corroding, necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install grounding system i.e. electrodes, ground wire in conduit, connectors and accessories to local authority requirements.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Connect ground rod electrodes using copper welding to be by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.

- .7 Install bonding wire for flexible conduit, connect both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Cleat bonding wire to conduit exterior.
- .8 Connect building structural steel and metal siding to ground.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of primary 600V system.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to equipment including but not limited to:
 - .1 Service equipment.
 - .2 Transformers.
 - .3 Frames of motors.
 - .4 Control panels.
 - .5 Building steel work.
 - .6 Distribution panels.
 - .7 Outdoor lighting.

3.4 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, fire alarm and security systems as follows:
 - .1 Telephones: Ground system to telephone company's requirements.
 - .2 Security, fire alarm systems as indicated.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.2 REFERENCES

- .1 CSA C22.1-18; Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .2 CAN/CSA C22.2 No. 18.1-13 (R2018); Metallic Outlet Boxes (Tri-National Standard, with ANCE NMX-J-023/1 and UL 514A), Includes Update No. 1 (2015), Update No. 2 (2017).
- .3 CSA C22.2 No. 85-14 (R2018); Rigid PVC Boxes and Fittings.
- .4 UL 514B; Conduit, Tubing and Cable Fittings.
- .5 UL 514C; Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Surface mounted outlet, switch and conduit boxes shall be:
 - .1 PVC conforming to CSA C22.2 No. 85, UL listed UL514B-UL514C.
 - .1 FT-4 rated.
- .6 Flush mounted outlet and switch boxes for the office, bathroom and lab areas shall be:
 - .1 Galvanized steel conforming to CSA C22.2 No. 18.1-13, Metallic Outlet Boxes.
- .7 Equip boxes for outlets other than lighting fixture outlets switches suitable coverplates to accommodate the specified switch, convenience receptacle, etc.
- .8 Exterior outlet boxes to be weatherproof of the types shown or noted on the drawings and be complete with weatherproof covers.
- .9 Provide approved Teck cable connectors for connection of Teck cables to boxes and enclosures.
- .10 Outlet boxes within hazardous locations shall be minimum NEMA 7 unless otherwise indicated.

2.2 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Rigidly attach outlet boxes to the building structure in an approved manner. Refer to Section 26 05 00 for mounting heights.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .5 Install 3 mm thick lead between boxes and the face of brick or concrete walls.
- .6 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .7 Vacuum interior of outlet boxes before installation of wiring devices.
- .8 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.2 REFERENCES

- .1 CSA C22.1:21; Canadian Electrical Code, part 1 (25th edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .2 CAN/CSA C22.2 No. 18.1-13 (R2018); Metallic Outlet Boxes (Tri-National Standard, with ANCE NMX-J-023/1 and UL 514A), Includes Update No. 1 (2015), Update No. 2 (2017).
- .3 CSA-C22.2 No. 18.2-06 (R2016); Nonmetallic Outlet Boxes, Includes Update No. 1 (2013) and Update No. 2 (2019).
- .4 CSA C22.2 No. 18.3-12 (R2017); Conduit, Tubing, and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B), Includes Update No. 1 (2014) and Update No. 2 (2020).
- .5 CSA-C22.2 No. 18.4-15 (R2019); Hardware for the Support of Conduit, Tubing, and Cable (Bi-National Standard with UL 2239), Includes Update No. 1 (2019) and Update No. 2 (2022).
- .6 CSA C22.2 No. 56-17; Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
- .7 CSA C22.2 No. 211.0-03 (R2017); General Requirements and Methods of Testing for Nonmetallic Conduit, Includes Updates No. 1 (2005), No. 2 (2006), No.3 (2011).
- .8 CSA C22.2 No. 211.2-06 (R2016); Rigid PVC (Unplasticized) Conduit, Update No. 1 (2011).
- .9 CSA C22.2 No. 227.3-15 (R2019); Nonmetallic Mechanical Protection Tubing (NMPT) and fittings (Bi-National Standard, with UL 1696).
- .10 NEMA TC 2-2020; Electrical Polyvinyl Chloride (PVC) Conduit.
- .11 UL 651; Schedule 40, 80, Type EB and A Rigid PVE Conduit and Fittings.

1.3 GENERAL

- .1 Acceptable construction method is PVC conduit or Teck cable unless otherwise stated.
 - .1 Use Teck cable for life safety systems such as emergency lights.
 - .2 PVC conduit shall be rigid, conduit assemblies shall be FT-4 rated.
- .2 Obtain approval from Departmental Representative for method of conduit or Teck installation.

1.4 LOCATION OF CONDUITS

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only. Wherever possible provide cast in place conduits to minimize surface mounted installations.

- .2 Ceiling: Fasten conduits along ceiling to exposed purlins, not steel liner panel.

1.5 EMBEDDED CONDUITS

- .1 Embedded conduits in concrete top slab - See Section 03 15 00, Section 26 05 00 and plans.
- .2 Drawings indicate conduit placement cast in place in top slab. Wherever possible provide cast in place conduits to minimize surface mounted installations.
- .3 Conduits placed in slab in process room area shall be encased in minimum 50mm of concrete up to 50mm above finished floor or shall be suitable for a class 1, zone 2 hazardous location.
 - .1 Maximum pipe OD cast into floor slab to be 20 mm.
- .4 Be responsible to review all shop drawings of all equipment prior to locating conduit to be cast in place. Locate conduit to best suit equipment requirements.
- .5 Review all process equipment layout prior to casting reservoir top slab. Maximize cast in place conduits to facilitate electrical installations.

Part 2 Products

2.1 CONDUITS

- .1 Rigid PVC conduit to provide physical and mechanical properties to conform to CSA C22.2 No. 211.2 and No. 211.0, NSF certified to UL651, NEMA TC2 unless otherwise noted.
- .2 PVC jacketed liquid tight flexible metal conduit where noted only: To CSA C22.2 No. 56, aluminum liquid-tight flexible metal. Provide when:
 - .1 Areas exposed to mechanical injury.
 - .2 To all motors and miscellaneous equipment.
 - .3 Conduits installed on or beyond the exterior of the building.
- .3 Minimum conduit size: 20 mm.

2.2 CONDUIT FASTENINGS

- .1 Two hole PVC straps to secure surface conduits 50 mm and smaller. Two hole PVC coated steel straps for conduits larger than 50 mm.
- .2 Stainless steel channel type supports and fittings for two or more conduits at 2 m on center.
- .3 Use stainless steel screws, maintain vapor barrier where applicable.

2.3 CONDUIT FITTINGS

- .1 Fittings: Manufactured for use with conduit specified. Coating: same as conduit.
 - .1 FT-4 rated.
- .2 Factory elbows where 90° bends are required for 25 mm and larger conduits.

- .3 Ensure conduit bends other than factory elbows are made with an approved bender. Making offsets and other bends by cutting and rejoining 90 degree bends are not permitted.
- .4 Watertight connectors and couplings for EMT and Teck cables.
- .5 Conduit between process room and any other room - Use EYS or EZS fittings to restrict the passage of gases from the lift hazardous areas to the non-hazardous areas.

2.4 FISH CORD

- .1 Polypropylene of adequate strength to pull additional wires/cables.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install all conduit, conduit fittings and accessories in accordance with the Canadian Electrical Code in a manner that does not alter, change or violate any part of the installed system components or the CSA/UL certification of these components.
- .2 Equip vertical runs of conduits with pull boxes containing approved wire strain supports at intervals as required by Code.
- .3 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .4 Use conduit for all wiring unless otherwise indicated in the specifications. Wiring is to be located in the concrete slab wherever possible, with surface mounted wiring to be used only when cast in place conduits are not possible. All devices shall be surface mounted types except as shown.
- .5 Do not pull wire or cable into conduit until rough building operations are complete.
- .6 When pulling conductors into conduit, do not use any lubricant which is harmful to the conduit or to the insulation of the conductors.
- .7 Lay out conduit as to avoid interference with other work and so that it can drain with no pockets in which water can collect.
- .8 Temporarily plug all conduits terminating in boxes or cabinets where moisture may enter.
- .9 Where runs are exposed on the surface, support conduit at intervals not exceeding as per that listed in the Canadian Electrical Code Part 1 and not exceeding 1.5 m.
- .10 Fastening conduits to walls: Use screws (matching those used for wall panels) into structural member with washers to preserve vapour barrier.
- .11 Fastening conduits to ceilings: Use screws (matching those used for ceiling panels) into structural member with washers to preserve vapour barrier.
- .12 Bends and offsets in conduits shall be equal to or less than the minimum bending radius of the cable to be installed.

- .13 Replace conduit if kinked or flattened more than 1/10 of its original diameter.
- .14 Run square and parallel or perpendicular to building lines.
- .15 Group conduits wherever possible in a neat and workmanlike manner, properly supported with approved hangers, securely anchored to surface channels.
- .16 Do not pass conduits through structural members.
- .17 Surface mount conduits except in finished areas or as indicated.
- .18 Provide liquid-tight flexible connection to all motors and miscellaneous equipment.
- .19 Use explosion proof flexible connection for connection to explosion proof motors.
- .20 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .21 Sleeve and seal all conduits passing through floors.
- .22 Maintain FT-4 rating.

3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 The plans indicate a partial listing of required cast in place conduit, provide conduits noted or implied. Install electric conduit in the concrete as required by the drawings and specified elsewhere in the specifications.
- .2 Locate terminations, outlet boxes and fixtures with reference to the final floor, wall or ceiling finish and so secured that they will not be displaced by concrete placing.
- .3 Terminate as shown on the plans. If the plans do not indicate a termination location:
 - .1 Terminate and cap above the floor such that the conduit can be extended at a later date.
- .4 Conduits with an OD larger than 29 mm and smaller than 60 mm - cast midway in top slab.
 - .1 Total available space in slab for multiple conduits : do not exceed 60 mm.
 - .1 If conduits cross total space available is not to exceed 60 mm. Thus two conduits that cross and are larger than 25 mm each is not permitted due to available space in the slab.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Organize conduits in slab to minimize cross-overs.
- .7 If the plans indicate termination near a building wall place vertical riser such that inside edge of conduit is within 50 mm of finished wall interior edge.
- .8 Complete all bends with a bending machine or use long sweep elbows.
- .9 Locations shown on plans are approximate only, set final locations to suit equipment use. If additional information of "exact" locations are provided during the construction process utilize such dimensions in placing the conduit.

- .10 Provide record drawings of all cast in place conduit.

3.5 CONDUITS UNDERGROUND

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

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 REFERENCES

- .1 CSA C22.1:21; Canadian Electrical Code, part 1 (25th edition), Safety Standard for Electrical Installations, Includes Errata 2021.

Part 2 Products

2.1 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with copper napthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 PVC DUCTS

- .1 PVC ducts, type DBII, concrete encased or direct buried, schedule 80 pipe, sizes as indicated.
- .2 Rigid PVC solvent welded type couplings, butt-end fittings, plugs, bends, caps, expansion joints, rigid PVC 50 angle couplings.

2.3 MARKERS

- .1 Polyethylene, 80 mm wide, yellow, marker tape marked "Caution, Buried Electric power Line". Repeat the imprint along the complete length of the tape.

Part 3 Execution

3.1 DIRECT BURIAL OF CABLES

- .1 Refer to Division 31 and do all excavation, backfill and related work required for the work of Division 26 in accordance therewith, except as modified by this article. Verify excavation routes and depths for underground electrical services are as indicated. Provide protective materials around and over electrical services.
- .2 For direct buried ducts or cables in all soil conditions excavate to below and a minimum of 200 mm to either side. Fill with a bedding of sand free of rock, stone and other sharp objects, minimum 150 mm above and below the cable.
- .3 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .4 Underground cable splices not acceptable.

- .5 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- .6 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .7 Cable separations.
 - .1 Maintain 75 minimum separation between cables of different circuits.
 - .2 Maintain 300 mm horizontal separation between low and high voltage cables.
 - .3 When low voltage cables cross high voltage cables maintain minimum 300 mm vertical separation with low voltage cables in upper position.
 - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cable and 150 mm between high voltage cable.
 - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
 - .6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.
- .8 Backfill in layers and compact to density of adjacent material.
- .9 Make all repairs to disturbed or damaged areas to match existing.
- .10 Provide cable warning tape 300 mm above the duct banks or cable as applicable, to indicate location of buried cables.
- .11 After sand protective cover specified is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in ducts simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cables into ducts and until cables properly terminated, seal ends of lead covered cables with wiping solder; seal ends on non-leaded cables with moisture seal tape.
- .7 Where ducts turn up above grade level, all bends shall have the same size and bending radius as the ducts. Fabricated bends may be used providing they are protected by concrete.
- .8 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

- .1 Mark cables along entire length of cable run and changes in direction.

- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C9-17 Dry-Type Transformers.
- .2 CAN/CSA C22.2 No.47-13 (R2018); Air-Cooled Transformers (Dry Type).
- .3 CAN/CSA C802.2-18, Test Method and Minimum Efficiency Values for Dry Type Transformers.
- .4 IEEE C57.12.91-2020; IEEE Standard Test Code for Dry-Type Distribution and Power Transformers.
- .5 NEMA ST 20-2014; Dry Type Transformers for General Applications.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to.
 - .1 Physical: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features.
 - .2 Electrical: Including kVA rating, primary and secondary voltages, etc.
 - .3 Quantity.
 - .4 Frequency.
 - .5 Angular displacement.
 - .6 Full load efficiency.
 - .7 Basic impulse level.
 - .8 Product Warranty.
 - .9 Design drawings, schedules, manufacturer's instructions on handling criteria, installation sequence and cleaning procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the dry-type transformers for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.4 COORDINATION

- .1 Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

Part 2 Products

2.1 TRANSFORMERS

- .1 Dry-type transformers: To CSA C9 and C802.2.
- .2 Type: ANN with copper primary and secondary coils.
- .3 KVA and voltage rating as indicated on drawings.

- .4 Insulation Classification: 220° C, UL-component-recognized insulation system with a maximum of 150° C rise above 40° C ambient temperature.
- .5 Basic impulse level (BIL): Standard.
- .6 Hipot: Standard.
- .7 Voltage Taps: Two 2.5 percent taps above and four 2.0 percent taps below normal full capacity.
- .8 Average sound level: NEMA ST 20 sound levels when factory tested according to IEEE C57.12.91.
- .9 Impedance at 170⁰C: Standard.
- .10 Enclosure: NEMA 12, removable front panel, drip hood.
- .11 Rating: Minimum K-Factor 4.
- .12 Temperature of exposed metal parts not to exceed 65°C.
- .13 Finish shall be light gray.
- .14 Mounting: As indicated on the drawings.

2.2 IDENTIFICATION

- .1 Label as per the following:
 - .1 KVA.
 - .2 Primary Voltage.
 - .3 Secondary Voltage.
 - .4 1 phase or 3 phase.
 - .5 Circuit number.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate level, secure, plumb, true and square to adjoining surfaces.
- .2 Ensure adequate clearance for ventilation.
- .3 Adjust isolation pad bolts until there is no compression visible.
- .4 Remove shipping supports after transformer is installed and before placing into service.
- .5 Wall mounted as indicated on the plans.

3.2 CONNECTIONS

- .1 Ground equipment according to Division 26.
- .2 Connect primary and secondary wiring in accordance with Division 26.

3.3 TESTING

- .1 Perform standard testing of transformers in accordance with Section 26 05 00.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - .1 Submittals required under this section shall indicate the following:
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
 - .6 Shipping sections and weights.
 - .2 Switchboard manufacturer to provide a coordination and short circuit study and submit to Departmental Representative with switchboard shop drawings:
 - .1 Manufacturer to obtain available fault current (at the customer connection point) from electrical power provider.
 - .2 Manufacturer to make all calculations, provide a complete report with separate statement confirming the following:
 - .1 Upstream Utility fusing and Utility fault level.
 - .2 Interrupting capacity of breakers being supplied.
 - .3 Provide device coordination curves for utility transformer and fusing, main breaker, main distribution, largest breaker, smallest breaker and 600:120/208 dry type transformers (75kVA and larger), largest motor.
 - .4 Summarize the study with a statement confirming device ratings are compatible with available short circuit and distribution equipment being provided. Confirm equipment is protected by respective breakers and comment on overall coordination.

1.2 REFERENCES

- .1 CAN/CSA C22.2 No. 106-M92 (R2001); HRC Fuses.
- .2 CSA C22.2 No. 5-16 (R2021), Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Tri-national standard, with UL 489 and NMX-J-266-ANCE-2016), Includes Update No.1 (2019).
- .3 CSA C22.2 No.31-18, Switchgear Assemblies, Includes Administrative Update (2021).
- .4 CSA C22.2 No. 39-13 (R2017), Fuseholder Assemblies.
- .5 CSA C22.2 No. 115:20, Meter-Mounting Devices.
- .6 IEEE C62.41.1-2002, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
- .7 IEEE C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the main distribution board equipment for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Submit Catalog Data and information as required to demonstrate that materials conform to the specification requirements. Data shall include features, characteristics, ratings and settings of all adjustable components.

1.4 MAINTENANCE MATERIALS

- .1 One set of spare parts as recommended by manufacturer, including:
 - .1 3 fuses for each type above 600A.
 - .2 6 fuses for each type up to and including 600A.

Part 2 Products

2.1 SERVICE ENTRANCE SWITCHBOARD

- .1 Service entrance board to CSA C22.2 No.31.
- .2 Power supply: 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current rated at 25 KA RMS symmetrical, voltage as indicated on the drawings.
- .3 Ampere rating: as indicated on the drawings.
- .4 Enclosure:
 - .1 Free-standing, totally enclosed sheet steel, 'sprinklerproof' enclosure with steel frame.
 - .2 Provision for installation of supply authority metering transformers.
 - .3 Customer metering instruments, transformers and selector switches.
 - .4 Distribution section or sections: See single line including spaces and spares as indicated.
 - .5 Hinged access panels with captive knurled thumb screws. Utility metering section to have provision for utility seals.
 - .6 High conductivity tin plated aluminum bus.
 - .7 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
 - .8 Identify phases with color coding.

2.2 MOULDED CASE CIRCUIT BREAKERS

- .1 Molded case circuit breakers to CSA C22.2 No.5.
- .2 Refer to Section 26 28 16.

2.3 FUSIBLE DISCONNECTS AND FUSES

- .1 Fuse holder assemblies to CSA C22.2 No.39.
- .2 HRC Fuses to CSA C22.2 No.106.
- .3 Refer to Section 26 28 23.

2.4 MAIN BREAKER SECTION

- .1 The main circuit breaker shall be a manually operable, fixed mounted molded case circuit breaker. Breaker shall be equipped with solid state o/c relay to provide the following time/current curve shaping adjustments:
 - .1 Long time pick-up setting.
 - .2 Long time delay.
 - .3 Short time pick-up.
 - .4 Short time delay.
- .2 Frame size ampere rating to be as indicated on the drawings.
- .3 Provide the relay with three light emitting diodes (L.E.D.'s) to indicate tripping occurred from long time overload, instantaneous or ground fault current. The relay shall be provided with contacts for remote indication. The breaker shall be equipped with in-built current sensors on each phase and neutral. Current sensors ampere tap setting shall be rated to match the frame size of the main breaker. Shunt trip shall be direct acting solenoid-type powered by the sensor/relay energy.

2.5 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end sized for grounding cable.
- .3 Bond non-current carrying metal parts to ground bus.
- .4 Connect to station ground and building ground bus.

2.6 CUSTOMER METERING SECTION

- .1 Digital metering:
 - .1 Standards: IEEE C62.41.1, IEEE C62.41.2.
 - .2 Phase selectable current and voltage (L-L and L-N).
 - .3 Capable of displaying kW, kVA, MWHR, kilowatt demand, current demand, kVA demand, frequency, power factor.
 - .4 LCD or LED display.
 - .5 Resettable minimum and maximum for current, voltage and p.f.
 - .6 Current and potential transformers as required.
 - .1 Potential transformers fused with separate fuse block, equipped with fuse holder and fuses.
 - .7 Current transformers: Dry type for indoor use with the following characteristics:
 - .1 Nominal voltage class as indicated.
 - .2 Rated frequency: 60 Hz
 - .3 Primary circuit rated to match ampere rating of main breaker trip. Secondary current rated at 5 amp.
- .2 Install metering units at "eye level" to read and use the meter.

2.7 SECONDARY DISTRIBUTION

- .1 Breakers shall have a minimum interrupting capacity of 25kA symmetrical.

- .2 The distribution section to be provided with sufficient spaces for breakers and spare spaces as indicated on drawings.
- .3 All transformer protective breakers and MCC protective breakers shall be equipped with fully adjustable LSI functions as shown.

2.8 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00:
 - .1 Service entrance switchboard finish to be exterior gray.
 - .1 Supply 2 spray cans of touch-up enamel.
 - .2 Treated to inhibit rusting.

2.9 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 22 05 54.
- .2 Nameplates:
 - .1 White plate, black letters, size 7, to indicate voltage, amp rating and designation
 - .2 Complete board labelled: 120/208 or 347/600 V, 3 phase, 4 wire Amps as indicated.
 - .3 Main disconnect labelled: "Main Breaker or Switch".
 - .4 Branch disconnects labelled: As indicated.

2.10 SHOP FABRICATION

- .1 Assemble and wire complete service entrance board.
- .2 Energize switchboard.
- .3 Check meters and phase selector switches.
- .4 Prepare switchboard for shipment to site.

2.11 FUTURE ENERGY MANAGEMENT

- .1 Provide terminal board and wiring from separate customer CT's and PT's to facilitate the future installation of thermal demand, watt hour energy management equipment, recorders, etc.

2.12 MANUFACTURERS

- .1 Preferable to have a single manufacturer for supply of above equipment.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate service entrance switchboard as indicated.
- .2 Connect main secondary service entrance cables to line terminals of switchboard.
- .3 Connect load terminals of distribution breakers to outgoing feeders, as indicated.
- .4 Check factory-made connections for mechanical security and electrical continuity.
- .5 Run one #3/0 AWG-bare copper grounding conductor in 25 mm conduit from ground bus to the main building ground.

- .6 Adjust relay settings to those indicated in shop drawings to ensure proper working and protection of components.
- .7 Manufacturer to provide test equipment and field test overload, magnetic and ground fault tripping. Include test report in Maintenance Manuals.
- .8 Perform 3 phase load testing under normal building load after project is deemed substantially complete. Measure voltage, current and power factor for 4 hours, sampling every 5 minutes and recording peak load. Customer metering device may be used for sampling. Recording instrument to be supplied by distribution manufacturer or third party - cost to be included.
- .9 Arrange for main distribution switchboard to be mounted on 4" (100 mm) housekeeping pad.
- .10 Switchboard manufacturer to provide a coordination and short circuit study and submit to Departmental Representative with switchboard shop drawings.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimensions.

1.2 REFERENCES

- .1 CSA C22.2 No.29-15 (R2019); Panelboards and Enclosed Panelboards, Includes Update No. 1 and 2 (2021).

Part 2 Products

2.1 PANELBOARDS

- .1 Provide circuit breaker type panelboards and main disconnect as shown on the plans.
 - .1 Load centre type panel boards are not acceptable.
- .2 Panelboards: To CSA C22.2 No.29 and product of one manufacturer.
- .3 Consist of cabinet, trim, removable interior, door cover, finished with concealed hinges and flush chrome plate lock and snap catch, all locks keyed alike (with four keys).
- .4 Construct cabinet of heavy gauge sheet steel with factory painted finish, with interior provided with adequate wiring space for conductors involved.
- .5 Equip panel boards with interiors designed for the voltage of the system, complete with the number and type of circuit breakers as shown. Multi-pole breakers shall be of one piece construction with common trip. Tie bars will not be accepted.
- .6 All copper bus equipped with solderless lugs for incoming cables. Neutral to have same ampere rating as mains.
- .7 Mains: Suitable for bolt on breakers.
- .8 Trim and door finish: Baked enamel grey.
- .9 Provide fillers in all panelboard spaces not occupied by breakers.
- .10 Current carrying capacity of single panel boards and each section of multiple section panel boards shall be at least equal to that of the feeder supplying them.
- .11 Provide CDP type panels where indicated
- .12 All CDP's and panelboards shall be minimum NEMA 12 rated.
- .13 Provide main breaker, size as indicated on single line diagram.

2.2 BREAKERS

- .1 Provide thermal and magnetic tripping in panelboards except as indicated otherwise.
- .2 Main breaker: Separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

- .3 Breakers for motors which are not in direct line of sight to be "lockable" for servicing of motors. Provide one lock for each four or less lockable type breakers.
- .4 Provide standard full width breakers unless otherwise noted.
- .5 Provide multi-pole breakers of one piece construction with common trip. Tie bars will not be accepted.
- .6 RMS symmetrical current interrupting capacity to match panel.
- .7 Provide circuit breaker locking clips.
- .8 Series rated circuit breakers acceptable
- .9 Refer to Section 26 28 16.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount panelboards to Code and be secure, plumb, and square and 2 metres from floor.
- .2 Current carrying capacity of single panel boards and each section of multiple section panel boards shall be at least equal to that of the feeder supplying them.
- .3 Install circuit breaker locking clips.
- .4 Wiring in panel boards shall be neat and set in as if laced.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Paint all backing boards "grey" with two coats prior to placing equipment.

3.2 IDENTIFICATION

- .1 Provide lamaroid identification labels as specified.
- .2 Number circuit breakers consecutively not alternately.
- .3 Circuit directory to be typewritten legend showing location and load of each circuit.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All products listed above in Item 1.1.1.
 - .2 Include all electrical wiring diagrams and installation drawings.
 - .3 Include material data sheets, dimensional and layout data of all equipment.

1.2 REFERENCES

- .1 CSA C22.2 No.42.1-13 (R2017); Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D), Update No. 1 (2016) and Update No. 2 (2020).
- .2 CSA C22.2 No.42-10 (R2020); General Use Receptacles, Attachment Plugs and Similar Wiring Devices, Includes Update No. 1 (2013), Update No. 2 (2016), Update No. 3 (2017), Update No. 4 (2019), and Update No. 5 (2021).
- .3 CSA C22.2 No.55:15 (R2020); Special Use Switches.
- .4 CAN/CSA C22.2 No.111-18; General-Use Snap Switches (Tri-national standard, with UL 20 and NMX-J-005-ANCE), Includes Update No. 1 (2021).

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in factory packaging, labeled with factory name and address.
- .2 Store materials indoors to manufacturer's recommendations in clean, dry, ventilated area.
- .3 Store and protect wiring devices from nicks, scratches, and blemishes.
- .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 SWITCHES

- .1 Single pole toggle to CSA C22.2 No. 111, white colour. Acceptable: Leviton or equal.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.

- .5 White toggle.
- .6 Specification grade.
- .3 Switches of one manufacturer throughout project.
- .4 Adequately support all boxes, independent of the conduit or cable runs.
- .5 Be responsible to ensure the integrity of the building vapour barrier.
- .6 Switches in Class 1, Zone 2 hazardous locations shall be manufactured by Crouse-Hinds No. EFS/EFD or approved equal. Number to suit application and amperage.

2.2 RECEPTACLES

- .1 Convenience Receptacles:
 - .1 Specification grade, 15 A (or as stated on the plans), 120 AC, U ground receptacle to CSA C22.2 No. 42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .2 Provide for all fractional horsepower motors complete with appropriate control of electrical power supply in accordance to process occurring.
 - .3 Install GFI circuit breakers for receptacles, except for fractional Hp motors.
- .2 Outdoor Receptacle:
 - .1 Duplex type, 15 ampere, 120V AC, U ground duplex receptacle to CSA C22.2 No. 42 complete with weatherproof cover, attached to outlet box at all four corners.
- .3 Where switches and receptacles are together: Ganged with a single cover plate.
- .4 Exterior: Use masonry type outlet boxes located in exposed concrete block or masonry of sufficient depth to allow conduit to pass through the centre of the block.
- .5 Provide appropriate receptacles for all appliances.
- .6 Receptacles of one manufacturer throughout project.
- .7 Adequately support all boxes, independent of the conduit or cable runs.
- .8 Be responsible to ensure the integrity of the building vapour barrier.
- .9 Receptacles in Zone 2 hazardous locations shall be manufactured by Crouse Hinds No. ENR or approved equal.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Grey PVC cover plates for wiring devices installed in surface-mounted utility boxes.
- .3 Grey PVC cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

- .5 Weatherproof double lift spring-loaded PVC cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded PVC cover plates complete with gaskets for single receptacles or switches.
- .7 Ensure all cover plates in the process room are suitable for a Zone 2 hazardous location and Category 2 wet location.

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.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated on plans.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect cover plate finish with plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings, see Section 01 33 23 Shop Drawings, Product Data, and Samples. Include breaker type, quantity and ampacity.
- .2 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.2 REFERENCES

- .1 CSA C22.2 No. 5-16 (R2021); Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010), Includes Update No. 1 (2019).

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Provide thermal and magnetic tripping except as indicated otherwise.
- .2 Main breaker: Separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .3 Breakers for motors which are not in direct line of sight to be "lockable" for servicing of motors. Provide one lock for each four or less lockable type breakers.
- .4 All breakers shall be standard full width breakers unless otherwise noted.
- .5 Moulded case circuit breakers to CSA C22.2 No. 5.
- .6 Bolt-on moulded case circuit breakers: Quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40° C.
- .7 Common trip breakers: With single handle for multi-pole applications.
- .8 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- .9 RMS symmetrical current interrupting capacity to match panel.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breakers to operate automatically by means of thermal and magnetic tripping devices and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breakers to operate by means of a solid state trip with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, fault short circuit protection.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breaker as indicated.

3.2 IDENTIFICATION

- .1 Provide lamacoid identification labels as specified.
- .2 Number circuit breakers consecutively not alternately.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Include product details and drawings of switches and enclosures.

1.2 REFERENCES

- .1 CSA C22.1:21; Canadian Electrical Code, Part 1 (25th edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .2 National Electrical Manufacturers Association (NEMA).

1.3 QUALITY ASSURANCE

- .1 Disconnect switches to be CSA certified for application and area installed.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Provide for electrical devices on plans, hard wired motors and heaters and to CSA C22.1.
- .2 Non-fusible, with voltage and amperage rated to suit loads.
- .3 Provision for padlocking in OFF position.
- .4 Mechanically interlocked door to prevent opening when handle is in ON position.
- .5 ON - OFF switch position indication on switch enclosure cover.
- .6 Heavy duty, industrial grade front operational quick-make, quick-break action.
- .7 Switches 100% load make/ load break rated.
- .8 Enclosures:
 - .1 Indoors:
 - .1 NEMA 12 in ordinary areas.
 - .2 NEMA 4 in humid environments.
 - .3 NEMA 4X in corrosive environments.
 - .4 NEMA 7 (Zone 2 Hazardous) rated in the process room.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches as per manufacturers recommendations.
- .2 Provide equipment identification in accordance with Section 26 05 00.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Provide the following diesel powered generator set under this specification.
 - .1 150kW continuous standby power, 0.8 power factor lagging.
- .2 Generating set consists of:
 - .1 Diesel engine.
 - .2 Alternator.
 - .1 Permanent magnet exciter design.
 - .3 Generator control panel.
 - .4 Muffler and flexible connections.
 - .5 Cooling system with low coolant level shut down switch and block heater.
 - .6 Battery charger and battery.
 - .7 Interconnecting wiring.
 - .8 Structural steel base.
 - .9 Integral dual wall subbase fuel tank complete with full fuel tank.
- .3 System designed to operate as standby source. Set shall be a packaged unit.
- .4 Controller to:
 - .1 Monitor operation of generator.
 - .2 Annunciate trouble.
 - .3 Sound alarms.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Make and model with brake horsepower curves.
 - .2 Alternator: make and model.
 - .3 Voltage regulator: make, model and type.
 - .4 Automatic transfer switch: make, model and type.
 - .5 Manual bypass switch: make and model.
 - .6 Battery: Make, type and capacity.
 - .7 Battery charger: Make, type and model.
 - .8 Dimensioned drawing of set including engine, alternator, control cubicle, exhaust system, fuel system and accessories.
 - .9 Confirmation of exhaust pipe diameter.
 - .10 Fuel consumption, tank size and cooling water data.
 - .11 Performance curves for local conditions and multipliers for ambient temperatures.
 - .12 Air flow requirements for cooling.
 - .13 Complete generator dimensional information including exhaust system, fuel tank, total weight, vibration isolators, mounting brackets, flange dimensions and

- elevations of exhaust air, battery dimensions, location and size of annunciation (control) panel, etc.
- .14 Generator decrement curves showing current delivered for specified faults.
- .15 Type and make of governor.
- .16 Annunciation panel layout, displays and controls.
- .17 Provide flow diagrams for:
 - .1 Diesel fuel.
 - .2 Lubricating oil.
 - .3 Cooling air.
- .18 Efficiency of generator.
 - .1 Continuous full load output at 0.8 power factor lagging.
- .19 Automatic ventilation system control including louvers and actuators.
- .20 List of components.
- .21 Complete dimensional data on radiator duct flange dimensions and height based on fuel tank utilized.
- .22 Description of operation including.
 - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start to of cranking until unit reaches rated voltage and frequency.
 - .2 Manual starting.
 - .3 Automatic shut down and alarms.
 - .4 Manual, local and remote emergency stop.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for backup diesel generator set equipment for incorporation into manual specified in Section 01 78 00 Closeout Submittals.
- .2 Operation and Maintenance Manual to include instructions for particular unit supplied and not general description of units manufactured by supplier and provide:
 - .1 Operation and maintenance instructions for engine, alternator, battery charger, battery, fuel system, engine room ventilation system, cooling system, oil changes, exhaust system and accessories, to permit effective operation, maintenance and repair.
 - .2 Technical Data: Illustrated parts lists with parts catalogue numbers.
 - .3 Schematic diagram of electrical controls.
 - .4 Technical information on Cooling/exhaust system.
 - .5 Details for adjustment and setting of time delay relays or sensing controls which require onsite adjustment.
 - .6 Certified copy of factory test results.

1.4 REFERENCES

- .1 CSA C22.2 No. 14-18; Industrial Control Equipment.
- .2 CSA C282:19; Emergency Electrical Power Supply for Buildings.
- .3 BS ISO 8528-4:2005; Reciprocating internal combustion engine driven alternating current generating sets.

- .4 IEEE 446-1995; IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
- .5 ISO 3046-1:2002; Reciprocating Internal Combustion Engines – Performance – part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods – Additional requirements for engines for general use.
- .6 ANSI/NEMA MG 1-2016, with 2021 Revisions; Motors and Generators, Includes 2021 updates to Parts 0, 1, 7, 12, 30, and 31.
- .7 NFPA (Fire) 70; National Electrical Code (NEC), 2020 Edition.
- .8 NFPA (Fire) 110; Emergency and Standby Power Systems, 2022 Edition.

1.5 SPARE PARTS

- .1 Include:
 - .1 2 fuel filter replacement elements.
 - .2 2 lube oil filter replacement elements.
 - .3 2 air cleaner filter elements.
 - .4 1 set of fuses for control panel.
 - .5 Special tools for unit servicing.

1.6 EQUIPMENT SUPPLY AND INSTALLATION

- .1 Supply and install components of the diesel engine driven generator set as noted. Provide coordination with Division 22- Mechanical, Division 23 – Heating, Ventilation and Air Conditioning (HVAC) and Division 40 – Process Control as required. Refer to applicable sections herein for additional scope of work related to each item.
 - .1 Diesel engine, alternator and radiator - supplied and installed by Division 26.
 - .2 Control panels - supplied and installed by Division 26.
 - .3 Mounting base - supplied and installed by Division 26.
 - .4 Transfer switch - supplied and installed by Division 26.
 - .5 Ventilation and Cooling System - supplied and installed by Division 23 and Division 40.
 - .6 Exhaust system – supplied by Division 26, installed by Division 23.
- .2 Equipment shall be suitable for use in systems in compliance to NFPA 70 Article 700, 701, and 702.
- .3 The generator set shall meet all requirements for NFPA 110 Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

1.7 OPERATION

- .1 Start standby generator on a signal from transfer switch, on loss of normal power.
- .2 Selector switch in AUTO position and the normal supply voltage operating, the diesel electric unit is on “automatic service” and shall start and transfer automatically on power failure. Upon return of normal power supply voltage, the generator set will continue to run for a pre-set period of 5 minutes and will then automatically return the transfer switches to normal. The engine will continue running for a preset period of 5 minutes and will then be automatically turned off.

- .3 Selector switch in "MANUAL" position, engine starts and runs up to output until shut off manually. (No transfer takes place).
- .4 Selector switch in "TEST" position, engine starts and switch transfers to standby service. (Simulating power failure as described for Automatic Conditions).

1.8 FACTORY TEST

- .1 Supplier shall conduct performance and full load tests in factory under supervision of the Departmental Representative upon completion of assembly of factory and prior to shipping to prove that unit will start automatically, pick up load and operate as required. Commission genset to CSA C282.
- .2 The test shall include:
 - .1 Demonstration of automatic start system.
 - .2 A 2-hour full load test, utilizing an adjustable load.
 - .3 Demonstration of safety features.
 - .4 During test, the following parameters shall be recorded at 30 minute intervals:
 - .1 Speed and frequency.
 - .2 Voltage and current per phase.
 - .3 Load.
 - .4 Coolant temperatures.
 - .5 Lubricating oil pressure.
 - .6 Fuel consumption for duration of test shall be stated.
- .3 Any undue overheating or failure of any components, caused by this overload, shall be considered a cause for rejection.
- .4 Demonstrate alarm and shut down condition without subjecting engine to these excesses.
- .5 Certified test results shall be submitted upon completion of factory test procedure.

1.9 SYSTEM START-UP

- .1 Preparation: Before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:
 - .1 Disconnect battery cables from batteries to prevent accidental starting.
 - .2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.
 - .3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture.
 - .4 Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.
 - .5 Ensure cooling system antifreeze is effective to at least minus 40 degrees C.
 - .6 Check belts for correct tension and adjust as necessary.
 - .7 Check and grease points.
 - .8 Check and tighten properly nuts, bolts, etc.
 - .9 Ensure safety guards are in place and properly secured.
 - .10 Check linkages for damage and freedom of movement.
 - .11 Check fuel supply system for leakage.

- .12 Ensure fuel supply and fuel injection systems are properly primed.
- .13 Check and tighten properly electrical connections.
- .14 Check starting battery electrolyte level specific gravity and for proper installation.
- .15 Check battery charger for proper operation and adjust as necessary.
- .16 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.
- .17 Check jacket coolant heater for proper operation.
- .18 Complete additional preparations deemed necessary.
- .2 Performance Verification: On completion of start-up preparations, take following action:
 - .1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.
 - .2 Reconnect starting battery cables to starting battery.
 - .3 Start unit only in presence of Departmental Representative and allow to warm up. Stop unit if abnormal conditions are encountered.
 - .4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.
 - .5 Adjust vibration isolators.
 - .6 Observe and ensure that lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.
 - .7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.
 - .8 Ensure manual voltage control is operating correctly.
 - .9 Ensure frequency is within operating parameters and electronic governor is operating correctly.
 - .10 Check engine air ventilation system for proper operation.
 - .11 Check operation of engine-mounted protective sensing devices and adjust as necessary.
 - .12 Check phase sequence of normal power supply and ensure standby power supply are in same sequence.
 - .13 Check operation of electronic controller protection, transfer, timing, metering, and enunciator functions and adjust as necessary.
 - .14 Check operation and calibration of analog metering and adjust as necessary.
 - .15 Apply electrical load, read the metres, and correlate these readings.

1.10 ON SITE ACCEPTANCE TEST

- .1 A satisfactory acceptance test shall be conducted on site after completion of installation. This acceptance test shall not be of less than four hours duration with full rated load on unit. Engine Manufacturer shall provide a 100% portable load bank of full rated load. After completion of above test, tests shall be performed to demonstrate overheat protection, low oil pressure protection and overspeed protection. Miscellaneous valves and piping required to demonstrate functioning of safety devices shall be provided.
- .2 The following data shall be taken at the start of the test and at half hour intervals thereafter:

- .1 Frequency.
- .2 Voltage.
- .3 Load (amperes).
- .4 Kilowatts.
- .5 Water temperatures (inlet and outlet).
- .6 Lubricating oil pressure.
- .7 Exhaust temperatures before turbo charger.
- .8 Ambient temperature.
- .3 On completion of the site acceptance test the supplier shall perform the following tests and demonstrate the satisfactory operation of the following control devices:
 - .1 High water temperature switch.
 - .2 Low oil pressure switch.
 - .3 Overcranking switch.
 - .4 Overspeed switch.
 - .5 Low water level.
 - .6 Fuel supply status.
 - .7 Low battery voltage level.
 - .8 Provide alignment of any flexible couplings.
- .4 Note: Before connection to electrical system check phase rotation for compatibility.

1.11 COMMISSIONING AND TRAINING

- .1 The manufacturer's representative shall be present during commissioning.
- .2 During commissioning period, instruct the plant operator in the proper operation, maintenance and repair procedures.
- .3 Training shall include operation, maintenance and repairs. (A minimum of 6 hours shall be included for initial training).
- .4 Co-operate with company hired by Departmental Representative to produce a video tape of operation, maintenance and training provided for all equipment. Include additional time as outlined in Section 01 79 00.
- .5 Provide a competent genset expert for training and testing after commissioning to instruct Owner's staff in maintenance and operation as per Section 01 79 00. Each trip shall be a minimum of 5.5 hr onsite. Include training requirements as outlined in Section 01 79 00 in scope of work.

1.12 GUARANTEE

- .1 Provide a written guarantee, signed and issued stating that the generating set is guaranteed against defects in material and workmanship for a period of 5 years, or 1500 operating hours, whichever occurs first, from the date of the Substantial Performance. Guarantee to cover labour, parts and travel.

1.13 UNIT DIMENSIONS

- .1 Co-ordinate all dimensions for ducting and openings in wall with Division 13 and 23.
- .2 Ensure a downward slope of the ducting from the interior to the exterior.

- .3 Genset and fuel tank not to exceed 2.3 m in length and 1.1 m in width.
- .4 Co-ordinate muffler type and method of installation with Division 23 to ensure overall interior building height is suitable for installation of muffler.
- .5 Genset cooling air flow requirement not to exceed 4,000 L/s.
- .6 Genset and full fuel tank not to exceed 2,500 kg.

Part 2 Products

2.1 GENERATOR SET

- .1 Capacity:
 - .1 The electric set shall be rated 150 kW continuous standby rating, 0.8 power factor, 347/600V, three phase, 4 wire, 60 Hz after adjustment for system losses at an ambient temperature of 29°C.
- .2 The speed of the generating set shall not exceed 1800 RPM and must be approved by the engine manufacturer for continuous operation. The manufacturer shall certify that the proposed speed does not exceed 90% of the maximum engine speed approved by the manufacturer for other applications.
- .3 The engine shall be liquid cooled, naturally aspirated or turbo-charged. Inter-cooling if used shall be a closed system complete with radiator.
- .4 Net brake horsepower, after allowance have been made for losses to engine driven accessories, shall be sufficient BHP to correspond to rated generator kW. Efficiency of generator shall be stated.
- .5 BHP, plus allowance for engine driven accessories, shall not exceed 80% of maximum BHP of engine at generator RPM as substantiated by Engine Manufacturer's regularly published BHP curves. Engine rating conditions shall be 29°C ambient. Engine manufacturer shall either show horse-power curves at these conditions or at other conditions together with derating factors including data on losses to engine driven accessories.
- .6 The excitation system shall be of brushless construction controlled by a solid- state voltage regulator capable of maintaining voltage within $\pm 2\%$ at any constant load from 0% to 100% of rating.
- .7 Stable generator operating conditions shall be re-established within 3 seconds following any sudden change in load between no load and full load. The transient voltage surge shall not exceed 20% for the above load changes. The regulator shall have a rheostat capable of adjusting the generator terminal voltage $\pm 5\%$.
- .8 The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- .9 Do not ground the neutral inside the generator.
- .10 The maximum allowable voltage dip during starting of any motor shall be 25%.
- .11 Provide over and under frequency protection.
- .12 Provide over and under voltage protection.
- .13 Submit curves to show fault current sustaining ability of generator.

2.2 ALTERNATOR

- .1 Alternator: to ANSI/NEMA MG1.
- .2 Rating: 3phase, 60Hz, at 0.8 PF, voltage and kW rating as indicated on the electrical drawings.
- .3 Output at 40°C ambient:
 - .1 100% full load continuously.
 - .2 110% full load for 1h.
 - .3 150% full load for 1 min.
- .4 Salient-pole, brushless, self-ventilated.
- .5 Drip proof.
- .6 Amortisseur rotor windings and skewed stator for smooth voltage waveform.
- .7 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .8 Exciter: Rotating brushless.
- .9 NEMA class H insulation on windings.
- .10 Alternator: Capable of sustaining 300% rated current for period not less than 10s permitting selective tripping of down line protective devices when short circuit occurs.
- .11 Limit temperature rise of the rotor and stator to 130°C.
 - .1 Clearly indicate sizing and temperature rise on shop drawings.

2.3 DIESEL ENGINE

- .1 Diesel engine: to ISO 3046-1.
 - .1 Engine: standard product of current manufacture, from company regularly engaged in production of such equipment.
- .2 Naturally aspirated and turbo charged, synchronous speed 1800 RPM, as indicated
- .3 Cooling System:
 - .1 Liquid cooled: Heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side, with ethylene glycol anti-freeze non-sludging above minus 46° C. Provide engine water coolant conditioner.
 - .2 Radiator shall be flange type suitable for direct connections.
 - .1 Provide a radiator duct flange to provide a convenient connection to duct work for the radiator discharge air.
 - .2 Be responsible to confirm size of required duct and louver system to be as per manufacturer recommendations and make any adjustments as may be required to upsize ducting and louvers shown on the plans if required.
 - .3 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40 degrees C.
 - .4 Block heater: Connected to line side automatic transfer switch, thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 110, Level 1.
 - .5 Locate block heaters to heat water in block and not circulate it through radiator. Provide all circuits and fuses.

- .4 Fuel System:
 - .1 Provide a fuel filter having replaceable elements which may be easily removed from their housing for replacement without breaking any fuel line connections or disturbing the fuel pumps on any part of the engine. Locate fuel filters ahead of the injection pump.
 - .2 Genset fuel tank: ULC labeled double-wall sub-base with a minimum run time of 8 hours at 100% load and minimum 400 L capacity (show calculations on shop drawings).
 - .3 Flexible fuel lines rated 150°C and 700 kPa.
 - .4 Tank level controls for remote filling.
 - .5 Tank to include fill port, vent port, leak detection alarm, vent alarm whistle, fuel level gauge, and low fuel level alarm.
 - .6 Use steel pipe and flexible connections at engine.
- .5 Governor:
 - .1 Electronic isochronous capable of +0.25% steady-state frequency regulation.
- .6 Lubrication system:
 - .1 Full pressure lubrication system with gear driven pump, pressure regulator, supplying filtered lubricating oil under pressure to main bearings, crank pin bearings, piston pins, timing gears, camshaft bearings, valve rocker mechanism and governor.
 - .2 Readily accessible drain valves with suitable piping shall be provided for convenient draining of complete lubricating oil system.
 - .3 Replaceable cartridge type lube oil filters. Filters shall have replaceable elements that can be easily removed without disturbing other parts of engine.
 - .4 Lube oil cooler.
 - .5 Oil level dip-stick.
- .7 Starting system:
 - .1 Provide a 24 volt D.C. electric starting system for the diesel, including starting motor, regulator and "maintenance free" sealed lead calcium selenium or lead antimony batteries (minimum 1200 CCA), capable of providing three 30-seconds cranking cycles without recharging. Cranking limiter to provide 3 cranking periods of 5 seconds duration, each separated by a 10 second rest.
 - .2 Battery charger : Remote mounted, constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: $\pm 1\%$ output for $\pm 10\%$ input variation. Automatic boost for 6h every 30 days. Equipped with DC voltmeter, DC ammeter and On-Off switch. Minimum charger capacity: 10 A.
 - .3 Provide battery rack and guard to house battery to protect against accidental contact.
- .8 Exhaust System
 - .1 Include exhaust system complete with muffler (commercial grade), thimble and flexible connection.
 - .2 Provide pre manufactured ULC rated wall thimble for engine exhaust through wall.
 - .3 Expansion joints: Stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

- .4 The insertion loss of muffler shall be rated not less than 24 DBA. Submit attenuation characteristics of muffler to Departmental Representative for review.
- .5 The muffler shall be complete with condensate drain and drain cock at outlet end of muffler.
- .6 Coated to be temperature and rust resistance.
- .7 All the above noted exhaust equipment shall be handed over to Mechanical Division 23 for installation. All exhaust piping to exterior shall be under Division 23.
- .9 Vibration isolated engine instrument panel with:
 - .1 Lube oil pressure gauge.
 - .2 Lube oil temperature gauge.
 - .3 Lube oil level gauge.
 - .4 Coolant temperature gauge.
 - .5 Coolant level gauge.
 - .6 Running time meter: Non-tamper type.
- .10 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .11 Submit copy of torsion vibration analysis of complete mounted system.
- .12 Condensate trap complete with drain for crankcase breather.
- .13 Combustion air cleaner. Air cleaner shall be of replaceable element type with an efficiency of at least 99.8%. Provide air filter service indicator.
- .14 Engine and battery drip tray.

2.4 CONTROL PANEL

- .1 Provide "normal" electronic control panel inside enclosure.
- .2 The controller shall include the following features:
 - .1 Fused DC circuits.
 - .2 Complete 2-wire start/stop control, which shall operate on closure of a remote contact.
 - .3 Protect speed sensing and a second independent starter motor disengagement systems against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
 - .4 Design the starting system for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
 - .5 Cranking cyler with 15-second ON and OFF cranking periods.
 - .6 Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
 - .7 Circuitry to shut down the engine and alarm.
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temperature.
 - .4 Low coolant level.
 - .5 Low lube oil pressure.

- .6 All pre-alarm and alarm conditions pilot lights shall lock into alarm and shall not automatically reset.
- .8 Engine cool down timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.
- .9 3-position (AUTO-OFF-TEST) selector switch:
 - .1 In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts.
 - .2 In the AUTO position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open.
 - .3 In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.
- .10 Alarm horn with silencer switch per NFPA 110.
- .3 Controller to meet NFPA 110 and to have pilot lights with test button to indicate the following:
 - .1 Not-in-Auto (flashing red).
 - .2 Overcrank (red).
 - .3 Emergency Stop (red).
 - .4 High Engine Temperature (red).
 - .5 Overspeed (red).
 - .6 Low Oil Pressure (red).
 - .7 Battery Charger Malfunction (red).
 - .8 Low Battery Voltage (red).
 - .9 Low Fuel (red).
 - .10 Auxiliary Pre-alarm (red).
 - .11 Auxiliary Fault (red).
 - .12 System Ready (green).
- .4 Provide terminals for each indicating light above, plus additional terminals for common fault and common pre-alarm.
- .5 Provide a 10 relay dry contact kit with normally open and normally closed contacts in a form C configuration to activate warning devices and other customer provided accessories allowing remote monitoring of the generator set.
- .6 Run relay to provide a three-pole, double-throw relay with 10 amps at 250 VAC contacts for indicating that the generator is running.
- .7 Common failure relay to remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
- .8 Supports Modbus via RS-485, or modbus TCP via Ethernet with an optional module or converter for communication to SCADA system.
- .9 Provide generator prealarm senders for local and/or remote annunciation for engine conditions approaching critical/shutdown parameters.

2.5 CONTROLLER PANEL FACE

- .1 Provide electronic display with microprocessor logic.
- .2 Backlit digital display and keypad.
- .3 Operating temperature: -40°C to 70°C.
- .4 Humidity: 5-95% non-condensing.
- .5 Display to provide the following:
 - .1 Dual range voltmeter 85 mm, $\pm 2\%$ accuracy.
 - .2 Dual range ammeter 85 mm, $\pm 2\%$ accuracy.
 - .3 Voltmeter-ammeter phase selector switch.
 - .4 Lights to indicate high or low meter scale.
 - .5 Direct reading pointer-type frequency meter 85 mm, 0.5% accuracy, 45 to 65 Hz scale.
 - .6 Panel-illuminating lights.
 - .7 Battery charging voltmeter.
 - .8 Coolant temperature gauge.
 - .9 Oil pressure gauge.
 - .10 Running-time meter.
 - .11 Voltage-adjust rheostat.

2.6 MONITORING AND CONTROL SOFTWARE

- .1 To monitor the condition of the generator set using SCADA CPU and monitor.
- .2 Use Modbus RTU or Ethernet communication protocol.
- .3 RS-485 or Ethernet network communication to Controller.
- .4 Communication module, network tools and software as required to enable communication to SCADA computer.
- .5 Software to include.
 - .1 Easily select, create, arrange or delete data windows.
 - .2 Pre configured display screens showing system status and settings.
 - .3 Data windows.
 - .4 Data register maps to allow data transfer to SCADA.

2.7 STEEL MOUNTING BASE

- .1 Mount generating set on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Fit assembly with vibration isolators.
- .3 Provide sound insulation pads for installation between isolators and concrete base.
- .4 Paint all steel with minimum two coats of epoxy or dry powder.

2.8 CONNECTORS

- .1 Unit to be complete with flexible connections for fuel, exhaust and ventilation for connection by Mechanical Trade.
- .2 Provide all control wiring.

2.9 GENERATOR MANUFACTURERS

- .1 Alternator and exciter shall be CSA approved. The generator set shall be CSA approved.
- .3 Instruments, meters and switches shall be CSA approved. **Execution**

3.1 LOCATING AND MOUNTING

- .1 Locate generating unit and install in location as indicated along with the following items:
 - .1 Generator control panel and generator breaker.
 - .2 Battery charger.
 - .3 Engine block heater.
 - .4 Engine silencer.
 - .5 Flexible fuel and exhaust connections (mechanical).
 - .6 Batteries, battery rack, and battery cables.
 - .7 Vibration isolators.
 - .8 Necessary power and control wiring for a complete and operational system.
 - .9 Radiator and cooling system.
- .2 Fit and adjust isolators in accordance with manufacturer's installation and adjustment instruction bulletin contained in unit manual.
- .3 Set genset frame assembly on a concrete base/housekeeping pad.
- .4 Fill fuel tank (after commissioning).

3.2 ALIGNMENT CHECK

- .1 Since engine-generator shaft alignment is adjusted at factory, check to ensure that no change has occurred due to shipment and handling.
- .2 Where engine and generator housings are close coupled and instruments at hand are not suitable for measuring alignment within confines of housings, just loosen engine and generator hold down bolts and ensure that each foot is carrying proportionate amount of weight and feet are level on base plate.

3.3 FUEL SUPPLY SYSTEM

- .1 Division 23 to supply fuel fill piping as per Section 23 35 16.

3.4 BATTERIES AND CHARGER

- .1 Locate batteries as indicated and ensure that batteries are accessible for service. Run and protect cables to starting motor using cables supplied with unit.
- .2 Install battery charger as indicated, adjacent to batteries and make connection to batteries.
- .3 Clean connections and tighten securely.

3.5 EXHAUST SYSTEM

- .1 Division 23 to install exhaust pipe and silencer using material supplied with unit. Coordinate with Division 23, Section 23 35 15 Generator Exhaust. Material supplied by Division 26.
- .2 Arrange silencer above and approximately in line with engine exhaust manifold with exhaust tail pipe protruding through thimble in wall.
- .3 Extend tail pipe not less than 150 mm beyond outside wall.
- .4 Support silencer with hangers so no weight or stress is applied to engine exhaust manifold or turbocharger.
- .5 Install flexible exhaust pipe between silencer and manifold.
- .6 Install exhaust system fireproof insulation material, after test run.
 - .1 As per Section 22 07 21.

3.6 COOLING AND VENTILATION

- .1 Division 23 to provide and install air outlet and inlet louvres and hoods in their respective openings. Coordinate with Division 23 – Heating, Ventilation and Air Conditioning (HVAC).
- .2 Division 23 to provide and install louver motors and linkages, adjust to ensure louvers are tight in closed position and give free damper movements from fully closed to fully open. Coordinate with Division 25 – Integrated Automation.
- .3 Fill engine radiator with 60% ethylene glycol antifreeze mix good for -40°C.
- .4 Interlock generator ventilation system with engine controls.
- .5 Provide HVAC control and/or panel as required to operate ventilation system.

3.7 PANEL, CONNECTIONS AND MONITORING

- .1 Locate panels as indicated.
- .2 Complete wiring and interconnections. Connect all controls. Control wiring from engine and generator devices to be installed in a separate conduit from all power wiring.
- .3 Identify cables at both ends.
- .4 All conduit or pipe connections to engine-generator shall have a flexible section to allow for vibration and noise transmission dampening. All wiring to the generator control panel shall be stranded extra flexible.
- .5 Connect cabling between transfer switch, and genset.
- .6 Connect cabling between controller and Ethernet switch and set up software on PC.
 - .1 Set up software on PC and interface alarms (minimum power failure, genset running and genset failure) into SCADA and PC system using hard wired contacts or genset monitoring software addresses.

3.8 ADDITIONAL WORKS

- .1 Suitably protect all hot spots and moving parts to prevent accidental contact by personnel. Provide conspicuous sign, warning personnel that engine may start automatically at any time.

3.9 TESTING

- .1 Notify Departmental Representative 5 working days in advance of testing date.
- .2 Perform tests in accordance with part 1.
- .3 Set up screens on PC as directed by Departmental Representative, confirm alarms set up on SCADA system.
- .4 Demonstrate satisfactory performance of dampers in ventilation system to provide adequate engine cooling.

END OF SECTION

Part 1

1.1 DESCRIPTION OF SYSTEM

- .1 UPS system to consist of:
 - .1 Input power converter.
 - .2 Output inverter.
 - .3 Battery and charger unit(s).
 - .4 Bypass system module.
 - .5 Microprocessor controlled logic and control panel.
 - .6 Input and output filters.
- .2 Provide continuous, regulated AC power to isolated load using power supply and battery.
- .3 Equipment to operate continuously and unattended.
- .4 Ensure that UPS is compatible with equipment that it feeds.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Schematic showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.
 - .2 Description of system operation, referenced to schematic diagram, for:
 - .1 Manual control during initial start-up and load transfer to bypass and back to inverter output.
 - .3 Full load kVA output at unity power factor.
 - .4 Type of ventilation: Natural or forced.
 - .5 Battery:
 - .1 Battery type and number of batteries/cells.
 - .2 Expected life.
 - .6 Inverter:
 - .1 Type and
DC current at minimum battery voltage to produce full load ac.
 - .7 Rectifier:
 - .1 Type, capacity and battery charging sequence.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating operation of UPS supplied for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.4 REFERENCES

- .1 CAN/CSA C813.1-14 (R2019), Performance Test Method for Uninterruptible Power Supplies.

- .2 IEEE 519-2014, IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.
- .3 ISO 9001: 2015, Quality Management Systems - Requirements.
- .4 ISO 14001: 2015, Environmental Management Systems - Requirements with Guidance for Use.
- .5 UL 1778; Uninterruptible Power Systems.

1.5 PROTECTION OF SYSTEMS

- .1 Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.
- .2 Surge suppressors:
 - .1 To protect system against supply voltage switching transients.
 - .2 To protect internal circuits where necessary against voltage transients.

1.6 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

1.7 DELIVERY AND STORAGE

- .1 Adequately enclosed and protected from weather and shipping damage.
- .2 Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.8 WARRANTY

- .1 Provide full 3-year, on-site product warranty from manufacturer guaranteeing the UPS system and battery against defects in operation, material and workmanship from date of Substantial Completion. Include parts and labour with warranty.

Part 2 Products

2.1 UNINTERRUPTIBLE POWER SYSTEM

- .1 System Capacity:
 - .1 2 kVA.
- .2 System AC-AC Efficiency: Greater than 89% at 100% load.
- .3 Input Power:
 - .1 AC Input Nominal Voltage: 208 VAC L-L, (120 VAC L-N @120°).
 - .1 Normal supply from AC mains.
 - .2 Emergency supply from automatic genset.
 - .2 Input Frequency Range: 45 – 65 Hz.
 - .3 Input current distortion with no additional filters: Less than 5%.
 - .4 Input Power Factor: 0.90 at full load with 120/208 VAC source, 2PH + N + G.
- .4 Output Power:

- .1 AC Output Nominal: Single phase 120/208V, 4 wire (2 phase + N + G), 60 Hz.
- .2 Maximum Load: 2 kVA.
 - .1 Minimum circuit breaker: 15 A, 2P.
 - .2 Connection: #12 AWG, 4 wire (L1-L2-N-G).
- .3 Output Frequency:
 - .1 Online: Maximum variation from set value under load changes, including transients, not to exceed $\pm 0.5\%$ Hz.
 - .2 On battery: 60 Hz.
 - .3 In bypass: 45 – 65 Hz.
- .4 Output voltage control:
 - .1 Voltage regulation: Voltage not to change by more than 3% as load increases gradually from zero to 100%, or for specified duration of full load after mains failure.
 - .2 Transient voltage change not to exceed $\pm 10\%$ of rated voltage upon 50% sudden load change, loss or return of ac input voltage to system when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within 3 Hz.
 - .3 Harmonics over entire load range:
 - .1 Total harmonic distortion (THD): 1% typical, 3% maximum under linear load.
 - .2 Single harmonic not to exceed 3% of total output voltage.
- .5 Output Power Factor: 0.8 power factor lagging 1.0 kVA.
- .6 Overload capability: > 130% for 4 seconds, 105% continuous.
- .7 Duration of full load output after mains failure not less than 5 min.
- .5 Interference suppression:
 - .1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.
 - .2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

2.2 SYSTEM PERFORMANCE

- .1 Normal operation:
 - .1 System operates on mains power when power exists.
- .2 Battery operation:
 - .1 System transfers automatically to battery operation.
 - .1 When manually selected at control panel.
 - .2 When main power fails.
 - .3 When mains power is restored system automatically resynchronizes with mains.
- .3 Bypass operation:
 - .1 For maintenance, system to be bypassed automatically or by manual selection at control panel to connect load directly to AC mains. Transfer without load interruption and leaving inverter energized.

2.3 MODES OF OPERATION

- .1 Normal: The input converter and output inverter operate in an online manner to regulate power continuously to the critical load. The input and output converters are capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

2.4 BATTERY

- .1 The UPS battery shall be of modular construction consisting of user-replaceable, hot-swappable, fused battery modules. Each battery module shall be monitored for voltage and temperature for use by the UPS battery diagnostic and battery charger circuitry.

2.5 REMOTE UPS MONITORING

- .1 Remote UPS monitoring shall be available via either RS232 or contact closure signals from the UPS.

2.6 SOFTWARE COMPATIBILITY

- .1 Software shall be compatible with the operating system.

2.7 ENCLOSURE

- .1 Rack mount in accordance with CSA and UL 1778.
- .2 Meters, indicating lamps and controls group mounted in panel front.
- .3 Environmental Conditions:
 - .1 Operating Environment: 0 to 40 degree Celsius.
 - .2 Operating Relative Humidity: 0 to 95%.
 - .3 Audible noise at 1 metre from unit: Maximum 62 dB.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount UPS system.
- .2 Assemble and interconnect components to provide complete UPS as per manufacturers instructions.
- .3 Connect AC mains to main input terminal.
- .4 Connect UPS output to load.
- .5 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.2 TESTING

- .1 Perform tests in accordance with Section 26 05 00 and CAN/CSA-C813.1.
- .2 Notify Departmental Representative 10 working days in advance of test date.
 - .1 Visual Inspection:
 - .1 Verify damage and installation per manufacturer s instructions.
 - .2 Inspection of electrical connections verifying:
 - .1 Correct input and bypass voltage.

- .2 UPS control wiring and terminations and voltage of battery modules.
- .3 Neutral and ground conductors are properly landed.
- .4 External service bypass panel for proper terminations.
- .3 Ensure proper system start-up and site testing verifying:
 - .1 Firmware control functions, bypass operation, system set points and inverter operation and regulation circuits.
- .4 Run UPS at full rated load to demonstrate proper operation with AC mains input, emergency generator input, no AC input.
- .5 Discharge battery by operating UPS with AC mains open for specified duration of full load.
- .6 Recharge battery automatically with full rated load on UPS and record readings of voltage of each cell.

3.3 START-UP

- .1 Upon arrangement with Departmental Representative Contractor to start-up of system, check, adjust, test and instruct operators.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on all phases of normal power supply.
 - .2 Initiate cranking of standby generator on normal power failure or abnormal voltage on any one phase below pre set adjustable limits for adjustable period of time.
 - .3 Automatically transfer load from normal supply to standby generator (when standby generator reaches rated speed and voltage).
 - .4 Switch to automatically transfer load from standby generator to normal power supply (when power is restored). Automatic re-transfer is required.
 - .5 Shut down standby generator after re-transfer, provide cool down using adjustable time delay.
 - .6 Time delay interlock relay to prevent instantaneous transfer or re-transfer.
 - .7 By-pass function for maintenance purposes on the emergency/standby side.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Make, model and type.
 - .2 Load classification:
 - .1 Tungsten lamp load: as indicated in kW.
 - .2 Ballast lamp load: as indicated in kW.
 - .3 Motor load: as indicated in kW.
 - .4 Restricted use: resistance and general loads, 0.8pf or higher as indicated in kW.
 - .3 Single line diagram showing controls and relays.
 - .4 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.
 - .2 Test control.
 - .3 Manual control.
 - .4 Automatic shutdown.
 - .5 Interrupting capacity (IC) rating.

1.3 REFERENCES

- .1 CSA CAN3-C17-M84 (R2020); Alternating-Current Electricity Metering.
- .2 CSA C61869-1:14 (R2019); Instrument Transformers – Part 1: General requirements (Adopted IEC 61869-1:2007, edition 1.0:2007, with Canadian Deviations).
- .3 CSA C22.2 No.5-16 (R2021); Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national Standard with UL 489, and NMX-J-266-ANCE-2016), Includes Update No. 1 (2019).

- .4 CSA C22.2 No 178.1:14 (R2019); Transfer Switch Equipment, Includes Update No. 1 (2015) and Update No. 2 (2018).
- .5 CSA C22.2 No.178.2-04 (R2014); Requirements for Manually Operated Generator Transfer Panels, Includes Update No. 1 (2017).
- .6 Electrical Equipment Manufacturers Association of Canada (EEMAC).
- .7 NEMA ICS 2-2000 (R2020); Controllers, Contactors, and Overload Relays, Rated 600 V.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 Closeout Submittals.
- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Technical data:
 - .1 Schematic diagram of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.
 - .4 Warranty certificate.

1.5 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.
- .2 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation "TEST", "AUTO", "MANUAL", "ENGINE START" and record results.
 - .3 Check voltage sensing and time delay relay settings.
 - .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.
 - .4 In-phase monitor operation.

1.6 TRAINING

- .1 Be responsible to review Section 01 79 00 and include training requirements as outlined in Section 01 79 00 in scope of work.

1.7 GUARANTEE

- .1 Provide a written guarantee, signed and issued stating that the transfer switch is guaranteed against defects in material and workmanship for a period of 5 years, or 1500 operating hours, whichever occurs first, from the date of the Substantial Performance.
 - .1 Year 1 and 2: Guarantee to cover labour, parts and travel.
 - .2 Year 3 to 5: Guarantee to cover parts.

Part 2 Products

2.1 MATERIALS

- .1 Meters to CAN3-C17.
- .2 Instrument transformers to CAN3-C13.
- .3 Contactors to ANSI/NEMA ICS 2.

2.2 TRANSFER AND RE-TRANSFER SYSTEM

- .1 Contact Type Transfer Equipment: to CSA C22.2 No.178.
- .2 Enclosed circuit breakers or switches mounted on common frames with 3 pole, double throw. Re-transfer system to match that shown for standby generator shown in Section 26 32 13.
- .3 Rated: 600 V, 60Hz, 200 A, 4 wire, solid neutral, 25kA as indicated on electrical drawings.
- .4 Current and potential transformers.
- .5 Operation of switch shall be such that it will detect a loss of any one of the three phases of normal power supply and shall operate to cause the engine to be started and transfer the load to the generator. When the three phases are restored to normal, the transfer switch shall automatically return to normal power supply.
- .6 By-pass function for maintenance purposes on the emergency/standby side.
- .7 Provide necessary wiring interconnection between transfer switch and engine control panel.
- .8 Transfer switch to be from same manufacturer as genset supply by Section 26 32 13.

2.3 CONTROLS

- .1 Provide key type four position "TEST", "AUTO", "MANUAL", "ENGINE RUN" switch, function of the switch shall be as follows:
 - .1 TEST position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
 - .2 AUTO position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
 - .3 MANUAL position - Transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
 - .4 ENGINE START position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine
- .2 Relays: Continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
 - .1 Voltage sensing: 3 phase for normal power and on one phase only for standby, solid state type, adjustable drop out and pick up, close differential, 2V minimum undervoltage and over voltage protection.
 - .2 Adjustable time delay on engine start: 0 to 10 seconds.
 - .3 Adjustable time delay on automatic re-transfer to normal, adjustable setting from 0 to 2 minutes.

- .4 Provide adjustable 0-30 second time delay (programmed neutral feature) on automatic re-transfer to normal. Set to 17 seconds.
- .5 Adjustable time delay on automatic transfer to emergency, 0 to 30 seconds.
- .6 Adjustable time delay on retransfer and unloaded engine running time, 20 seconds to 10 minutes. Timer to work in both "test" and "automatic" positions.
- .7 Maintained contact type test switch.

2.4 ACCESSORIES

- .1 Provide pilot lights on door of transfer switch to indicate that switch is in "STANDBY" or "NORMAL" feed position.
- .2 Provide the following accessories:
 - .1 Auxiliary relays to provide 2 normally open and 2 normally closed contacts for load shedding and genset start stop operation.
 - .2 Auxiliary relay to provide 1 N.O. and 1 N.C. contacts for remote alarms.
 - .1 Auxiliary contact to close when normal power fails to start generators.
 - .2 Auxiliary contact to close when transfer of power is initiated. Contacts not to be physical switch based.
 - .3 Neutral plate, fully rated.
- .3 Potential transformers - dry type for indoor use:
 - .1 Ratio: 600 to 120.
 - .2 Rating: 600 V, 60Hz, BIL 5 kV.
 - .3 Accuracy rating: 2%.
- .4 Current transformers - dry type for indoor use:
 - .1 Ratio: as indicated.
 - .2 Rating: 600 V, 60Hz, BIL 5 kV.
 - .3 Accuracy rating: 2%.
 - .4 Positive action automatic short-circuiting device in secondary terminals.

2.5 ENCLOSURES

- .1 EEMAC 1 gasketed.

Part 3 Execution

3.1 INSTALLATION

- .1 Install transfer switches as per manufacturer's recommendations.
- .2 Install wiring between genset and transfer switch in conduit cast in the floor.
- .3 Provide and install all required power and control cables and cable hardware to complete transfer switch operation.
- .4 Check relays and adjust as required.
- .5 Install and connect remote alarms.
- .6 Locate and test all equipment.

3.2 TESTING

- .1 On the completion of the installation, perform the initial start-up by a factory trained representative who shall verify satisfactory operation of the transfer switch and generator.
- .2 Test all four positions of transfer switch (test, auto, manual, engine start) at 30 minute intervals for a minimum of 3 cycles and allow to operate for 10 minutes for each feature.
- .3 Provide start-up operating instructions, maintenance and operation training at the time of start up.
- .4 After conducting tests provide certified written report of the tests and instruction provided.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Verification of the SPD Systems' compliance with the required ANSI/UL 1449, 3rd Edition Listing by Underwriters Laboratories (UL) or other valid Nationally Recognized Verification of the SPD Systems' compliance with the required ANSI/UL 1449, 3rd Edition Listing by Underwriters Laboratories (UL) or other valid Nationally Recognized laboratory.
 - .2 Manufacturers' electrical specifications and/or mechanical drawings indicating unit dimensions, weights, full installation instructions, and wiring configuration.
 - .3 Compliance data, including Agency Listing or Agency Control Identification No.; Manufacturer's Model numbers; SPD Type; System Voltage Type; Wiring Diagrams; Voltage Protection Ratings; applicable Technical Specifications and/or mechanical drawings; and Installation Sheets.
 - .4 Compliance data that all basic SPD/TVSS models have been tested, qualified and labeled as "Type 1 or Type 2" SPD, and intended for use on either Line or Load side of overcurrent protectors.
 - .5 Additional product information sheets and bulletins shall be provided to further clarify design, performance, application, and installation qualifying details.

1.2 REFERENCES

- .1 CSA C22.1:21; Canadian Electrical Code, Part I (25th edition), Safety Standard for Electrical Installations, Includes Errata (2021).
- .2 IEEE C62.41.1-2002; IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits.
- .3 IEEE C62.41.2-2002; IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits.
- .4 IEEE C62.45-2002; IEEE Recommended Practice on Surge Testing for Equipment in Low-Voltage (1000 V and Less) AC Power Circuits.
- .5 IEEE C62.62-2018; IEEE Standard Test Specifications for Surge-Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 V and Less) AC Power Circuits.
- .6 IEEE 142-2007; IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- .7 IEEE 1100-2005; IEEE Recommended Practice for Powering and Grounding Electronic Equipment.
- .8 National Electrical Manufacturers Association (NEMA).
- .9 NFPA (Fire) 20; Standard for the Installation of Stationary Pumps for Fire Protection, 2022 Edition.
- .10 NFPA (Fire) 70E; Standard for Electrical Safety in the Workplace, 2021 Edition.
- .11 NFPA (Fire) 75; Standard for the Protection of Information Technology Equipment, 2020 Edition.

- .12 NFPA (Fire) 780; Standard for the Installation of Lightning Protection Systems, 2020 Edition.
- .13 UL 1283; Electromagnetic Interference Filters.
- .14 UL 1449; Surge Protective Devices.

1.3 DEFINITIONS

- .1 Single Element: The safety tested implementation of industrial-grade, 'extra-large block' MOV's close-coupled/connected to each surge-path Using minimum 45kA rated Single Element per surge-path architecture that provides single voltage and 'response time' thresholds to virtually eliminate inherent and random SPD degradation.
- .2 Zoned and Cascading Protection/Isolation System: The safety tested implementation of 'Zoned' Primary and Secondary levels of industrial-grade, 'extra-large block' MOV's close-coupled/connected to each surge-path.
- .3 SCCR –Short Circuit Current Rating: The proven suitability of an SPD for use on an AC power circuit that is capable of safely delivering not more than a declared symmetrical or available current at a declared voltage during a 'short circuit condition'.

1.4 EXCLUSIONS

- .1 No User accessible, integral or external, disconnect switch intended for easy removal of the SPD from power source is permitted.
- .2 SPD designs with "User Replaceable Surge Current Diversion Modules", or 'plug-in' replaceable SPD modules shall not be permitted.
- .3 "Balanced Suppression Platform", conventional multi-element arrays, or "Computer-matched MOV Array" technology shall not be permitted as a substitute for safety-fused single element technology.
- .4 No mixing of SPD/TVSS brands will be permitted within the same facility.

1.5 LABELING

- .1 Type 1 or 2: All SPD's shall be labeled as Type 1 or 2, intended for Load or Line side of over-current protection.
- .2 SCCR Rating: All SPD's shall be labeled with Independent High Current Lab Test 'Short Circuit Current Ratings' (SCCR) of 200kAIC per NEC 285.6.
- .3 UL 1449, 3rd Ed: All SPD submittals shall bear either the 'c ETL us Listed', 'c UL us Listed', or 'c CSA us Listed' Mark and shall be Listed to the most recent 3rd Edition of UL Standard 1449. Note: "Manufactured 'in compliance with', " or 'in accordance with' or 'approved' or 'certified' is not equivalent to actual ETL, UL, or CSA Listing, and does not qualify for the intent of these specifications.

Part 2 Products

2.1 GENERAL REQUIREMENTS

- .1 Labeled as Type 1 or 2, intended for Load or Line side of over-current protection.
 - .1 Type 1: Line-side SPD, no breaker or disconnect into the primary level Main Distribution Panel or Motor Control Center.

- .2 Type 2: Load-side SPD, 'close-coupled' to a dedicated circuit breaker or disconnect within power panel or switchgear.
- .2 UL 1449, 3rd Ed. All SPD's shall bear either the 'c ETL us Listed', 'c UL us Listed', or 'c CSA us Listed labels.
- .3 Provide Non-degrading, Single Element Protection.
- .4 SPD technology shall employ full 7 mode protection paths to protect all L-L, L-N, L-G & N-G for Wye Systems; L-L & L-G in Delta, and impedance grounded Wye Systems.
- .5 Built-in LED type Protection Status Indicators to monitor each mode and stage of SPD protection. No other test equipment should be required for SPD monitoring or testing upon installation of SPD System.
- .6 No audible noise.
- .7 No appreciable magnetic fields. Provide proven application of use directly in computer rooms in any location without danger to disc units, disk packs, or tapes.
- .8 Enclosure: Heavy duty NEMA 12 dust-tight, drip-tight enclosure, as indicated.
- .9 Full manufacturer's replacement warranty (parts): 10 years.
- .10 Supply and installation of surge protective devices to be as per CSA C22.1 Article 250, 280 & 285.

2.2 SERVICE ENTRANCE SURGE SUPPRESSOR (TVSS)

- .1 Unit parallel in design and connected in parallel to main switchboard. Each surge suppression element (MOV) individually fused so that a failure of one element and/or fuse has no affect on other surge suppression elements.
- .2 Transient Voltage Surge Suppression unit (TVSS) shall be rated for Category C location per ANSI/IEEE C62.41- 1991 environments connected on the load side of the facilities meter.
- .3 Provide maximum UL 1449 3rd Edition Suppressed Voltage Protection Rating (VPR) for main service entrance according to the following:

UL 1449 VPR (Voltage Code)	L-N	L-G	N-G	L-L
120/208 (208Y)	700V	700V	700V	1200V
120/240 (240S)	700V	700V	700V	1200V
347/600 (600Y)	1500V	1500V	1500V	2500V
600 Delta (600DD)	-	2500V	-	2500V

- .4 Surge Capacity Rating: 100kA per phase- voltage to match plant.
- .5 Unit shall have indicator status lights for the TVSS device, verifying proper operation.
- .6 Provide unit with a short circuit current rating, which equals or exceeds that of the Main Switchboard.

- .7 Provide UL 1283 listed unit as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 30 dB at 100 kHz, 50 dB at 1 MHz, 50 dB at 10 MHz, and 45 dB at 100 MHz.
- .8 Include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
- .9 Provide Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of TVSS status.
- .10 Provide integral, non-fused disconnect system which causes no interruption to the protected load for testing and maintenance. Disconnect system shall not require removal or replacement for warranty or other repairs.
- .11 Provide an audible alarm with an alarm on/off switch to silence the alarm and a push-to-test switch to test the alarm function.
- .12 Provide an adjustable (resetable) counter to totalize transient voltage surges in both the normal and common mode. Provide readout with at least a seven-digit LCD located on the unit front cover and provide with a 10-year battery back-up to maintain counts in the event of power loss.

2.3 DISTRIBUTION PANELS

- .1 Unit to be rated for Category B location per ANSI/IEEE C62.41- 1991.
- .2 Surge Capacity Rating: 100kA per phase. Phase measured between (L-L and L-G).
- .3 Provide maximum UL 1449 3rd Edition Suppressed Voltage Protection Rating (VPR) for 120/208 Volt wye connected systems as follows:
 - .1 L-N = 700V
 - .2 L-G = 700V
 - .3 N-G = 700V
 - .4 L-L = 1200V
- .4 Unit shall have indicator status lights for the TVSS device, verifying proper operation.
- .5 The internal design of the unit shall incorporate sine wave tracking.
- .6 Provided disconnect suitable for distribution panel.
- .7 Provide UL 1283 listed unit as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 30 dB at 100 kHz, 50 dB at 1 MHz, 50 dB at 10 MHz, and 45 dB at 100 MHz.
- .8 Include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
- .9 Provide Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of TVSS status.
- .10 Provide an audible alarm with an alarm on/off switch to silence the alarm and a push-to-test switch to test the alarm function.
- .11 Provide an adjustable (resetable) counter to totalize transient voltage surges in both the normal and common mode. Provide readout with at least a seven-digit LCD located on the unit front cover and provided with a 10-year battery back-up to maintain counts in the event of power loss.

Part 3 Execution

3.1 INSTALLATION

- .1 Supply and install, wire and connect to SDP in accordance with manufacturer's recommendations and installation instructions.
- .2 Fully comply with the provider's installation requirements, precautions, on-site testing and application verifications to validate User Warranty and to achieve maximum SPD System integrity and performance.
- .3 Provide breakers in panel as required.
- .4 Located adjacent to main distribution with leads run at minimum possible length.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 REFERENCES

- .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 ANSI C82.4-2017 American National Standard for Lamp Ballasts - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- .3 IEC 60529 Ed. 2.2 b:2013; Degrees of protection provided by enclosures (IP Code) CONSOLIDATED EDITION.
- .4 IEEE C62.41.1-2002; IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits.
- .5 IEEE C62.41.2-2002; IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits.
- .6 Canadian Standards Association (CSA International).
- .7 National Electrical Manufacturers Association (NEMA).
- .8 Underwriters' Laboratories of Canada (ULC).

1.3 ACCEPTABLE PRODUCTS

- .1 Light fixtures in Luminaire Schedule identify quality, performance criteria and other parameters.
- .2 Fixtures from other manufacturers may be acceptable provided:
 - .1 Appearance and lighting performance are similar.
 - .2 Quality is equal or better.
 - .3 Lamp and ballast/driver criteria remain the same.
 - .4 The fixture is provided with modifications and accessories to provide a complete product in keeping with the intent of the project.

Part 2 Products

2.1 LIGHTING FIXTURES

- .1 Supply and install per drawings and be complete with protective covers, drivers, suspension devices and attachments to provide best appearance and installation.
 - .1 Type A – Exterior full cut-off LED wall surface mount fixture suitable for exterior wet locations.
 - .1 Size: 128 mm high x 354 mm wide x 208 mm deep wall mounted type c/w full cutoff to direct light down.
 - .2 Lamp(s): UL listed 70 W LED.

- .3 Voltage: 120 volts.
- .4 Beam angle: 60/90 degrees
- .5 Construction: aluminum housing with bronze finish.
- .6 Correlated Color Temperature (CCT): 5,000 K.
- .7 Driver: 120 V surge protected integral electronic driver.
- .8 Location: As shown on plans.
- .2 Type B – Interior LED surface mounted ceiling vapor tight fixture.
 - .1 Size: 178 mm wide x 1,265 mm long for surface or chain mounting from interior ceiling as indicated on plans.
 - .2 Type: cULus listed LED 4.0 with 8,000 lumen output.
 - .3 Voltage: 120 volts.
 - .4 Housing enclosure: Reinforced polyester self extinguishing fiberglass housing with watertight hub for 1/2 inch conduit entry at each end and polyurethane gasketing to provide a continuous seamless seal between diffuser lens and housing.
 - .5 Correlated Color Temperature (CCT): 4000 K.
 - .6 Color Rendering Index: CRI 85.
 - .7 Diffuser lens: Internal prismatic lens with 15% DR high impact additive.
 - .8 Driver: 0 – 10 V continuous dimming driver compatible with standard 0 – 10 V control dimmers.
 - .9 Include accessories to mount fixtures from chains as indicated on drawings.
 - .10 Location: As shown on plans.
- .3 Type C – Interior recessed LED solid state light for T- bar suspended ceiling.
 - .1 Size: 609 mm wide x 1,219 mm long for T-bar ceiling.
 - .2 Type: cULus listed LED 4.0 with 6,400 lumen output.
 - .3 Voltage: 120 volts.
 - .4 Housing enclosure: Die formed cold rolled steel with full length die-formed stiffeners and unibody endplate.
 - .1 Finish: Iron phosphate pretreatment and finished with 90% reflective white enamel.
 - .5 Correlated Color Temperature (CCT): 4000 K.
 - .6 Color Rendering Index: CRI 85.
 - .7 Diffuser lens: Frost #12 pattern acrylic 3 mm thick prismatic lens.
 - .8 Driver: 0 – 10 V continuous dimming driver compatible with standard 0 – 10 V control dimmers.
 - .9 Hinging/Latching:
 - .1 Positive spring loaded steel latches with baked white enamel finish.
 - .2 Safety-lock T-hinges allowing hinging and latching on either side.
 - .10 Location: As shown on plans.
- .4 Type D – Interior LED wall/ceiling/pendant mount fixture.
 - .1 Size: 187 mm wide x 1,218 mm long for surface mount.
 - .2 Type: cULus listed 25 W LED lamps.

- .3 Voltage: 120 volts.
- .4 Housing enclosure: Die formed cold rolled steel with injection molded UV stabilized polycarbonate end caps secured with stainless steel screws.
 - .1 Finish: Electrostatically applied polyester powder coat.
- .5 Correlated Color Temperature (CCT): 4,000 K.
- .6 Color Rendering Index: CRI 80.
- .7 Diffuser lens: Opal extruded polycarbonate 4 mm thick prismatic lens.
- .8 Driver: Constant current at 350 mA, 120 V.
- .9 Closed cell neoprene gasketing as required for UL damp location listing.
- .10 Location: As shown on plans.
- .5 Type E – Exit lights provided by Section 26 52 00.
- .6 Type F – Interior LED surface hazardous area fixture.
 - .1 Fixture to be suitable for a Zone 2 Hazardous location (Class I, Division 2/Zone 2 rated) and NEMA 4X rated
 - .2 Size: 1.2 m nominal length.
 - .1 Ensure adequate clearance above crane bridge. Coordinate with Division 41.
 - .3 Type: cULus listed LED 4.0 with minimum 8,000 lumen output.
 - .4 Voltage: 120 volts.
 - .5 Housing enclosure: copper free aluminum alloy, with aluminum framed hinged glass door.
 - .6 Correlated Color Temperature (CCT): 4000 K.
 - .7 Location: As shown on plans.
- .7 Type G – Shower dome light provided by Section 22 05 01
- .8 Type H – Exterior wall mount fluorescent globe style enclosed fixture.
 - .1 Size: 273 mm long x 137mm wide x 206 mm deep.
 - .2 Lamps: One (1) – LED, minimum 20 W.
 - .3 Voltage: 120 volts
 - .4 Housing enclosure: Enclosed and gasketed vapor proof cast aluminum.
 - .5 Globe type: Red glass.
 - .6 Guard: Cast aluminum vandal guard.
 - .7 Mounting: Wall mount with electrical box.
 - .8 Location: As shown on plans.
- .9 Type I – Exterior full cut-off LED wall surface mount fixture suitable for exterior wet locations.
 - .1 Size: 128 mm high x 354 mm wide x 208 mm deep wall mounted type c/w full cutoff to direct light down.
 - .2 Lamp(s): UL listed 70 W LED.
 - .3 Voltage: 120 volts.
 - .4 Beam angle: 60/90 degrees
 - .5 Construction: aluminum housing with bronze finish.
 - .6 Correlated Color Temperature (CCT): 5,000 K.
 - .7 Driver: 120 V surge protected integral electronic driver.
 - .8 Location: As shown on plans.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated. Install lamps in all fixtures.
 - .1 Provide adequate support to suit ceiling system.
- .2 Ensure lighting does not interfere with operation on monorail.
- .3 Locate number of lights shown on drawings to provide even coverage without shadows notwithstanding consideration of future bulb replacement by operators.

3.2 WIRING

- .1 Connect luminaires to lighting circuits.
 - .1 Install per Section 26 05 23 Wire and Cable.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires from ceiling grid in accordance with local inspection requirements.

3.4 MOUNTING HEIGHTS

- .1 Install devices at following heights above finished floor:
 - .1 Light fixtures not part of T bar ceiling.
 - .1 Surface mount lights to ceiling in process room.
 - .2 Surface mount light to ceiling in electrical room.

3.5 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.6 TEMPORARY LIGHTING

- .1 Contractor to be responsible for maintaining building lighting during construction.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

1.2 REFERENCES

- .1 CSA C22.2 No. 9.0-96 (R2016), General Requirements for Luminaires.
- .2 CSA C22.2 No. 137-18, Electric Luminaires for use in Hazardous Locations, Includes Update (2021).
- .3 CSA C22.2 No.141-15 (R2019), Emergency Lighting Equipment.
- .4 CSA C860-11 (R2020), Performance of Internally Lighted Exit Signs, Includes Update No. 1 (2011).
- .5 National Electrical Manufacturers Association (NEMA).
- .6 UL 844-12, Standard for Luminaires for use in Hazardous (Classified) Locations.

1.3 DELIVERY

- .1 Deliver batteries in dry state unless hermetically sealed.
- .2 Provide electrolyte in hazard-proof container.

1.4 LOCATION

- .1 Emergency lighting as indicated on plans
- .2 Locate self powered exit light at each exterior doorway.

1.5 CODE

- .1 Provide circuit for each room.
- .2 In accordance to National Building Code latest edition.
- .3 Use Teck cable.

Part 2 Products

2.1 EMERGENCY LIGHTING EQUIPMENT

- .1 Supply voltage: 120 VAC and Output Voltage: 12 VDC.
- .2 Minimum illumination operating time: 30 minutes
- .3 Battery: Sealed, maintenance free, 10 yr design life.
- .4 Chargers: Solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected regulated output $\pm 0.01V$ for $\pm 10\%$ input variations.
- .5 Solid state transfer.

- .6 Low voltage disconnect: Solid state, modular, operates at 80% battery output voltage.
- .7 Signal Lights: LED type for:
 - .1 Battery Failure.
 - .2 Battery Disconnect.
 - .3 Charger Failure.
 - .4 Lamp Failure.
 - .5 Service Alarm.
 - .6 AC Power ON.
 - .7 Charger High Rate.
- .8 Lamp heads: Integral on unit and remote, 345 ° horizontal and 180 ° vertical adjustment.
- .9 Lamp type: Main Unit -two glare free, LED lamps - 5 watts.
- .10 CSA Certified to C22.2 No. 137 and C22.2 No. 141. To be suitable for a Class I Division 2 environment.
- .11 Mounting: Universal mounting plate for wall or junction box.
- .12 Cabinet: Suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

2.2 EXIT SIGNS

- .1 To CSA C22.2 No. 137, CSA C22.2 No. 141 and CSA C860, packaged in accordance with Canadian Code for Preferred Packaging guidelines.
- .2 Suitable for use in a Class I, Division 2 environment.
- .3 120 V supply, 12 VDC, Operating time 90 minutes.
- .4 Maintenance free battery and solid state charger.
- .5 Pictogram Exit Sign.
- .6 LED lights.

2.3 REMOTE HEADS

- .1 Supply voltage: 12VDC.
- .2 Dual lamp, copper free aluminum, grey finish, with die cast junction box.
- .3 CSA Certified to C22.2 No. 137 and C22.2 No. 141. To be suitable for a Zone 2 Hazardous location (Class 1, Division 2/Zone 2)
- .4 LED – minimum 4W.

Part 3 Execution

3.1 INSTALLATION

- .1 Conductors: TEW type minimum 1.63 mm (14 gauge) twisted pair.
- .2 Cables: Minimum #14 AWG multi conductor armoured Teck cable.
- .3 Fill batteries delivered in dry state with electrolyte.
- .4 Mount exit signs centered 200 mm over door trim.

- .5 Install in accordance with National Building Code.
- .6 Connect to appropriate light circuit.
- .7 Direct heads as indicated.

END OF SECTION

DIVISION 27

COMMUNICATIONS

Part 1 General

1.1 PERFORMANCE REQUIREMENTS

- .1 Co-ordinate the installation, testing and commissioning of the following three (3) telephone lines with the Telephone Utility.
 - .1 Building telephone, security and fax system.
 - .2 PLC modem and dial up system.
 - .3 1 spare line.
- .2 Provide conduit for future telephone service to electrical room. Cap and mark conduit (both ends).
- .3 Provide a system of conduits, boxes, jacks, etc., for the future telephone service in the building. Provide entrance conduit as required by the Telephone Utility.
- .4 Provide conduit through building wall to exterior suitable for telephone cables whether or not telephone cables are available at the time of plant commissioning.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.3 REFERENCES

- .1 CSA T530-99; Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A).
- .2 CSA C22.2 No. 214-17; Communications Cables (Bi-national standard, with UL 444), Includes Update No. 1 (2018) and Update No. 2 (2021).
- .3 CSA C22.2 No. 182.4-M90 (R2020), Plugs, Receptacles, and Connectors for Communication Systems.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for the security system equipment for incorporation into manual specified in Section 01 78 00 Closeout Submittals.
- .2 Include following:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions on operation, adjustment and cleaning.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Manufacturer's operation instructions.

Part 2 Products

2.1 CONDUIT SYSTEM

- .1 Rigid PVC sized at 20 mm for one outlet, 25 mm for two outlets, 32 mm for three outlets.

2.2 OUTLET BOXES

- .1 PVC FS type, as required.

2.3 COVER PLATES

- .1 PVC to suit the requirements.

2.4 PANEL

- .1 Complete all wiring and connections within a telephone panel with a hinged door 610 mm x 457 mm x 102 mm flush mounted.

2.5 WIRING

- .1 Supply and install all wiring and jacks as indicated on the drawings, to the satisfaction of the Telephone Utility.
- .2 Use Cat 6 wiring.
- .3 Supply and install type 1104 boxes for telephone jacks at all locations as shown on the drawings.
- .4 Connect each and every PLC and PC to telephone system to allow dial in by use of a manual cable connection.
 - .1 Primary connection to PLC's and PC's is internet, the telephone line is to be available as a back up access system.
- .5 Connect each and every PLC to telephone system to allow dial in to PLC by use of a manual cable connection.
- .6 Provide a ground wire.

2.6 TELEPHONE AND FAX

- .1 Locate voice/data services as per drawing.
- .2 Departmental Representative is responsible for Telephone Utility costs relating to bringing telephone (two lines) to the wastewater trash removal building site and for any Telephone Utility costs to bring wiring up to building. Location of service entrance to be approved by Departmental Representative prior to installation commencement.
- .3 Be responsible for costs relating to wiring phone and modem service within the building including connections into Telephone Utility supplied equipment.
- .4 Contractor is responsible to contact Telephone Utility and make arrangements to have Telephone Utility service brought to the site and installed.
- .5 WTP:
 - .1 Supply a four handset (requires one telephone jack) cordless DECT 6.0 spread spectrum phone c/w tapeless message recorder.
 - .2 Provide an extension ringer (Federal Signal model TELC minimum 105 dBA @ 1 m) located in treatment area.
- .6 Locate two additional telephone jacks in locations as directed by Departmental Representative.

2.7 INTERNET

- .1 High speed internet is indicated to be part of project Works.

- .2 Co-ordinate and wire equipment as required to accept high speed internet connection.
- .3 As a back-up complete wiring to allow PC and PLC access to dial up internet.

Part 3 Execution

3.1 CO-ORDINATION

- .1 Prior to locating all outlets and installing conduit systems, coordinate with the Telephone Utility engineering department to confirm all construction details.

3.2 PULL BOXES

- .1 No conduit run shall be longer than 30 m without a pullbox being installed, regardless of the number of bends.
- .2 No conduit run shall contain more than 2 - 90° bends, or the equivalent, without having pullbox installed in the run.

3.3 FISH WIRES

- .1 Each empty conduit shall contain a fish wire, to facilitate wiring installation.

3.4 INSTALLATION

- .1 Install raceway system, wiring, distribution system, pull boxes, conduit sleeves and clamps for a complete system.
- .2 Install all wiring and connection neatly inside telephone panel. Use uni strut to mount panel.
- .3 Install grounding facilities and make corrections.
- .4 Supply and install duplex receptacle, mounted on the entrance backboard, and connect to separate 120 volt 15A circuit as detailed on the drawings. Supply and install a #6 green copper ground wire from the telephone backboard to the main building ground.
- .5 Mount telephone outlets at the same height as adjacent receptacles.
- .6 Connect and set up printer supplied as part of SCADA Works.
- .7 Arrange for the installation of the Telephone Utility on behalf of the Departmental Representative.

END OF SECTION

DIVISION 28

ELECTRONIC SAFETY AND SECURITY

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Provide a security system for the wastewater trash removal building complete with intrusion panel, operator keypad, alarm horn, magnetic door contacts, glass break detectors and any other hardware required for a complete and functional system.
- .2 All materials and installations shall be industrial grade.
- .3 Integrate with SCADA supplier. Be responsible to review related shop drawings and related drawings. Be responsible to install all security systems as outlined and provide all interconnecting wiring as required.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Include all major components of system, warning signs, labels, riser diagrams and material data sheets.

1.3 REFERENCES

- .1 ULC 304; Standard for Control Units, Accessories and Receiving Equipment for Intrusion Alarm Systems (CAN/ULC-S304:2016).
- .2 ULC 306; Intrusion Detection Units.
- .3 ULC 318; Standard Power Supplies for Burglar Alarm Systems (ULC S318-96).
- .4 ULC ORD-C634-16; Guide for the Investigation of Connectors and Switches for Use with Burglar Alarm Systems.
- .5 UL 603; Power Supplies for Use with Burglar-Alarm Systems.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for the security system equipment for incorporation into manual specified in Section 01 78 00 Closeout Submittals.
 - .1 Include complete programming set points and code listing information in maintenance manuals.

1.5 TRAINING

- .1 Provide on-site demonstrations of system operation by the system manufacturer representative to train personnel in the operation and maintenance of the system.
- .2 These services are to be provided during the commissioning of the project.

1.6 VERIFICATION

- .1 Before final inspection, test each system component individually and provide a letter of verification to Departmental Representative stating that the system has been checked out and is fully operational.

1.7 WARRANTY

- .1 Ensure each piece of equipment installed is warranted by the manufacturer to be free of defects in operation, material and workmanship for a period of 12 months from date of substantial completion.

Part 2 Products

2.1 CONTROL PANEL

- .1 Panel – Wall mounted type, modular design complete with the following:
 - .1 Minimum five supervised zone capacity and five user codes.
 - .2 Standby power batteries sized to provide current for minimum 10 hours.
 - .3 Differentiation between open line condition and alarm condition.
 - .4 End-of-line resistors to control supervisory current in each circuit.
 - .5 Relays as required for necessary operation as indicated and as required for SCADA system.
 - .6 Built in telephone dialer and voice message for future connection.
 - .1 Co-ordinate alarms with SCADA supplier. All alarms to be sent through the SCADA for notification to the operator.
 - .7 Provide dry relay output contacts suitable for signal retransmission to PLC for:
 - .1 Door(s) operation suitable for transmission of door open/closed operation to SCADA.
 - .2 System arm/disarm operation suitable for transmission of system armed/disarmed operation to SCADA.
 - .3 Alarm in progress.
 - .4 System “trouble” as indication when fault occurs in wiring or other faults as sensed by unit.

2.2 CONTROL KEYPAD

- .1 Keypad by-pass to allow for arming and disarming of system.
- .2 Keypad to sound during arm/disarm stage.
- .3 Provide 2 line English display that is back lit. Display time and date as well as detection zones and status indicators.
- .4 Provide door cover over keys.
- .5 Provide 2 units of same manufacturer as Control Panel. Each station shall be able to operate the system independently.

2.3 DETECTION DEVICES

- .1 ULC listed for use with control panel.
- .2 Complete with all hardware and accessories required for installation and connection to the system.
- .3 Magnetic door contacts.
 - .1 Suitable for flush mounting on all exterior doors.
- .4 Alarm Horn.

- .1 Weatherproof alarm horn suitable for wall mounting outdoors to provide audible alarm annunciation.
- .5 Smoke Detectors.
 - .1 Wired with automatic drift compensation.
 - .2 Built in, dual sensor with smoke and heat detection.
 - .3 Built in horn.
 - .4 Local test button.
 - .5 Provide 4 units – locations as per plan.
 - .6 Units to be combination smoke/carbon monoxide detectors.
- .6 Glass Break Detectors.
 - .1 Provide 360⁰ coverage within a 7 m radius.

2.4 SYSTEM OPERATION

- .1 When supervised door is opened, zone indicating pilot light flashes and audible alarm at control panel is activated. When "Acknowledge" pushbutton is pressed, audible alarm is silenced and flashing pilot light changes to steady glow.
- .2 System is returned to normal when door is closed and "Reset" key switch at control panel is utilized or keypad by-pass satisfied.
- .3 When deactivating switch is operated, supervised door on that zone can be opened without causing an alarm. Zone "Trouble" pilot light is illuminated when the zone is deactivated but audible alarm at control panel does not sound.
- .4 Fault in wiring of a zone shall cause audible alarm at control panel to sound even if zone is deactivated.
- .5 Units to integrate to SCADA system.
 - .1 Alarm notification.
 - .2 Arm/disarm notification.
 - .3 All door(s) open/closed sequence monitoring.
 - .4 System "trouble" as indication when fault occurs in wiring or other faults as sensed by unit.
- .6 All security system equipment shall be provided by a single supplier.

Part 3 Execution

3.1 INSTALLATION

- .1 Install all components for a complete operational system by Contractors experienced with the installation of security systems.
 - .1 Includes both building and video security systems.
- .2 Program building security system to Owner's requirements.
- .3 Identify all equipment, switches, devices, etc. Tag all control wiring at both ends.
- .4 Install all wiring in PVC conduit unless concealed. Ensure there are no exposed wires.
- .5 Wire to telephone line and handset. Ensure no other device can prevent alarm transmission from security system.

- .6 Co-ordinate with door frame supplier to have holes for magnetic door switches pre-drilled into doors and door frames as required.
- .7 Install one control keypad near main entrance door and one near the alternate entrance door for the WTP building.
- .8 Provide hard wiring to connect Wastewater Trash Removal Building to the Institution's existing building management system for monitoring of building security system. Nearest BMS panel is located in the basement of the existing 50 bed facility. Provide wiring as required for building security system logs in SCADA to be developed for:
 - .1 Alarm notification: Security has been breached (Note: Also a telephone dial out condition).
 - .2 Arm/disarm notification: Log and display each date and time alarm system is armed or disarmed.
 - .3 Door open/closed notification: Log and display each date and time door(s) is opened or closed.
 - .4 System Trouble: Log and display each date and time system "Trouble" is activated.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Provide a closed circuit television (CCTV) video monitoring security system for the Wastewater Trash Removal Building.
 - .1 Complete with cameras, high definition digital network video recorder (NVR), monitor, interconnecting, camera housings, support brackets, mounting poles and output wiring.
 - .1 Number of channels to be based on number of cameras.
 - .2 Interconnect network video recorder with SCADA monitor.
 - .3 Interconnect cameras to the Institution's existing video monitoring system at the 50 bed complex.

1.2 PERFORMANCE REQUIREMENTS

- .1 Integrate video cameras and stored video onto an internal plant network that can be viewed remotely using web based software.
- .2 Use standard components for equipment and materials that are manufactured and available for purchase as standard replacement parts as long as the product is commercially available from the manufacturer.
- .3 Include, at no additional cost, online support services and availability of a toll-free (U.S. and Canada), 24-hour technical assistance program (TAP) for emergencies for all manufactured products.
- .4 Provide warranty such that the manufacturer will repair or replace without charge, manufactured products proven defective in material or workmanship for the stated warranty period from the date of shipment.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme including:
 - .1 Functional description of equipment.
 - .2 Technical data sheets of all devices.
 - .3 Device location plans and cable lists.
 - .4 Video camera surveillance chart.
 - .5 Video interconnection detail drawings.
- .3 Submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for the security system equipment for incorporation into manual specified in Section 01 78 00 Closeout Submittals.
- .2 Include following:

- .1 System configuration and equipment physical layout.
- .2 Functional description of equipment.
- .3 Instructions on operation, adjustment and cleaning.
- .4 Illustrations and diagrams to supplement procedures.
- .5 Manufacturer's operation instructions.

1.5 REFERENCES

- .1 BS EN 62262:2002+A1:2021, Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).
- .2 ULC S317-96, Standard for Installation and Classification of Closed Circuit Video Equipment (CCVE) Systems for Institutional and Commercial Security Applications.

Part 2 Products

2.1 HD CAMERAS

- .1 Colour high definition resolution cameras with the following features:
 - .1 Tamper-Resistant Hardware.
 - .2 Includes Both Composite and Unshielded Twisted Pair (UTP) Outputs.
 - .3 12 VDC or 24 VAC Operation, Autofocus.
 - .4 Construction: 316L stainless steel construction with electropolish finish. with stainless steel mounting bracket.
 - .5 Video.
 - .1 Signal System: NTSC or PAL.
 - .2 Video Output: NTSC/PAL, A/V mini-jack (3.5 mm).
 - .3 Network: 100Base-TX.
 - .6 Mechanical.
 - .1 Cable Entry: One 0.75-inch (1.91 cm) NPT threaded opening c/w explosionproof sealable fitting.
 - .2 Angle of view 35° to 88°.
 - .7 Environment.
 - .1 Suitable for Class I, Division 2 environment.
- .2 Indoor cameras.
 - .1 Active pixels: 786 x 494.
 - .2 Minimum illumination: Colour 0.55 lux.
 - .3 Ethernet compatible.
 - .4 Junction boxes as required.
 - .5 Analytical features: Built-in motion detection with selectable sensitivity and threshold.
 - .6 Supply three (3) cameras for Wastewater Trash Removal Building.

2.2 NETWORK VIDEO RECORDER

- .1 Provide a platform to allow a complete and integrated access control and physical security management (PSIM) system.

- .2 Software updates to be downloadable from a publicly available website.
- .3 Support up to 32 IP video streams.
- .4 Provide 300 Mbps throughput for recording of analog and IP video streams, playback and export.
- .5 Support recording of MPEG-4 and H.264 IP streams.
- .6 Operate a fully open architecture with support for both IP-specific camera as well as cameras with ONVIF compliance.
- .7 Support automatic detection of IP cameras. Third-party IP cameras shall be automatically detected dependent on IP driver versions and manufacturers specifications.
- .8 System shall contain two (2) Gigabit Ethernet (1000Base-T) ports; one for IP camera/encoder data, and one to connect to a network for client computer access.
- .9 Viewed, managed, and played back through a single user interface simultaneously with other Digital Sentry digital video management systems through supplied DS Admin or DS ControlPoint Client software.
- .10 Includes an internal DVD+/-RW optical drive and two (2) DVI-D ports.
- .11 Support audio recording from cameras with Sarix technology in addition to third-party manufacturer's audio recording.
- .12 Support additional storage utilizing an optional DSSRV-SCSI interface card to connect to attached Pelco DX8100, DX4100, DX4500/DX4600, DX4700/DX4800 storage drive.
- .13 Capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on a per channel basis.
- .14 Allow archival of video data to computers or SAN storage devices over a network connection with the DS Archive Utility. The archival schedule shall be either automatic at user-defined intervals or manual and shall be configurable per connected camera.
- .15 Network health and event monitoring through SNMP and New Digital Sentry® System Information (DSSI) Utility.
- .16 Display system health monitoring data utilizing front panel LED displays and display popups.
- .17 System Specifications.
 - .1 Mounting: Locate inside PLC cabinet or provide a separate stand alone cabinet.
 - .2 Processor: Intel® Xeon E3 or better.
 - .3 Operating System: Windows 10 Ultimate 64-bit.
 - .4 Internal Memory: 8 GB RAM.
 - .5 Network: Two (2) Gigabit Ethernet RJ-45 (1000Base-T) ports.
 - .6 User Interface: DS Control Point.
 - .7 Internal Storage :
 - .1 DSSRV2-DVD: Minimum of 6 TB.
 - .8 RAID Level: Not required.
 - .9 External Storage: Available through plug in USB ports, Pelco's DX8100HDDI or third party SCSI with optional DSSRV-SCSI card..
 - .10 Drives
 - .1 System Drive: DSSRV2-DVD – four (4), 3.5-inch hard drive bays.

- .2 Optical Drive: DVD±RW.
- .11 USB Ports: Three (3) USB 2.0 ports (1 front, 2 rear), two (2) USB 3.0 ports (rear).
- .12 Power Input: 100 to 240 VAC, 50/60 Hz, autoranging.
- .18 Environmental Specifications.
 - .1 Operating Temperature: 10° to 35°C (50° to 95°F)
 - .2 Operating Humidity: 20% to 80%, noncondensing.
 - .3 Maximum Humidity Gradient: 10% per hour.
 - .4 Operating Altitude: -15 to 3,048 m (-50 to 10,000 ft).
 - .5 Operating Vibration: 0.25 G at 3 Hz to 200 Hz at a rate of 0.5 octave/minute.
 - .6 Dimensions: 50.8 x 43.4 x 8.9 cm.
- .19 Certifications
 - .1 CE, Class A; meets EN50130-4 standard requirements.
 - .2 FCC, Class A.
 - .3 UL/cUL Listed.
 - .4 CCC.
 - .5 KCC.
- .20 IP Video Management Client Software requirements
 - .1 Provide the capability of running a client application in addition to the video management system.
 - .2 Use supplied computer with system compatible software as the user interface for viewing system. Display live and recorded video and current event video on any client computer using a proper login and password.
 - .3 Client Software to be unlicensed and available to be installed on as many clients as required by the user.
 - .4 Client Software to be compatible with multiple DVR and NVR platforms.
 - .5 Client Software to be password controlled such that password functionality set at each connected system will be recognized at the client. Password shall limit the ability to access live or recorded video as well as the ability to export video.
 - .6 Client Software to allow multiple monitor support for up to four displays per client workstation, providing virtual matrix functionality.
 - .7 Client Software to allow the connection of keyboard controllers to the client workstation to control PTZ operations and camera call-up.
 - .8 Client Software to allow video streams to be selectable from a system tree on an individual camera, individual system, client defined local groups, or from predefined recorder based groups.
 - .9 Client Software to be a tab based work environment with the ability to undock the tabs creating a virtual workspace on single or multiple monitor clients.
 - .10 Client tabs to include system management, live, and search options. Tabs can be displayed simultaneously on the client.
 - .11 Systems Tab to display and sort available systems, connection status, system names, system IP addresses, and custom categories. This tab shall additionally allow:
 - .1 Manual connect and disconnect of systems to the client.

- .2 Virtual systems naming.
- .3 Auto Connecting.
- .4 Adding, deleting, and editing available systems.
- .5 Live video tab to have the ability to be created up to four times on a single client workstation providing for video display combinations and simultaneous video streams from as many different systems with consideration for maximum client bandwidth.
- .12 Live video tab will provide the following functionalities:
 - .1 Quick Review which will display recorded video from the last 1, 5, 15, 30, 60 or 90 minutes, providing near instantaneous review of recent events.
 - .2 One week graphical display of recorded video.
 - .3 Borderless display option.
 - .4 Screen layout selection.
 - .5 On the fly on-screen display changes including time, date, camera name, frame rate, frame size, alarm display, and border indicators.
 - .6 Digital zoom.
 - .7 User selectable in-video PTZ control or dashboard style control.
 - .8 Drag and drop audio support associating any audio with any video.
 - .9 Search video tab will allow for the search of one or multiple cameras from one or multiple systems simultaneously. Search tab will provide the following functionalities:
 - .1 Time and date search.
 - .2 Advanced data search with DataPoint interfaced software to Active Alert Intelligent Video and POS.
 - .3 Drag and drop audio support to associate audio with any video.
- .13 Video export to any system accessible media including locally to HDD, CD/DVD, Flash USB device or to network storage.
- .14 Video authentication of exported video via check sum verification.
- .15 Alarm video tab to allow for alarm pop-up and playback of active alarms. Alarms may be based on motion activity, an external software trigger from Active Alert analytics or a preset data alarm from DS DataPoint. Display an alarm list pane for playback of queued alarms.
- .16 Incorporate virtual matrix functionality whereby camera sequences may be created on the monitoring workstation:
 - .1 Each sequence to have a maximum of 15 cameras.
 - .2 Each camera in the sequence to have its own individual dwell time, from 1 to 60 seconds.
 - .3 Each entry in a sequence to have the capacity to trigger PTZ camera presets, patterns, or auxiliaries.
 - .4 Have the capability to display recorded video with full VCR controls. This feature shall display video from multiple cameras simultaneously. The user shall be able to play video as fast as possible (all images), in real time, or by skipping a selectable number of seconds.

- .5 Support simultaneous playback of up to sixteen cameras all synchronized with each other. Non-synchronous playback of multiple cameras shall not be acceptable.
- .6 Support tours of multi-camera displays.
- .17 Remote Client Minimum PC Requirements:
 - .1 Processor: Intel® Core i7 processor with integrated graphics.
 - .2 Memory: 8 GB or higher
 - .3 Graphics Card: Graphics controller card with 512 MB (or greater) dedicated video memory.
 - .4 Optical Drive: DVD.
 - .5 Operating System: Windows 7 (64 bit) or better.
- .21 Warranty
 - .1 3 year parts and labor.
- .22 Supplied Accessories.
 - .1 Power Cord: One (1), all cables are 3 prong, connector, 1.8 m (6 ft).
 - .2 USB Keyboard and Mouse: One (1).
 - .3 Bezel key: Two (2).
 - .4 Rack Mount Kit: Brackets, rails, and hardware for rack mounting.
 - .5 Documentation, resource and recovery disc.
 - .6 24" color monitor.

2.3 MONITOR(S)

- .1 24" LCD flat wide screen colour monitor: Static contrast ratio 700:1, 170°/160° (CR>10) viewing angle, resolution 1920 x 1080.
 - .1 Remote monitor in office:
 - .1 Place monitor on desk in office. Provide video cable as required to operate monitor.
 - .2 Provide PS/2 over CAT 5 extenders at each end to extend keyboard and mouse to office using Cat 6 cable. Provide keyboard and mouse and required cables.

2.4 MOUNTING RACK

- .1 Provide a mount rack for mounting CCTV that resists vandalism. Provide a rack suitable for wall mounting in the office

2.5 POWER SUPPLY

- .1 Provide a hard wired CCTV power supply for powering CCTV systems.

Part 3 Execution

3.1 INSTALLATION

- .1 Install all components in cabinet for a complete operational system by Contractors experienced with the installation of video security systems.

- .2 Provide instruction for others to mount cameras and field devices not pre-mounted inside PLC cabinet.
- .3 Mount cameras at an angle suitable to Owner's requirements
- .4 Wire cameras, video recorder and monitor.
- .5 Program recording and monitors to Engineer's requirements.
- .6 Identify all equipment, switches, devices, etc. Tag all control wiring including referencing camera numbering at both ends on record drawings and field.
- .7 Locate and position monitor in office as directed by the Departmental Representative.
- .8 Confirm access from web.
- .9 Co-ordinate with other sub trades.
- .10 Complete wiring for three (3) future exterior cameras.

3.2 TESTING

- .1 Test each system component individually and provide written verification of same.
- .2 Submit test results in the maintenance manuals.

END OF SECTION

DIVISION 31

EARTHWORK

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples. Submittals to include but not limited to:
 - .1 Non-Woven Geotextile.

1.2 REFERENCES

- .1 ASTM D3786/D3786M-18; Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
- .2 ASTM D4355/D4355M-21; Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
- .3 ASTM D4491/D4491M-21; Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- .4 ASTM D4533/D4533M-15; Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
- .5 ASTM D4595-17; Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
- .6 ASTM D4632/D4632M-15a; Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- .7 ASTM D4716/D4716M-20; Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
- .8 ASTM D4751-21a; Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .9 ASTM D4759-11(2018)e1; Standard Practice for Determining the Specification Conformance of Geosynthetics.
- .10 ASTM D4833/D4833M-07(2013)e1; Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
- .11 ASTM D4873/D4873M-17; Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
- .12 ASTM D6241-14; Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.3 DELIVERY AND STORAGE

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.
- .2 Packaging and labeling in accordance with ASTM D4873.
- .3 Store and handle in accordance with manufacturer's and/or Supplier's recommendations.
- .4 Provide Mill Certificate and the MARV (Minimum Average Roll Value). Provide data upon request by the Departmental Representative.

1.4 TESTING PROCEDURES

- .1 All testing procedures and related Works to be in accordance with the most current ASTM standard.
- .2 The laboratory shall provide a Manufacturer's certificate that includes the name of manufacturer, chemical composition, product description, statement of compliance to specification requirements.

Part 2 Products

2.1 GENERAL

- .1 The following applies to all non-woven synthetic fibre fabric supplied in rolls:
 - .1 Composed of a continuous chain polymeric filaments or yarns of polyester, formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet exposure (minimum 60 days), insect and rodent resistant.
 - .2 The minimum value (weakest direction) for strength properties of any individual roll tested from the manufacturing lot or lots of a particular shipment shall be in excess of the minimum value (weakest principal direction) stipulated herein.
 - .3 Minimum width 3.6 m.
 - .4 Environmental Non-Woven geotextile (geocushion) to be specifically designed as a cushion for liner protection.

2.2 SEPARATION GEOTEXTILE

- .1 Physical Properties based on MARV (Minimum Average Roll Values) determined in accordance with ASTM 4759:

<u>Physical Property</u>	<u>Requirements</u>	<u>Test Method</u>
Grab Tensile Strength	900 N – minimum	ASTM D4632
CBR Puncture	2200 N – minimum	ASTM D6241
Trapezoid Tear	350 N – minimum	ASTM D4533
Apparent Opening Size	0.18 mm – maximum	ASTM D4751
Permittivity	1.4 sec ⁻¹ – minimum	ASTM D4491
Flow Rate	4000 L/min/m ² - minimum	ASTM D4491
U.V. Resistance	70% per 500 hrs – minimum	ASTM D4355

- .2 Where 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.

<u>Physical Property</u>	<u>Requirements</u>	<u>Test Method</u>
Puncture Strength	575 N – minimum	ASTM D4833
Mullen Burst	2000 kPa – minimum	ASTM D3786

Part 3 Execution

3.1 INSTALLATION

- .1 Once subgrade has been inspected and approved by the Departmental Representative, place geotextile materials by unrolling onto graded surface in orientation of construction.
- .2 Do not drag geotextile and place smooth, free of tension stress, folds, wrinkles or creases.
- .3 Place geotextile fabric to the complete limits of the roadway sub-grade including intersections, turning lanes and side slopes or as directed by the Departmental Representative.
- .4 Overlap each successive strip of geotextile minimum 600 mm (or as recommended by Manufacturer, whichever is greater) over previously laid strip.
- .5 Protect geotextile from displacement and damage during placement of material layers.
- .6 Cover geotextile with granular materials ensuring the drop or handling of the granular material does not damage the fabric. Utilize equipment that does not overstress the soil, an indication of overstressing is the equipment causing rutting at the time of placement or spreading of granular materials.
- .7 First lift of cover over geotextile to be minimum 150 mm thick aggregate placed by end dumping adjacent to the geotextile or over previously placed aggregate. End dumping or tail gate dumping of aggregate on the geotextile will not be permitted.
- .8 Compact first lift of aggregate thoroughly with a steel drum roller. Do not use a vibratory compactor for the first 150 mm lift over the geotextile.
- .9 Prior to using roadway for haul vehicles place minimum 300 mm of granular material and obtain Departmental Representative's approval.
- .10 Remove or repair damaged or improperly installed geotextile as directed by the Departmental Representative. Repair patches to provide a minimum of 900 mm overlap to damaged area in all directions.

3.2 PROTECTION

- .1 Do not permit passage of any vehicle directly on geotextile at any time.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The work of this section includes excavation of topsoil from designated areas, a partial listing of the area for topsoil removal is:
 - .1 Building footprint
 - .2 Underground piping alignment.
 - .3 Parking lot footprint.
- .2 Areas which are affected by construction vehicle traffic, equipment and material storage, and other works shall be restored to its original condition or better by grading and additional topsoil placement.
- .3 Excavated topsoil shall not be removed from the job site.

1.2 DEFINITIONS

- .1 In Situ Topsoil: is the upper, outermost layer of soil in which most plants have their roots and generally contains the highest percentage of soil organic matter. For this project topsoil is defined as the uppermost 75 mm of soil, regardless of soil color change or lack of color change between the topsoil and subsoil below the topsoil.
 - .1 All soil below the topsoil depth indicated above is classified as subsoil.
- .2 Subsoil: Soil of any type (sand, silt and/or clay in any percentage) under the topsoil, generally containing less soil organic matter than topsoil. Subsoil may have the same or similar color or a different color than topsoil.

Part 2 Products

- .1 Not applicable to this section.

Part 3 Execution

3.1 TOPSOIL REMOVAL

- .1 Strip and grade all areas designated on drawings to design lines, grades and cross-sections.
- .2 Remove topsoil in a manner to avoid mixing with underlying soil.
- .3 Stockpile topsoil not exceeding 2 m height, for its later replacement as topsoil dressing for seeding.
- .4 Dispose of unused topsoil and waste material to location as indicated or as directed by Departmental Representative.
- .5 Do not handle topsoil which is in a wet or frozen condition or in any manner in which soil structure is adversely affected.

- .6 Strip topsoil to full depth as indicated above or as directed by Departmental Representative. Avoid mixing topsoil with subsoil.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM D698-12(2021); Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).

1.2 PROTECTION

- .1 Prevent damage to trees, landscaping, natural features, bench marks, existing buildings, fences, existing roadways and surface or underground utility lines which are to remain. Make good any damage.

Part 2 Products

2.1 MATERIALS

- .1 Not Applicable.

Part 3 Execution

3.1 GENERAL

- .1 Restore damaged and disturbed surfaces to equal or better than original condition.
- .2 Maintain damaged or disturbed surfaces including pavements, boulevards, curbs, sidewalks, ditches and culverts as directed by the Departmental Representative until permanent repairs and restoration has been made.

3.2 GRADING

- .1 Grade trenches and non construction areas, i.e. temporary roads, office areas, equipment areas, etc. Grade to levels, profiles and contours existing prior to construction or grade homogeneous with new construction as approved by Departmental Representative.
- .2 Restore ditches as affected by construction to their original grade unless otherwise stated.
- .3 Compact fill in disturbed areas unless specifically stated otherwise:
 - .1 To standard Proctor Dry Density to ASTM D698 of:
 - .1 95% - fill under driveways and roadways.
 - .2 90% - other areas or at least equal to density of adjacent undisturbed soil.

3.3 ROACHING (MOUNDING)

- .1 Roaching (mounding) of the trench will be permitted to compensate for settlement. The height of the roach depends upon land use, the degree of compaction achieved and soil frost. Frozen soils require higher roaches than non-frozen soils. For agricultural lands, the roach should be low and wide (unfrozen case) to facilitate topsoil replacement.
- .2 Leave periodic gaps in roach (i.e. 250 mm), at all obvious drainage courses to allow for surface run off. Maintain gaps.
- .3 Roaching (mounding) of trenches is not to exceed 300 mm.

- .4 Restore trenches to original grade and condition after settlement has occurred and prior to the end of the warranty period for the Works.

3.4 CLEAN UP

- .1 Clean up to satisfaction of the Departmental Representative:
 - .1 Areas affected by Work of any material dropped or spilled during trenching and hauling operations.
 - .2 Haul excess excavated material, debris and trash from site and dispose.

3.5 SETTLEMENT

- .1 Promptly repair any settlement of backfill which occurs prior to end of warranty period.
- .2 Re-compact defective areas and place and compact additional backfill up to grade. Use material matching adjacent surface and compact to specified density.
- .3 Pay all costs to repair damages to other Work caused by such settlement.

3.6 SURPLUS

- .1 Dispose of surplus material as directed by Departmental Representative.
- .2 Dispose of material unsuitable for fill or grading as directed by Departmental Representative.
- .3 Excavated surplus material shall not be removed from the job site unless directed by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM C136/C136M-19; Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .2 ASTM D698-12(2021); Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
- .3 CAN/CGSB 8.2-M88; Sieves, Testing, Woven Wire, Metric.
- .4 Province of Manitoba W210 (2015); The Workplace Safety and Health Act
- .5 Province of Manitoba Workplace Health and Safety Division – Guideline for Excavation Work (2007)

1.2 DEFINITIONS

- .1 Rock is defined as material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass and boulders or rock fragments having individual volume in excess of 1 m³, which cannot be removed by means of heavy duty mechanical excavating equipment (i.e. 40 tonnes) without drilling and blasting. If material cannot be removed by equipment rated at 40 tonnes, but can be removed by larger equipment, it shall still be considered rock. Frozen material is not classified as rock excavation.
- .2 Common excavation: Excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.
- .3 Topsoil: Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.3 PROTECTION

- .1 Existing buried utilities and structures including water, sewer, gas, electric and communications:
 - .1 Before commencing work, confirm location of existing buried utilities on and adjacent to site and follow applicable utility guidelines for works near utilities.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures if indicated are for guidance only. Completeness and accuracy is not guaranteed.
 - .5 Prior to commencing any excavation Work, notify Departmental Representative and applicable authorities having jurisdiction and establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during Work.

- .6 Conduct, with Departmental Representative, survey of existing fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments affected by Work.
- .7 Maintain and protect from damage utilities and structures encountered. Obtain direction of Departmental Representative and utility representative before moving or otherwise disturbing utilities or structures. In event of damage, immediately make repair to approval of utility representative and Departmental Representative.
- .8 Repair any damage to utilities in accordance to the direction of the Utility Departmental Representative at no cost to the Departmental Representative.
- .2 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, paved surfaces, survey bench marks and monuments which may be affected by work.
 - .2 Protect existing buildings, and surface features which may be affected by works from damage while work is in progress and repair damage resulting from work at no extra cost to the Departmental Representative.
 - .3 Where excavation necessitates root or branch cutting, do so only as approved by Departmental Representative. If pruning is necessary, make cuts clean, smooth and slanted. Apply tree paint to all wounds.
- .3 Prefabricated Cages and Shields:
 - .1 Whenever prefabricated cages or shields are used they shall comply with all applicable safety regulations, provide safe access and egress to the cage and permit placing and tamping of bedding material under and around piping.
 - .2 Provide safe access and egress to the cage or the trench for the use of the Departmental Representative to view pipe installations at all times. This includes ramps to access the cage or trench.
- .4 Shoring and bracing:
 - .1 Whenever shoring, sheeting, timbering and bracing of excavations is required it shall comply with all applicable safety regulations, provide safe access and egress to the area and permit placing and tamping of bedding material under and around piping.
- .5 Utilities:
 - .1 Check with utility companies to locate and advise utility of proposed construction activities regarding buried pipe, cables, services and hydro pole requirements.
 - .2 For new construction around a hydro pole, Manitoba Hydro generally requires 1.0 metre of undisturbed flat ground around the hydro pole then a maximum slope of 2:1 to ground elevation.
 - .1 Trench sidewalls shall be minimum 3 m from hydro poles.
- .6 Maintain unobstructed access to fire and police appurtenances, telephone, electric, water, sewer and other public utilities and private properties.

- .7 Perform excavation in accordance with Province of Manitoba W210 and "Guideline for Excavation Work".
- .8 Protect open excavation against flooding and damage from surface run-off water.

Part 2 Products

2.1 MATERIALS

- .1 All imported backfill, granular material, pit run, gravel and screened rock shall be subject to Departmental Representative's approval.
- .2 Following are the types of backfill and bedding material:
 - .1 Type 1 Select Granular Backfill Material: Pit-run, crushed rock or crushed gravel free from shale, clay, friable materials, roots and organic matter which would disintegrate through decay or weathering.
 - .2 Type 2 and Type 3 Backfill Material: Sound, hard, crushed rock or crushed gravel free from organic or soft material that would disintegrate through decay and weathering.
 - .3 Type 4 Common Backfill: Approved material selected from trench excavation or other source, unfrozen and free from cinders, ashes, sods, refuse, stones or lumps exceeding 150 mm in diameter or other deleterious materials.
 - .4 Sand Bedding: shall be free running and clean. Under freezing conditions, dry sand shall be used. Sand shall be graded within the following limits in accordance with ASTM C136M and CAN/CGSB 8.2:

GRADING REQUIREMENTS FOR IMPORTED BACKFILL AND BEDDING

Canadian Metric Sieve Size	Percent of Total Dry Weight Passing Each Sieve			
	Type 1 Material	Type 2 Material	Type 3 Material	Sand
75 000	90% - 100%			
28 000	80% - 100%		100%	
20 000		100%		
10 000				100%
5 000	40% - 80%	40% - 70%	0% - 5%	90% - 100%
2 500		25% - 60%		
630				25% - 60%
315	10% - 35%	8% - 25%		
80	5% - 30%	6% - 17%		0% - 3%

- .5 Excavated Bedding Material: Excavated bedding material shall be unfrozen clay, silt, sand or gravelly sand excavated from the trench which is free from stones and hard lumps of earth larger than 10 mm in diameter.
- .3 Use sand for bedding unless otherwise stated in Section 33 11 16.

Part 3 Execution

3.1 SITE PREPARATION

- .1 Remove trees, shrubs, vegetation and other obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Strip and stockpile for re use any available topsoil prior to excavations.
- .3 Strip and save for reuse granular material of driveways and roadways where affected by trenching operations.

3.2 ALIGNMENT

- .1 Follow the centerline as staked by Departmental Representative. Do not deviate from the required horizontal alignment by more than 100 mm with the trench or tunnel centre line.
- .2 Where a profile of the proposed pipeline or a table delineating depth of piping is provided, and where elevations are given on the stakes, install piping within 25 mm of the required elevations. In cases where neither profile nor table delineating depth of the proposed pipeline is provided, the plans shall specify a minimum depth of cover for the pipeline. Provide minimum horizontal distance between the trench sidewall and pipe of 100 mm or one half the pipe diameter for pipes greater than 200 mm.

3.3 STOCKPILING

- .1 Stockpile fill materials on approved right of ways. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Utilize suitable construction techniques and signage to ensure stockpile are not a safety hazard to pedestrian and vehicle traffic.
- .4 Do not damage existing roadways or surface features with stockpiled material.

3.4 DEWATERING

- .1 Dewater trenches as required to permit progress of work. Provide temporary drainage and pumping as necessary.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Dispose of water in a manner not detrimental to public and private property or any portion of work completed or under construction and in accordance with environmental regulations.
- .4 Further excavate any trench bottom that has deteriorated, obtain the required level by means of suitable compacted granular material.
- .5 Submit for Departmental Representative's review details of proposed dewatering methods, such as well points.

3.5 EXCAVATION

- .1 Perform excavation in accordance with Province of Manitoba "W210 The Workplace Safety and Health Act" and Guidelines for Excavation Work."

- .1 Safe excavation of Trenches is the responsibility of the Contractor. The Departmental Representative will not be held liable for any deviations from existing safe work procedures.
- .2 Excavate to lines, grades, elevations and dimensions shown on the drawings and as directed by Departmental Representative.
- .3 Remove unsuitable material and other obstructions encountered during excavation.
- .4 Fill over-excavation to required elevation with Type 1, Type 2 or Type 3 material as directed by the Departmental Representative and compact to at least 95% of Standard Proctor Density in accordance with ASTM D698.
- .5 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.
- .6 Minimum trench width to be 300 mm greater than outside pipe diameter.
- .7 To minimize trench width use a trench cage unless otherwise approved by Departmental Representative.
- .8 Maximum trench width at top of pipe to be not greater than outside pipe diameter plus 900 mm plus allowance for cage width.
- .9 Where the maximum trench width is exceeded due to unstable soil conditions or over-excavation, the Departmental Representative will review the external loading condition of the pipe to determine if the class of bedding and pipe type or strength specified needs to be upgraded.
- .10 Remove boulders and large stones (diameters of 150 mm or larger) to provide 150 mm minimum clearance under and on sides of pipe. Do not use these in the backfill.
- .11 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .12 Dispose of surplus and unsuitable excavated material in approved location.
- .13 Do not obstruct flow of surface drainage or natural watercourses.

3.6 TRENCH BOTTOM PREPARATION

- .1 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft, organic matter.
- .2 Notify Departmental Representative when soil at bottom of excavation appears unsuitable for foundation material and proceed as directed by Departmental Representative.
- .3 Remove unsuitable material from trench bottom to extent and depth directed by Departmental Representative.
 - .1 Use 20 mm clean stone for bedding after removing unsuitable foundation material.
 - .2 Supply and place first 300 mm thickness where unsuitable trench bottom is the result of poor dewatering or construction techniques.
 - .3 If Departmental Representative determines a thickness greater than 300 mm is required to be removed and replaced any required thicknesses greater than 300 mm and any required geotextile is a pay item to contract.

- .1 First 300 mm thickness is not a pay item.
- .4 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .5 Where required due to removal of unsuitable material or unauthorized over-excavation, correct as follows:
 - .1 Bring bottom of excavation to design grade with 20 mm clean stone.
 - .2 Compact trench bottom to density of at least equal to density of adjacent surrounding soil or to a minimum of 95% Standard Proctor Density in accordance with ASTM D698.

3.7 PRE-INSTALLATION INSPECTION

- .1 Submit proposed procedures and techniques for bedding and backfill to the Departmental Representative for review if requested.

3.8 PIPE BEDDING

- .1 Do not proceed with bedding operations until Departmental Representative has reviewed installations.
- .2 Bedding to include that material that supports the pipe and extends up to an elevation 200 mm above the pipe shall be as follows:
 - .1 Bedding sand shall be placed in the trench such that the pipe is supported along its entire length (and under bells and flanges) by a layer of sand, the thickness of which shall be no less than 100 mm. Additional bedding sand shall be placed around and above the pipe to a point above the pipe which is no less than 200 mm. All bedding sand shall be shovel placed and hand tamped (using a 4 kg and 40 sq cm round tamper) in separate layers, each of which shall be no greater than 100 mm. Place and compact layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
- .3 Unless otherwise specified, piping shall be placed in accordance with manufacturer's recommendations using sand bedding.

3.9 CLASSES OF BACKFILL

- .1 Backfilling to include that material 200 mm above the pipe to the ground surface. Following are classes of backfilling:
 - .1 Class 1 - Common Backfill - Fill the trench to the top with Type 4 common backfill material in maximum 600 mm lifts and compact. Compact to a density at least equal to density of adjacent, undisturbed soil. For the last 600 mm lift, compact with the wheels or tracks of the excavating or grading equipment. The backfilled trench to be left in a slightly mounded condition to minimize the effects of settlement.
 - .2 Class 2 - Compacted Common Backfill - Fill the trench in maximum 300 mm compacted layers to the top with Type 4 common backfill material. Compact the backfill to a minimum 95% Standard Proctor Density with moisture content between 0.9% and 1.2% of optimum in accordance with ASTM D698.

- .3 Class 3 - Compacted Select Granular Backfill - Fill the trench in maximum 150 mm compacted layers to the top with Type 1 material. Compact the backfill to a minimum 98% Standard Proctor Dry Density with moisture content between 0.9% and 1.2% of optimum in accordance with ASTM D698.
- .2 Unless otherwise specified, use Class 1 - common backfill material.
- .3 Under roads, use Class 2 - compacted common backfill material.

3.10 BACKFILLING

- .1 Do not proceed with backfilling operations until Departmental Representative has inspected installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris. Suitable backfill material to be at optimum moisture content to attain desired compaction.
- .4 Backfilling around installations:
 - .1 Obtain Departmental Representative's review of installations for general conformance for backfill and to allow record information to be obtained.
 - .2 Place backfill and surround material as specified in other Sections.
 - .3 Place layers simultaneously on both sides of installed work to equalize loading.
- .5 When a prefabricated cage or shield is used in the trench, special care shall be taken to ensure that there is no lateral or longitudinal movement of the pipe when the cage is moved.
- .6 Compact using approved mechanical tamping devices or by hand tamping to achieve specified compaction.

3.11 INSPECTION AND TESTING

- .1 Testing of materials and compaction will be carried out by testing laboratory. Frequency of tests will be determined by Departmental Representative.
- .2 Cost for inspection and testing by Departmental Representative.

3.12 RESTORATION

- .1 Complete roaching, clean-up, and repair of settlement as per Section 31 22 00 Rough Grading and Restoration.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM D698-12(2021); Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 National Building Code of Canada – 2015.
- .3 Province of Manitoba W210 (2015); The Workplace Safety and Health Act.
- .4 Province of Manitoba Workplace Health and Safety Division – Guideline for Excavation Work (2007).

1.2 SITE CONDITIONS

- .1 Sub-surface information is as per Section 01 00 00 General Requirements.

1.3 SHORING, BRACING AND UNDERPINNING

- .1 Prevent movement or settlement, safeguard and maintain integrity of adjacent structures, earth, bench marks, services, walks, trees, bearing piles and adjacent grades. Provide bracing and shoring as required.
- .2 Shore and brace excavations to prevent failure in accordance with the National Building Code of Canada and applicable local and provincial regulations.
- .3 Make good and pay for any damage and be liable for any injury resulting from inadequate shoring, bracing or underpinning.

1.4 PROTECTION

- .1 Protect bottoms of excavations from softening. Should softening occur, remove softened soils and replace with compacted Type 1 fill at no additional cost.
- .2 Protect bottoms of excavations from freezing.
- .3 Grade around excavation to prevent surface water run-off into excavated area.
- .4 Provide safe access and egress to the excavation in accordance with Provincial Regulations. Provide means for the Departmental Representative to access the excavation at all times.
- .5 Provide adequate protection around benchmarks, layout markers, survey markers and geodetic monuments.
- .6 Provide protection to ensure no damage to existing fencing, facilities and equipment situated on site.
- .7 Implement measures to minimize dust as result of excavation or backfilling Works.
- .8 Do not stockpile excavated material to interfere with site operation or drainage.

Part 2 Products

2.1 MATERIALS

- .1 In accordance with Section 31 23 10 – Excavation and Backfilling for Trenching.

2.2 USE OF FILL

- .1 The excavated material or Type 4 material will be utilized for fill under void forms, grade beams, and against the exterior side of foundation walls unless otherwise directed by Departmental Representative based upon soil suitability.

Part 3 Execution

3.1 SITE PREPARATION

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

3.2 PROTECTION

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

3.3 EXCAVATING

- .1 Perform excavation in accordance with Province of Manitoba "W210 The Workplace Safety and Health Act" and Guidelines for Excavation Work."
- .2 Excavate to elevation and dimensions indicated for installation, construction and inspection of Work specified.
- .3 Excavate to defined lines to minimize quantity of fill material required.
- .4 Provide shoring or bracing to requirements of all safety regulations.
- .5 Earth bottoms of excavations to be dry undisturbed soil, level, free from loose materials and organic matter.
- .6 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.
- .7 Excavate to plus or minus 50 mm of design elevations for general excavation Work and plus or minus 25 mm for footings or structural floors or pads.
- .8 Prior to placing fill under slabs on grade, compact existing subgrade to obtain same compaction as specified for fill. Remove "soft" material as required and fill with approved material.
- .9 Correct unauthorized excavation at no extra cost as follows:

- .1 Fill under bearing surfaces and footings with A-Base in accordance with Section 32 11 23 Aggregate Base Courses compacted to 98% of Standard Proctor density in accordance with ASTM D698.
- .2 Fill under other areas with Type 2 fill compacted to 95% of Standard Proctor Density in accordance with ASTM D698.
- .10 Removal rubble encountered in course of excavation as directed by the Departmental Representative.

3.4 DEWATERING

- .1 Keep excavations free of water while Work is in progress.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Dispose of water for any portion of Work completed or under construction in a manner not detrimental to public and private property and in accordance to all regulations and specifications.
- .4 Furnish and operate suitable pumps on a twenty four hour basis to keep excavation free from water until concrete is placed, waterproofing is complete, structural adequacy against uplift forces and earth pressure is assured.

3.5 STOCKPILING

- .1 Stockpile fill materials for re-use as directed. Stockpile granular materials in manner to prevent segregation. Stockpile topsoil in designated area, prevent contamination with silts, clays and gravel.
- .2 Protect fill materials from contamination.
- .3 Remove excess or unsuitable material including grubbing from site or import material as required to obtain design grades.

3.6 BACKFILLING

- .1 Do not commence backfilling until areas of Work to be backfilled have been inspected by Departmental Representative.
- .2 Areas to be backfilled shall be free from debris, snow, ice, water or frozen ground. Backfill material shall not be frozen or contain ice, snow or debris.
- .3 Maintain optimum moisture content to plus or minus 3% to enable compacted materials to attain specified density.
- .4 Do not place backfill against cast in place concrete walls until top is in place, and concrete has achieved 75% of the design strength.
- .5 Backfill simultaneously each side of walls and other structures to equalize soil pressures.
- .6 Obtain Departmental Representative's approval prior to placing backfill against foundation walls.
- .7 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, erect bracing or shoring to counteract unbalance and leave in place until removal is approved by Departmental Representative.

- .8 Place and compact fill materials, Type 4, in continuous horizontal layers not exceeding 300 mm loose depth. Use methods to prevent disturbing or damaging foundation insulation. Make good any damage.

3.7 FILL TYPES AND COMPACTION

- .1 Dimensions specified in following paragraphs are minimum requirements of fill after compaction. Use vibrating compactors or other means to the satisfaction of the Departmental Representative.
- .2 Under void forms, grade beams and against basement walls: Type 4 material.
- .3 Exterior side or perimeter walls: use Type 4 material to subgrade level. Compact to 95% Standard Proctor Density in accordance with ASTM D698.
- .4 If, during progress of Work, tests indicate fills do not meet specified requirements, remove defective fills, replace and retest at no extra cost.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM C136/C136M-19; Standard test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .2 ASTM D698-12(2021); Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .3 ASTM D4318-17E1; Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .4 CAN/CGSB 8.2-M88; Sieves, Testing, Woven Wire, Metric.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Adhere to Provincial and National Environmental requirements.

1.3 TRAFFIC PROVISIONS

- .1 Provide and maintain roadways for vehicular and pedestrian traffic and access to fire hydrants.

1.4 UTILITY SERVICES

- .1 Check with utility companies to locate and advise utility of proposed construction activities regarding buried pipe, cables, services and hydro pole requirements.

Part 2 Products

2.1 TESTING AND APPROVAL

- .1 Testing and subsequent approvals shall be in accordance with Section 01 45 00.

2.2 MATERIALS

- .1 Embankment materials require approval by Departmental Representative.
- .2 Material used for embankment not to contain frozen lumps, sod, large roots, logs, large rocks, stumps or any other materials not suited for embankment work.
- .3 Granular materials: As described in Section 32 11 23 Aggregate Base Courses.
- .4 Waste: Any organics or silty material which has a plasticity index of 20 or less in accordance with ASTM D4318, with more than 20% of the soil particles passing the No. 200 sieve in accordance with ASTM C136 and CAN/CGSB 8.2 or material found to be in excess or unsuitable by the Departmental Representative.
- .5 Silty material will be considered as that material which has a plasticity index of 20 or less in accordance with ASTM D4318, with more than 20% of the soil particles passing the No. 200 sieve in accordance with ASTM C136 and CAN/CGSB 8.2. Material found to be in excess or unsuitable, as determined by the Departmental Representative i.e. organics, is to be disposed at an approved site arranged by the Contractor.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that condition of substrate is acceptable for roadway embankment Work:
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 EXCAVATION

- .1 General:
 - .1 Maintain crowns and cross slopes to provide good surface drainage.
- .2 Unsuitable materials:
 - .1 Notify Departmental Representative whenever unsuitable materials, whether in a homogeneous mass or in isolated pockets, are encountered and remove unsuitable materials to lateral limits and depth and extent as directed by Departmental Representative.
 - .2 Unsuitable materials to be stockpiled or disposed of as indicated or directed by Departmental Representative.
- .3 The limits of excavation shall be determined by the Departmental Representative.

3.3 PROOF ROLLING

- .1 Complete Proof Rolling when directed by Departmental Representative.
- .2 Proof rolling is used to detect soft areas of low shear strength in an "as excavated" subgrade for fill, pavement or detecting non-uniform embankment compaction.
- .3 For proof rolling use a heavy (15-16 tonne) rubber tired roller with four wheels abreast on independent axles and wheel pressures (550 kPa to 1030 kPa) or a heavily loaded truck to approximately 10 tonnes per axle and minimum tire pressure of 550 kPa.
- .4 Ground speed to be a maximum of 8 km/hour. Recommended speed is 4 km/hour.
- .5 Accomplish proof rolling by two complete coverage of the area with proof rolling equipment in one direction and a second series made at right angles to the first direction, if possible. One coverage means every point of the proof rolled surface has been subjected to the tire pressure of the loaded wheel.
- .6 Observe surface of the proof rolled areas, note visible deflection and rebound of soil surfaces or for granular surface shear failure as ridging between wheel tracks.
- .7 Any area of soft, rutted or displaced materials shall be re-compacted with additional fill or the existing material removed and replaced with the soil material as specified by the Departmental Representative or properly moisture conditioned as necessary.
- .8 For new construction, permanent rutting in excess of 25 mm should be considered failure. In addition, elastic (rebound) movement or rutting in excess of 25 mm with substantial cracking or substantial lateral movement should be considered failure.

3.4 COMPACTION EQUIPMENT

- .1 Provide and use compaction equipment suitable to obtain specified densities.
- .2 Ensure the compaction extends to a minimum depth of 150 mm below the surface being compacted. If necessary, carry out water sprinkling in such a manner as to provide a uniform soil wetting distribution over the area to be compacted.
- .3 Areas not accessible to rolling equipment, compact with mechanical compactors.

3.5 STRIPPING

- .1 Strip all topsoil over areas to depths indicated in or as directed by Departmental Representative prior to beginning of excavation and embankment work.
- .2 Stockpile or windrow topsoil in a manner which will prevent contamination of topsoil with underlying soil materials and allow for future re use.
- .3 Backfill and compact areas over-excavated in accordance with this, using subbase material as specified by the Departmental Representative.
- .4 Remove unsuitable materials found during stripping. Replace with suitable materials.

3.6 EMBANKMENT AND SUBGRADE COMPACTION

- .1 After the removal of topsoil and organics, scarify the subgrade to a minimum depth of 100 mm and compact to 95% of Standard Proctor Density in accordance with ASTM D698.
- .2 Remove unsuitable materials found during preparation and compaction. Replace with suitable materials.
- .3 Proof roll subgrade and remove additional 300mm of material as directed by Departmental Representative where soft areas are encountered.
- .4 Do not proceed with embankment construction until obtaining Departmental Representative's approval.
- .5 Do not place frozen material as fill for embankments or place embankment fill material on frozen surfaces.
- .6 Maintain a crowned surface during construction to ensure ready run-off of surface water.
- .7 Place and compact to full width in uniform layers not exceeding 150 mm loose thickness.
- .8 Break soil down to sizes suitable for compaction and mix for uniform moisture and soil conditions to full depth of layer.
- .9 A broad range of moisture content shall be permitted but generally materials should be within $\pm 2\%$ of optimum moisture content. The material shall not be so wet nor so dry that compaction equipment cannot compact the fill into a homogeneous mass. Material too wet shall be dried or wasted as directed by the Departmental Representative, and material too dry shall be wetted as directed by the Departmental Representative.
- .10 When excess water has been applied, either by sprinkling operations or by precipitation, to cause local or continuous ponding, soil compaction shall not be permitted until sufficient soil drying has occurred, creating a condition lending itself favorably to compacting operations.
- .11 Unless otherwise specified, the sub-grade material shall be supplied, placed and compacted in layers not exceeding 150 mm in compacted thickness to a minimum of 95%

percent of Standard Proctor Density in accordance with ASTM D698, for the full width, and each layer shall be trimmed level and inspected, tested and approved by the Departmental Representative before the succeeding layer may be applied.

3.7 FINISHING

- .1 Do scarifying, blading, compacting or other methods of work as necessary to provide thoroughly compacted roadbed shaped to grades and cross sections indicated or directed.
- .2 Trim and crown the final compacted layer of sub-grade (finished surface) to within minus 15 mm or plus 25 mm of design elevations of the bottom of granular material as shown on the drawings and to the satisfaction of the Departmental Representative. Elevations shall not be uniformly high or low. Fill depressions greater than 15 mm with clay and bond the clay to the lower layer alternatively use gravel at no cost to the Departmental Representative.
- .3 Trim ditch bottom to within 25 mm of design elevations and to Departmental Representative's satisfaction. Elevations shall not be uniformly high or low. Use laser level for final ditch trimming.
- .4 Finish back and side slopes of common material to a neat condition, suitable for seeding, true to line and grade.
 - .1 Remove boulders encountered in cut slopes and fill resulting cavities.
 - .2 Hand finish slopes that cannot be finished satisfactorily by machine.
- .5 Remove soft or other unstable material that will not compact properly and fill resulting depressions with approved material.
- .6 Upon completion of embankment construction, if so directed, place stockpiled and windrowed topsoil and unsuitable material against embankment and trim to maintain embankment slope.

3.8 MAINTENANCE

- .1 Maintain the construction site during construction.
- .2 Take all precautions to prevent damage due to weather, vandalism, etc. and repair any damage.
- .3 Work the excavation to maintain good surface drainage during periods of precipitation.
- .4 Cleanup of any material spilled on roads during disposal of unwanted material.

3.9 WATER FOR COMPACTION

- .1 Provide water as deemed necessary by the Departmental Representative to attain adequate compaction.
- .2 Apply water with equipment capable of uniform distribution.

3.10 GRANULAR BASE MATERIALS

- .1 Place and compact in accordance with Section 32 11 23 Aggregate Base Courses.

3.11 SURPLUS MATERIAL

- .1 Dispose of surplus material not required for fine grading and landscaping as directed by Departmental Representative.

END OF SECTION

Part 1 General

1.1 TOLERANCES

- .1 Prior to concreting, the liner shall be located as shown on the Drawings within the following tolerances.
 - .1 Top of pile, in plan 75 mm in any direction.
 - .2 Piles shall not be more than 50 mm off centre measured at cut-off elevation
 - .3 Pile shall not deviate more than 1% out of plumb.
 - .4 Diameter of liner and socket $\pm 5\%$ of nominal diameter at any position.
- .2 Correct any piles which are outside these tolerances. Correction may include additional reinforcement or increased dimensions of pile caps or additional piles.
 - .1 Be responsible to pay for any additional structural engineering review that may be required for corrections. Do not advance any claims for delays to due additional review required for corrections.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials in accordance with Section 03 30 00.
- .2 Reinforcing Steel including dowels in accordance with Section 03 21 00.

Part 3 Execution

3.1 FIELD RECORDS

- .1 Maintain accurate records on depth of caissons, excavated soil penetrated, water seepage and other pertinent conditions.
- .2 Measure the depth of all pile holes in the presence of the Departmental Representative before any concrete is poured. Show the pile depths on the "as built" drawings, of pile depths obtained in actual placement.

3.2 INSTALLATION

- .1 Using sonotube cast piles true and plumb in the exact location to elevations as indicated on the drawings.
- .2 Place compacted sand or other granular (compacted to minimum 95% proctor) around all forms (sonotubes) for columns up to void form elevation. Ensure columns are straight and plumb".
- .3 Obtain Departmental Representative's approval prior to placing any concrete. Remove loose material, foreign matter and water.
- .4 Install steel reinforcement in accordance with Section 03 21 00.
- .5 Fill caisson excavations with concrete to elevations indicated. Place concrete in accordance with Section 03 30 00 using methods to prevent segregation.
- .6 Vibrate top 3 m of concrete in shaft.

3.3 REINFORCING

- .1 Pile reinforcing shall be rigidly fastened together and shall be held in position in such a manner as to insure its proper location in the finished pile.

3.4 CLEAN UP

- .1 Disposed of excavated materials to an approved site.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

Part 1 General

1.1 SUBMITTALS

- .1 Submit material samples and material test results in accordance with Section 01 45 00 Quality Control.

1.2 REFERENCES

- .1 ASTM C117-17; Standard Test Methods for Material Finer than 75-Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM C131/C131M-20; Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .3 ASTM C136/C136M-19; Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .4 ASTM D698-12(2021); Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³ (600kN-m/m³)).
- .5 ASTM D1883-21; Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.
- .6 CAN/CGSB 8.2-M88; Sieves, Testing, Woven Wire, Metric.

1.3 INSPECTION AND TESTING

- .1 All workmanship and all materials furnished and supplied under this Specification are subject to inspection and testing by the Departmental Representative including all operations from the selection and production of materials through to final acceptance of the specified work.
- .2 The Departmental Representative will reject materials or works not meeting this Specification.

Part 2 Products

2.1 BASE MATERIALS

- .1 Granular sub base: Use "C" Base granular material described below for granular sub-base course.
- .2 Granular base: Use "A" base granular material described below for granular base course.
- .3 Classes of Base Courses are as described below:

	<u>"A" Base</u>		<u>"C" Base</u>	
Passing Standard Sieves	Gravel	Limestone	Gravel	Limestone
37.5 mm sieve			100%	
25 mm sieve			85-100%	100%
19 mm sieve	100%	100%		
16 mm sieve	80-100%			
4.75 mm sieve	40-70%	35-70%	25-80%	25-80%

	<u>"A" Base</u>		<u>"C" Base</u>	
Passing Standard Sieves	Gravel	Limestone	Gravel	Limestone
2 mm sieve	25-55%			
425 µm sieve	15-30%	10-30%	15-40%	
75 µm sieve	8-15%	8-17%	8-18%	8-20%
Minimum Crush Count	35%	100%	15%	100%
Max. Los Angeles Abrasion Loss	35%	35%	40%	40%
Maximum Shale Content	12%		20%	
Maximum Clay Balls	10%			

- .1 Gradations to be tested in accordance with ASTM C117 and ASTM C136. Sieve sizes in accordance with CAN/CGSB 8.2.
- .2 Los Angeles Abrasion Loss in accordance to ASTM C131.
- .4 The granular material shall consist of sound, hard crushed rock or crushed gravel and be free from organic or soft material that disintegrates through decay or weathering.
- .5 The granular material shall be well graded and shall not vary from maximum to minimum of the specification ranges for consecutive tests.
- .6 Clay balls are the percent by weight of clay particles retained on a 12.5 mm sieve.
- .7 Shale content is the percent by weight of the shale particles retained on a 4.75 mm sieve.
- .8 The crush count is the percentage by weight of aggregate particles retained on a 4.75 mm sieve which are not shale or limestone and which have at least one freshly fractured face.
- .9 For "A" base granular base course, the field tests taken during any crushing shift shall yield an average of 65% or lower passing the 4.75 mm sieve.
- .10 For quarried limestone, a maximum of 7% clean fine sand or any quantity of limestone fines may be added to achieve the required gradation.
- .11 Binder material is any approved material which has a minimum 75% passing the 425µm sieve, a liquid limit not greater than 50 and a plasticity index not less than 10. All material passing the 75 µm sieve is to be binder material.

Part 3 Execution

3.1 SUBGRADE OR SUB BASE INSPECTION

- .1 Do not place granular materials until finished subgrade surface on which granular material is to be placed is inspected and approved by Departmental Representative.

3.2 PLACING GRANULAR MATERIALS

- .1 Place on a shaped, compacted, clean and unfrozen surface free from snow and ice.
- .2 Place using methods which do not lead to segregation or degradation of aggregate.
- .3 Place material in uniform layers not exceeding 150 mm when compacted or to such other depth as approved by Departmental Representative.
- .4 Where geotextile is used for granular placement, place in accordance with Section 31 05 19.13 Geotextiles.

- .5 Shape, grade and compact each layer to specified density before next layer is placed.
- .6 Shape each layer of granular material to within ± 15 mm of design elevations to the Departmental Representative's satisfaction. Elevations shall not be uniformly high or low.
- .7 Remove and replace that portion of a layer in which granular material becomes segregated during spreading.
- .8 Promptly spread all granular material delivered to the site, do not allow granular material to remain unspread on the roadbed overnight.
- .9 Promptly compact all granular material immediately after spreading, do not allow granular material to remain uncompacted on the roadbed overnight.

3.3 COMPACTING GRANULAR MATERIALS

- .1 Compact all granular sub-base material to a density not less than 98% Standard Proctor Density and granular base material to a density not less than 100% Standard Proctor Density in accordance with ASTM D698 using pneumatic tired rollers, steel drum vibratory equipment or other approved equipment.
- .2 Shape and roll to obtain a smooth, even and uniformly compacted base, blade as required to maintain the specified cross section.
- .3 Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying until moisture content is corrected.
- .4 Areas not accessible to rolling equipment, compact with mechanical compactors.

3.4 TRIMMING

- .1 Trim and crown the compacted granular base material to the finished elevation/grades shown on the plans.
- .2 Finished base surface shall be within 10 mm of established grade but not uniformly high or low.
- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 MAINTENANCE

- .1 Maintain finished base in a condition conforming to this section until succeeding material is applied or until acceptance.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CAN/CGSB-1.5-M91, Low Flash Petroleum Spirits Thinner.
- .2 CGSB 1-GP-12c-68, Standard Paint Colours.
- .3 CGSB 1-GP-71-83, Method, of Testing Paints and Pigments.
- .4 CGSB 1-GP-74M-79, Paint, Traffic, Alkyd.

1.2 SAMPLES

- .1 Submit samples in accordance with Section 01 33 23.
- .2 Submit to Departmental Representative following material sample quantities at least 4 weeks prior to commencing work.
 - .1 Two 1 L samples of each type of paint.
 - .2 Sampling to CGSB 1-GP-71.
 - .3 Mark samples with name of project and its location, paint manufacturer's name and address, name of paint, CGSB specification number and formulation number and batch number.

Part 2 Products

2.1 MATERIALS

- .1 Paint:
 - .1 To CGSB 1-GP-74M, alkyd traffic paint.
 - .2 Colour: to CGSB 1-GP-12C, white 513-301.
- .2 Thinner: to CAN/CGSB-1.5.
- .3 Glass Beads: minimum 80% true spherical shape; clear of cloudiness, dark inclusions, trapped air, or other defects; and conforming to the following:
 - .1 Index of Refraction: 1.5 minimum when tested in liquid immersion at 25°C according to CGSB 1-GP-71 Method 49.1.
- .4 Gradation of glass beads for mixing with and for surface application on thermoplastic material, tested according to ASTM D1214:

Sieve Size (mm)	% Passing by Mass
0.85	90 - 100
0.3	15 - 50
0.18	8 0 - 10

2.2 MIX FORMULATION

- .1 Glass Sphere Content: minimum 20%, maximum 30% by mass of thermoplastic material
- .2 White Colour: conforming to CGSB Colour #505-30.

Part 3 Execution

3.1 EQUIPMENT REQUIREMENTS

- .1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

3.2 CONDITION OF SURFACE

- .1 Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.

3.3 APPLICATION

- .1 Lay out pavement markings as indicated on drawings.
- .2 Unless otherwise approved by Departmental Representative apply paint only when air temperature is above 10°C, wind speed is less than 60 km/h and no rain is forecast within next 4 h.
- .3 Apply traffic paint evenly at rate of 3 m²/L.
- .4 Do not thin paint unless approved by Departmental Representative.
- .5 Paint lines to be of uniform colour and density with sharp edges.
- .6 Thoroughly clean distributor tank before refilling with paint of different colour.

3.4 TOLERANCE

- .1 Paint markings to be within plus or minus 12 mm of dimensions indicated.

3.5 PROTECTION OF COMPLETED WORK

- .1 Protect pavement markings until dry.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings in accordance with section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals required under this section include, but are not limited to the following:

- .1 Galvanized Fencing Materials.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM A53/A53M-20, Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-21, Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 ASTM A121-19, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
 - .4 ASTM A392-11a(2017), Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - .5 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .6 CGSB 1-GP-181M-77, coating, Zinc-rich, organic, ready mixed.
- .3 Canadian Standards Association (CSA).
 - .1 CSA A23.1:19/A23.2:19, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
 - .2 CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No. 1 (2020).
 - .3 CSA A3000-18, Cementitious materials compendium. Includes Update No. 1 and Errata (2021).
 - .4 CAN/CSA-A23.5, Supplementary Cementing Materials.

Part 2 Products

2.1 MATERIAL

- .1 All galvanizing as per ASTM A120 and to meet or exceed Class 3 galvanizing.

- .2 Chain Link Fence Fabric: Galvanized steel wire shall be made to ASTM A392. The fabric shall consist of chain link 4.8 mm (No. 6 gauge) steel wire, galvanized after weaving by a hot process. The wire shall be woven to a 51 mm (2 in.) mesh.
- .1 Average mass on zinc coating to be not less than 610 g/m² of uncoated wire.
- .2 Minimum tensile breaking strength of 10,000 N*min.
- .3 Fence fabric to be continuous from top to bottom
- .3 Line Posts: The line posts or pickets shall have a tensile strength of 207 mPa or greater. Posts shall have a 73 mm outside diameter and shall consist of standard continuous-weld schedule 40 hot dipped galvanized steel pipe. The minimum mass per metre shall be 8.6 kg. No tubing, conduit or open seam material will be allowed. Line posts shall be supplied with weatherproof eye top caps to accommodate horizontal top rail and shall be as outlined below:

Fence Height mm	Post Diameter mm	Post Length mm
2,500	60.3	4,329

- .1 Terminal Post (end, corner and straining): The terminal posts shall consist of 114.3 mm outside diameter standard continuous-weld schedule 40 hot dipped galvanized steel pipe. Minimum mass per metre shall not be less than 15.9 kg. Each terminal post shall be equipped with a post cap. No tubing, conduit or open seam material will be allowed.

Fence Height mm	Post Diameter mm	Post Length mm
2,500	60.3	4,329

- .1 Gate Posts: The gate posts shall consist of 114.3 mm outside diameter standard continuous-weld schedule 40 hot dipped galvanized steel pipe. Minimum mass per metre shall not be less than 15.9 kg. Each gate post shall be equipped with a post cap. Under no circumstances shall a corner post also be a gate post.

Fence Height mm	Post Diameter mm	Post Length mm
2,500	60.3	4,329

- .1 Bottom and Top Rails: The bottom and top rails shall consist of 45 mm outside diameter standard continuous-weld schedule 40 hot dipped galvanized steel pipe. Pipe length shall permit coupling approximately every 6,100 mm. Galvanized couplings, galvanized as per ASTM Standard A 120 shall be of outside sleeve type and shall be used where necessary to join the top rail. These couplings shall be not less than 178 mm in length and be capable of taking up expansion and contraction in the top rail.
- .2 Bracing: Bracing shall consist of the same type of material as that used for the top rail. All fittings shall be galvanized and to consist of either pressed steel, malleable iron or cast iron.
- .3 The Tension Bands: The tension bands shall consist of galvanized steel.
- .4 Tension Wire: Tension wire shall consist of galvanized steel (610 g/sq. m.). Tension wire shall consist of galvanized single strand 5 mm wire of good commercial quality.
- .5 Tie Wires: 3.7 mm diameter (9 gauge) galvanized steel wire.
- .6 Gates: Unless otherwise noted on the plans, the gates shall be double swing, opening gates, half width of opening on each gate. The units shall be welded at all joints,

complete with diagonal bracing and hot-dipped galvanized after welding. Gates shall come equipped with galvanized malleable iron hinges, latches and latch catches.

- .1 Gate latches shall be suitable for padlocks which can be attached and operated from either side of the gate. The hinges shall permit each gate to swing back against the fence 180 degrees if required. Gate braces where required shall be 35 mm (1 5/16 in.) outside diameter galvanized steel pipe galvanized in accordance with ASTM Standard A 120. Gate shall be a minimum of 2 metres from any corner post.
 - .1 Refer to section 08 71 00 for padlocks.
- .2 Gate Stops: Provide approved hold open mechanism on both leafs of the gate.
- .7 Projection Arms: Galvanized steel to accommodate barbed wire coil, sloped 45 degrees.
- .8 Barbed Wire: 2.5 mm wire, 635 mm diameter coil 20 mm blade type barbs at 45 mm on centre, zinc steel to ASTM A121.
 - .1 Loops spacing when installed not to exceed 230 mm.
- .9 Concrete: Concrete to type HS sulphate resistant and have 28 day strength of not less than 25 MPa.

Part 3 Execution

3.1 GENERAL

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface of 50 mm.

3.2 ERECTION

- .1 Build to the line and grades shown on the plans in accordance with CAN/CGSB-138.3. Install line posts, corner posts, top rails, post caps to provide a rigid structure, fabric and gates. Use manufacturer's standard fittings, fasteners and hardware. Slope barbed wire arms outward.
- .2 Maximum spacing of posts is 3.048 m on center. Be responsible to locate any buried utilities (water, wastewater, electricity, etc.) prior to installing posts.
- .3 Space straining posts at equal intervals not exceeding 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150 m.
- .4 Install additional straining posts at sharp changes in grade and where directed by Departmental Representative.
- .5 Install corner post where change in alignment exceeds 10°.
- .6 Install gate posts on both sides of gate openings.

The fence shall be erected in a workmanlike manner. Install terminal, line and gate posts plumb and in a set alignment. Posts shall be installed to a depth equal to the difference between the proposed fence height and the specified post length. Use hydraulic equipment to push or pound line posts into the existing ground.

Location	Overall Bore Depth	Concrete Footing		Granular	
		Diameter	Length	Diameter	Length

Line Posts	as required	n/a	n/a	n/a	n/a
Terminal Posts	1829	300	914	300	914
Gate Posts	1829	300	914	300	914

The length of the Terminal and Gate (end, corner and straining) Posts shall be such that a minimum 700 mm is embedded into the concrete footing while maintaining all above ground dimension and spacing requirements.

- .7 Set post to within 200 mm from bottom of concrete footing as indicated on the drawings. Install tamped crushed 20 mm down limestone into top 900 mm of bore hole above concrete footing. Set top of tamped limestone at ground elevation.
- .8 Position bottom of fabric 50 mm +/- 25 mm above finished grade with tension wire stretched taut between posts. Ensure final grade of earth is in accordance with above tolerances at all locations.
- .9 Position bottom of fabric 50 mm +/- 25 mm above finished grade with tension wire stretched taut between posts. Ensure final grade of earth is in accordance with above tolerances at all locations.
- .10 Pass top rail through line post tops to form continuous bracing. Install 175 mm long couplings so midspan of coupling is centered at pipe ends.
- .11 Adjust top rail as required to ensure coupling is a minimum of 3.0 m from any gate or corner post. Couplers are not permitted on top rail within 3.0 m of gate or corner posts.
- .12 Install centre and bottom brace rail on all corner and gate leaves.
- .13 Do not install fence fabric until concrete has cured a minimum of 5 days.
- .14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals. Knuckled selvedge at bottom. Twisted selvedge at top.
 - .1 Installed fence fabric to be pull tested with a 12 kg load. Maximum deflection to be less than 30 mm.
- .15 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands. Stretch fabric between terminal posts. Properly tension the fabric to ensure that there is no sag or give once erection is completed.
- .16 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals. Give tie wires minimum two twists.
- .17 Splice fabric by untwisting strands and re-twisting to join fabric ends.
- .18 Do not bend fabric around corners. Cut, stretch and tie at corner end or gate posts.
- .19 Start new fabric at each corner post or grade change.
- .20 Install barbed wire on arms, tensioned and secured.
 - .1 Tretch and fix two barbed wires to post arms
 - .2 Tie barbed wire coil to stretched wired at maximum 230 mm spacing.

3.3 GATE INSTALLATION

- .1 Install gates of sizes shown on plans using fabric to match fence height. Install three hinges, leaf, latch, catches. Set gate bottom approximately 150 mm above ground surface.
- .2 Level gate throughout its swing and ensure it swings freely.

3.4 TOUCH UP

- .1 Repair damaged galvanized surfaces. Clean damaged surface with wire brush serving loose and cracked castings. Apply two coats of approved zinc pigmented paint to damaged area.
- .2 Re-level ground beneath fence and around posts.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations. Dispose of surplus material.
- .2 Re-level ground beneath fence and around posts.

END OF SECTION

Part 1 General

1.1 SCHEDULING OF WORK

- .1 Schedule placing of topsoil and finish grading to undertake seeding operation under optimum soil moisture conditions and weather conditions.

1.2 TOPSOIL AREAS

- .1 All areas affected by the Works.

Part 2 Products

2.1 MATERIALS

- .1 Imported or Stockpiled Topsoil: Topsoil free of subsoil, roots, vegetation weeds and stones larger than 50 mm capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

Part 3 Execution

3.1 PREPARATION

- .1 Grade subgrade, eliminating uneven areas and low spots, ensuring positive drainage. Remove debris, roots, branches, stones in excess of 75 mm diameter and other deleterious materials.

3.2 SPREADING OF TOPSOIL

- .1 Do not spread topsoil until Departmental Representative has inspected and approved subgrade.
- .2 Spread topsoil with adequate moisture during dry weather over approved, dry, unfrozen subgrade, where seeding is required by Departmental Representative.
- .3 Spread all available stripped and stockpiled topsoil to a depth of 50 - 75 mm for seeding purposes.
- .4 If available topsoil materials does not cover entire site final thickness to be as directed by Departmental Representative.

3.3 FINISH GRADING

- .1 Fine grade entire topsoil area to contours and elevations as indicated. Eliminate rough spots and low areas to ensure positive drainage.
- .2 Fine grade and loosen topsoil to 50 mm depth.
- .3 Remove stones, roots, grass, weeds, construction materials, debris and foreign non-organic objects from topsoil.
- .4 Slope grade away from buildings.
- .5 Grade ditches to depth required for maximum run-off.

- .6 Obtain Departmental Representative's approval of topsoil grade and depth before starting seeding.

END OF SECTION

Part 1 General

1.1 SCHEDULING OF WORK

- .1 Schedule hydraulic seeding and finish grading to undertake seeding operation under optimum soil moisture conditions and weather conditions.
- .2 Complete hydraulic seeding works only after settlement and re-grading has occurred.
- .3 Assume a minimum of 2 mobilizations to site to complete works. The second mobilization is to include a second application of fertilizer and reseeding areas that have not shown grass growth as directed by Departmental Representative.

1.2 AREA TO BE SEEDED

- .1 All areas affected by the works.

1.3 REFERENCES

- .1 ASTM D5338-15(2021), Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials Under Controlled Composting Conditions, Incorporating Thermophillic Temperatures.
- .2 ASTM D7367-19E2, Standard Test Method for Determining Water Holding Capacity of Fiber Mulches for Hydraulic Planting.

1.4 MAINTENANCE PROGRAM

- .1 A maintenance program (other than that indicated below) has not been included as part of this contract rather a second mobilization to site has been included.

1.5 GENERAL

- .1 Obtain soil samples from 3 different areas. Provide 3 lab soil tests. The soil tests to provide N,P,K and S analysis in (PPM), soil PH, EC(dS/M), OM(%) plus give recommendations as to what nutrients to add to establish turf.
- .2 Use a mechanically agitated hydroseeder.

1.6 STORAGE AND HANDLING

- .1 Deliver all materials in ultraviolet and weather resistant factory labeled packages. Store material in a cool dry place away from open flames ensuring strict adherence to manufacturer recommendations.

1.7 SUBMITTALS

- .1 Product Data:
 - .1 Manufacturer or representative shall submit Application Rates Guide, Installation and Mixing Instructions, and Product Specifications.
- .2 Certifications:
 - .1 Manufacturer or representative shall submit a letter of certification that the products meets or exceeds all material composition requirements, laboratory testing properties, and product packaging requirements. Certification shall detail

that the straw or fiber was processed at over 160 degrees Fahrenheit to ensure material is weed free.

Part 2 PRODUCTS

2.1 GRASS SEED MIXTURE

- .1 Grass seed: Certified Canada No. 1 Grade. Provide a seed mix proposal to establish growth. Seed mixture shall be well suited to site and shall consist of the following as a guide. Provide seed types as required to guarantee growth
 - .1 28% Aberdeen Creeping Red Fescue
 - .2 20% Shaddow III Chewings Fescue
 - .3 16% Sheep Fescue
 - .4 16% Hard Fescue
 - .5 20% Dominator Perennial Rye Grass (cover crop)

2.2 HYDRAULIC MULCH

- .1 100% thermally refined wood fiber, heated to a temperature greater than 193 °C for 15 minutes at a pressure greater than 552 kPa.
- .2 Non-toxic.
- .3 Minimum 100% biodegradability in accordance with ASTM D5338.
- .4 Functional longevity up to 3 months in accordance with ASTM B5338.
- .5 Water holding capacity: minimum 1100% in accordance with ASTM D7367.
- .6 Product to include bio-stimulant
- .7 Approved Product: Terra-Mulch Trera-Wood with UltraGro or approved equal.

2.3 BINDER (TACKIFER)

- .1 Earthbound 2000 or equivalent from Terra Novo Inc..

2.4 FERTILIZER

- .1 Fertilize at a minimum rate as determined by the soil test. All fertilizer shall be slow release in natural and be comprise of a minimum of 10% organic fertilizer.

Part 3 EXECUTION

3.1 PREPARATION

- .1 Grade subgrade, eliminating uneven areas and low spots, ensuring positive drainage. Remove debris, roots, branches, stones in excess of 25 mm diameter and other deleterious materials. Remove subsoil that has been contaminated with oil, gasoline or calcium chloride. Dispose of removed materials as directed by Departmental Representative.

3.2 FINISH GRADING

- .1 Fine grade entire area to have hydraulic seeding applied, to contours and elevations as indicated on the plans, or as per original conditions unless otherwise directed by the

Departmental Representative. Eliminate rough spots and low areas to ensure positive drainage

- .2 Fine grade and loosen topsoil to 25 mm depth prior to seeding.
- .3 Remove stones, roots, grass, weeds, construction materials, debris and foreign non-organic objects from topsoil.
- .4 Grade swales to depth required for maximum run-off.
- .5 Obtain Engineer's approval of topsoil grade and depth before starting seeding.

3.3 HYDRAULIC SEEDING

- .1 Hydraulic seeding shall be carried out as soon as possible after the completion of the surface preparation.
- .2 Hydraulic seeding shall not be performed under windy conditions, or during periods of rainfall or severe drought, on areas covered by standing water, on frozen surfaces or under other adverse conditions, as determined by the Departmental Representative.
- .3 Mixing:
 - .1 Fill hydroseeder tank with water to a level where the paddles are $\frac{1}{4}$ covered and may be activated.
 - .2 Activate the mechanical agitation system.
 - .3 Prime pump and any discharge hoses before adding any mulch.
 - .4 Add the appropriate amount and type of soil stabilizer and tackifier as recommended for the site specific application. Allow soil stabilizer and tackifier and water to mix for 5 minutes prior to adding mulch. Please see manufacturer application rate chart for amounts of specific Soil Stabilizer & Tackifier and mulch.
 - .5 Continue filling tank with water to approximately $\frac{3}{4}$ full and begin adding bags of mulch.
 - .6 Add all quantity of mulch before the water level reaches 85% of the tanks capacity.
 - .7 Add seed and/or other amendments to slurry as required.
 - .8 Completely fill tank with water and allow slurry to mix for a minimum of 5 minutes or until all mulch is mixed into a consistent slurry.
- .4 Slurry mixture applied per hectare:
 - .1 Seed: 6.7 kg/ha
 - .2 Mulch: 2,200 kg/ha
 - .3 Binder: as per manufacturer's specifications.
 - .4 Fertilizer: per soil tests.
 - .5 Water: quantity as required to form slurry.
- .5 Schedule Hydraulic seeding of area through arrangement and approval of Departmental Representative, ensure soil has adequate moisture.
- .6 Prior to application and mixing of the mulch measure and mark the site to known areas to ensure appropriate seed, amendment, and mulch application rates.
- .7 Bring hydroseeder to appropriate operating speed and agitator speed for slurry application.

- .8 Apply in a consistent and even manner across soil surface.
- .9 Apply from opposite directions to ensure the highest level of coverage, effectiveness, and performance.
- .10 If spraying is stopped at anytime, close the spray nozzle at the end of the hose to avoid water draining from the hose. If using a tower applicator, stop normally and upon restart remove the spray tip, discharge a small amount of mulch, replace the tip and return to applying the product.
- .11 Protect Hydraulic seeded areas from pedestrian and vehicular damage where possible.
 - .1 Maintain Hydraulic seeded areas free of weeds, pests and disease.
 - .2 Apply herbicide (if required) when it will not cause damage to new grass or other plants.
 - .1 Avoid use of dicambal and picloram solutions near trees and shrubs.
 - .2 Use only mecoprop on Bentgrass turf areas.

END OF SECTION

DIVISION 33

UTILITIES

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings in accordance with section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Precast concrete manholes- including cement type, sections, lengths, benching, adjusting rings supplied and pipe connection locations.
 - .2 Waterproofing if specified.
 - .3 Frames and Covers.
 - .4 Horizontal joint sealing materials.
 - .5 Pipe connections through manhole wall joint details.
 - .6 Ladder Rungs.

1.2 REFERENCES

- .1 AASHTO M 199M/M 199-21; Standard Specification for Precast Reinforced Concrete Manhole Sections (ASTM Designation C 478M-15a and C 478-15a).
- .2 ASTM A48/A48M-03(2021); Specification for Gray Iron Castings.
- .3 ASTM A615/A615M-20; Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- .4 ASTM C443-21; Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
- .5 ASTM C478M-18; Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
- .6 ASTM C578-19; Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .7 ASTM C923/C923M-20; Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- .8 ASTM C990-09(2019); Standard Specification for Joins for Concrete Pipes, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- .9 ASTM C1107/C1107M-20; Standard Specification for Packages Dry, Hydraulic-Cement Grout (Nonshrink).
- .10 ASTM D4101-17e1; Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.
- .11 CSA A23.1-19; Concrete Materials and Methods for Construction.
- .12 CAN/CSA A165 Series-14; CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
- .13 CSA A257 Series:19; Standards for Concrete Pipe and Manhole Sections.
- .14 CSA A3000-18; Cementitious materials compendium, Includes Update No. 1 and Errata (2021).

Part 2 Products

2.1 MANHOLES

- .1 Precast manhole sections: to ASTM C478M. Top section to be flat slab top type with opening offset for vertical ladder installation.
- .2 Sizing and sections: 1,200 mm dia. x 910 mm base height, 1,200 mm riser sections to suit, 1,200 mm to 760 mm flat top reducer 637 mm dia. traffic bearing manhole frame and cover. Top riser section below flat top reducer to be 300 mm, height of remaining riser sections should be such that the number of joints are minimized.
- .3 Joints: to be made watertight using flexible plastic gasket that meets or exceeds ASTM C990. Size with a cross section to provide "squeeze-out" after installation.
 - .1 Use ConSeal CS 102, Kent Seal #2 or approved equal.
- .4 Ladder rungs: Safety steps cast-in-place into manhole sections. Provide rungs at 300 mm o/c for entire length (Note first step below manhole cover to be within 450 mm).
 - .1 20 mm diameter clear anodized aluminum (Alloy type 6351-T6) in accordance to ASTM C478 and AASHTO M199 or Polypropylene in accordance with ASTM D4104 with a 12 mm Grade 60 deformed reinforcing bar to ASTM A615.
 - .2 Rungs to have a safety pattern and have an overall width of 400 mm.
- .5 Adjusting (grade) rings: to ASTM C478M.
- .6 Frames, covers to dimensions as indicated and following requirements:
 - .1 Metal covers to bear evenly on frames. A frame with cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray cast iron castings: to ASTM A48, strength class 30B.
 - .3 Castings to be coated with two applications of asphalt varnish.
 - .4 Manhole frames and covers: heavy duty municipal type for road service (AASHTO HS-20) complete with two 25 mm lifting holes.
- .7 Pipe Connections: Use a flexible pipe to manhole connector whenever a pipe penetrates into a precast concrete manhole or structure.
 - .1 Factory core or cast and install a rubber gasket to provide a water tight seal connector boot for SDR-35 PVC Pipe connections to the interior opening of the manhole structure.
 - .2 Manufacture the connectors to conform to ASTM C923, ASTM C443 and CSA A257.
 - .3 Use Hamilton Kent HKT Connectors, A-Lox Z-Lok or approved equal.
- .8 Cement for Manholes: CSA A3000, Portland cement, Type HS.
 - .1 Grout used for formed invert channel (benching) use minimum 20 mPa compressive strength and use type HS cement.
- .9 Invert Channel (benching);
 - .1 Factory grout the bottom of all manholes to form a semi-circular pattern to provide a direct channel for effluent through the manhole. Bench to provide a smooth U-shaped channel with a steel trowel finish. Side height of channel to be minimum 0.75 times diameter of sewer. Slope adjacent floor at 1 on 10. Curve channels smoothly. Slope invert to establish sewer grade.
 - .1 Extend pipe 300 mm from wall before curvature begins.

- .10 Waterproofing:
 - .1 Two factory applied coats of “U seal” or “Thoroseal” to the manhole exterior. Field coat lifting holes.
 - .2 Factory apply on all outside surfaces including base.
 - .3 Follow manufactures recommendation regarding application of product.
 - .4 Do not transport or backfill until cured, minimum 1 hour. Ensure backfill does not damage coating.
 - .5 After field chamber assembly field coat exterior and interior surfaces at all lifting holes and joints.
- .11 Factory core and install a rubber gasket for water tight seal connector boot for SDR-35 PVC Pipe connections to manhole. The connectors are to be manufactured to ASTM C923, ASTM C443 and CSA A257. Use Hamilton Kent HKT Connectors or approved equal.
- .12 Joints: to be made watertight using flexible butyl rubber sealant that meets or exceeds ASTM C990. Size with a cross section to provide ‘squeeze-out’ after installation.
 - .1 Use ConSeal CS 102, Kent Seal #2 or approved equal.
- .13 Ladder rungs: Safety steps cast-in-place into manhole sections. Provide rungs at 300 mm o/c for entire length with the first step, below manhole cover, to be within 450 mm.
 - .1 20 mm diameter clear anodized aluminum (Alloy type 6351-T6) in accordance to ASTM C-478 and AASHTO M-199 or Polypropylene in accordance with ASTM D4101 with a 12 mm Grade 60 deformed reinforcing bar to ASTM A-615.
 - .2 Rungs to have a safety pattern and have an overall width of 400 mm.
- .14 Adjusting (grade) rings: to ASTM C478M.
- .15 Frames, covers to dimensions as indicated and following requirements:
 - .1 Metal covers to bear evenly on frames. A frame with cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48, strength class 30B.
 - .3 Castings to be coated with two applications of asphalt varnish.
 - .4 Manhole frames and covers: heavy duty municipal type for road service (AASHTO HS-20) complete with open grating.
 - .5 Concrete brick for elevation adjustment: to CSA A165 Series.

2.2 **GROUT-NON SHRINK TYPE**

- .1 Prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. It shall meet the requirements of ASTM C 1107 “Specification for Packaged Dry, Hydraulic-Cement Grout, Nonshrink” and shall have a minimum 28-day compressive strength of 28,000 kPa (7,000 psi).
 - .1 Mortar: Sikaset Plug , BASF Set 45 or approved equal hydraulic cement.
- .2 Bonding agent to hardened (existing) concrete surfaces: Use a latex-based bonding agent as recommended by grout manufacturer. Grouting Adhesive:
 - .1 Sikadur 32, Master builders Congressive Liquid (LPL) or approved equal.

Part 3 Execution

3.1 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 10 - Excavating and Backfilling for Trenching.

3.2 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
 - .1 Tolerance off alignment not to exceed that stated for Sanitary Sewer piping.
- .2 Complete units as pipe laying progresses.
- .3 Dewater excavation and remove soft and foreign material before placing concrete base.
- .4 Precast units:
 - .1 Set bottom section of precast unit on 200mm thick layer of compacted sand bedding that is placed on top of undisturbed ground.
 - .1 Be prepared to remove water that may infiltrate into the excavation.
 - .2 Make each successive joint watertight with approved flexible butyl rubber sealant.
 - .1 For flexible butyl rubber sealant ensure joint is clean and dry before joint sealant application. Ensure "squeeze out" on the exterior occurs. If joint is "wet" use approved primer.
 - .3 Grout with non-shrink grout to make water tight as per the following.
 - .1 Coat hardened (existing) concrete surfaces with bonding agent prior to grout application. Add admixtures (bonding agent) in accordance with manufacturer's instructions. Provide uniformity of mix.
 - .2 Thoroughly mix mortar ingredients in quantities needed for immediate use.
 - .3 For lifting holes through wall: Grout and plug lifting holes entire wall thickness with non-shrink grout to make water tight.
 - .4 Non-penetrating lift holes for pre-cast pins in wall used for lifting purposes: Grout lifting pin area void with non-shrink grout to make water tight. Ensure lifting pins are covered with a minimum 25mm thickness of grout.
 - .5 For joints with flexible butyl rubber sealant: Grout interior portion of joint. Allow minimum of 2 weeks for settlement of flexible butyl rubber sealant before grouting.
- .5 Clean surplus grout and joint compounds from interior surface of unit as Work Precast units:
- .6 For pipe connections:
 - .1 Confirm pipe connections through walls are at correct elevations and position.
 - .2 Ensure the pipe spigot end is chamfered and lubricated before inserting into gasket in wall.
- .7 Remove concrete lip on spigot end of top riser such that the frame and cover unit rests on the full sections of the riser pipe.

- .8 Bedding and Backfill:
 - .1 Barrel Sides :
 - .1 Backfill with compacted common (Class 2 backfill). Compact backfill in 300 mm lifts to 95% Standard Proctor Dry Density unless otherwise noted on the plans.
 - .2 Under base: Use minimum 150 mm compacted select granular fill 95% Standard Proctor Dry Density. Use compacted select granular between undisturbed earth and bottom of base.
 - .3 Under pipe: Compacted granular to within 200 mm of pipe invert. Bedding as per Section 31 23 10 Class 3.
- .9 Frames and Covers:
 - .1 Place frame and cover on top section to elevation as indicated. If adjustment required use concrete adjusting ring manufactured as manhole adjustment ring.
 - .2 Install frames and covers to prevent infiltration of surface or groundwater into manholes.
 - .3 Set frames with flexible butyl rubber sealant as used between riser sections. Push and seal in place with load applied with hydraulic machinery.
- .10 Landscape around manholes to bring ground around manhole flush to the top of the frame and cover.
- .11 Clean manholes of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- .12 Touch up and repair factory waterproofing as required.
- .13 Installing units in existing systems:
 - .1 Do not complete switchover to new sewer system until all process equipment is tested and ready for use.
 - .2 Temporarily block flow in upstream manhole.
 - .3 Cut fully through the existing sewer pipe leaving neat, square ends and remove the required length or remove existing sewer pipe at a joint within the excavation.
 - .4 Excavate the required depth below the existing sewer for granular foundation and bedding.
 - .5 Ensure full support of existing pipe during installation, (and carefully remove that portion of existing pipe to dimensions required) and install new unit as specified.
 - .6 Make joints watertight between new pipe and existing manhole.
 - .7 Install required length of new sewer, connect to existing sewer with approved coupling, and connect to new manhole.
 - .8 Remove construction debris and materials from manholes and sewers when the Work is complete.
 - .9 Maintain flow in existing manhole by using a sewage sucker truck during manhole installation.
 - .10 Following installation, remove temporary blockage in upstream manhole.

3.3 PIPING CONNECTIONS

- .1 Factory core and install a rubber bell connector boot for Wastewater Sewer SDR-35 PVC Pipe.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All products listed in Item 1.1.1 above.
 - .2 Include material data sheets, dimensional and layout data of all equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Obtain separate set of drawings and mark the variations as the work progresses to complete record plans of equipment and services installed at variance with locations and methods shown on original drawings as specified in 01 78 00 Closeout Submittals.

1.3 REFERNECES

- .1 ASTM D2737-21; Standard Specification for Polyethylene (PE) Plastic Tubing.
- .2 ASTM C578-19; Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .3 AWWA C901-17; Polyethylene (PE) Pressure Pipe and Tubing, 3/4 in. (19 mm) Through 3 in. (76 mm), for Water Service.
- .4 CSA B137:20 SERIES PACKAGE; Thermoplastic Pressure Piping Standards Package – Consists of all the CSA B137:20 standards.
- .5 ULC 701; Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering (CAN/ULC S701-11).
- .6 NSF/ANSI/CAN 61-2021; Drinking Water System Components – Health Effects.
- .7 NSF/ANSI/CAN 372-2020; Drinking Water System Components – Lead Content.

1.4 PIPE BURIAL DEPTH

- .1 Minimum cover under existing or proposed ditches: 2.5 m.
 - .1 Insulate (minimum 50 mm thick) where cover is less than above.
- .2 Minimum cover under existing or proposed roads: 3.0 m.
 - .1 Insulate (minimum 50 mm thick) where cover is less than above.
- .3 Be responsible to review proposed elevations of proposed or existing roads, ditches and lots to determine placement depth (elevation) of service piping. Provide grade stakes as required for roads, ditches and lots.
- .4 Complete operations and advise Departmental Representative in a timely manner to allow Departmental Representative's inspection to obtain record information prior to placing bedding material over pipe.

1.5 CONNECTION TO EXISTING WATER MAIN

- .1 Expose and verify existing water main works and ensure all required materials are onsite prior to connecting to existing water main. Obtain Departmental Representative approval for materials to be used.
- .2 Field locate valves, couplings and fittings to ensure Works on the existing water main can be completed within a short time frame.
- .3 Contractor responsible to arrange through the Departmental Representative, the interruption of service of the Stony Mountain Institution water main to permit the 38 mm service line connection to the main.
- .4 All arrangements are to be made with the Departmental Representative:
 - .1 Contractor to provide the Departmental Representative a minimum of 1 week of notice prior to any planned interruption of service:
 - .1 To coordinate mainline shut-off, prior to connection to existing mainline.
- .5 Interruption of service shall not exceed 4 hours.

Part 2 Products

2.1 WATER SERVICE

- .1 Tube: High Density Polyethylene (HDPE).
 - .1 CTS (copper tubing sized) SDR 9 series 200 (minimum) PE 4710 HDPE tubing suitable for potable water and third-party certified and listed to AWWA C901, CSA B137.1 and NSF 6.1.
 - .1 Use 38 mm size.

2.2 LOW-LEAD WETTED SURFACES

- .1 Wetted surfaces of plumbing products components containing brass or bronze: Wetted surfaces of fittings such as corporation stops, couplers, curb stops, and saddles shall use a low lead alloy that complies with ANSI/AWWA C800 (latest revision) for maximum lead content of the wetted surfaces to be <0.25% (by weight) lead.
 - .1 Wetted surfaces: Certified to NSF/ANSI Standard 61 (current edition) and NSF/ANSI standard 372 where applicable.
- .2 Stamp or emboss all fittings with a mark or name indicating that the product is manufactured from the low-lead alloy.

2.3 STAINLESS STEEL INSERT STIFFENER

- .1 PE Pipe: For all ends of PE pipe used in a compression fitting provide a rigid, solid tubular stainless steel liner (insert stiffener) suitable for use in tubing series being used.
- .2 Flared at one end and beveled at approximately 45° at the other end to retain placement within the service line.
- .3 Manufacturer recommended for use in the compression fitting.
- .4 ID to be as follows:
 - .1 38 mm.

2.4 SERVICE SADDLE

- .1 Saddle body to provide full support around the pipe circumference, be suitable for iron pipe sizes, may not distort the pipe, gasket to fully contact the pipe surface, and to conform to minor pipe irregularities.
- .2 Stamp saddle with the manufacturer's name and saddle model number.
- .3 Provide written manufacturer's approval for use on pipe type.
- .4 Tapping to be nominal diameter of service line piping however do not exceed manufacturer's maximum recommended opening for size of main.
- .5 Service saddle shall have standard AWWA CC female threaded inlet connections.
- .6 PVC Mains - Use all stainless steel, with a wide body (double stud).
- .7 High Density Polyethylene Mains - In accordance to manufacturer's (pipe and saddle) recommendations. Verify with manufacturer prior to ordering.

2.5 CORPORATION MAIN STOP VALVES

- .1 Use of corporation main stop valves is mandatory.
- .2 Ball style with EPDM rubber seal.
 - .1 Waterworks brass: Low-lead alloys as stated above.
 - .2 Minimum 1,350 kPa working pressure.
 - .3 Compression type ends suitable for CTS (ASTM D2737) sized HDPE plastic or copper tube.
 - .1 Use a compression type end to connect to HDPE consisting of 2 pieces to make a seal to the outside of the pipe- a "gasket and gripper" and a nut.
 - .4 End types:
 - .1 One end compatible to female thread outlet of service saddle (AWWA/CC).
 - .2 Other end CTS sized grip compression ends suitable for CTS PE plastic and copper tubing.

2.6 CURB STOP VALVES – CTS ENDS

- .1 Use 90° turn, ball type valve with CTS sized grip compression type ends suitable for CTS sized PE plastic and copper tubing.
- .2 Non-draining.
- .3 Waterworks brass: Low-lead alloys as stated above.
- .4 Minimum 1,350 kPa working pressure.
- .5 Compression ends suitable for CTS (ASTM D2737) sized HDPE plastic or copper tube.
 - .1 Use a compression end to connect to HDPE consisting of 2 pieces to make a seal to the outside of the pipe- a "gasket and gripper" and a nut.

2.7 SERVICE BOXES

- .1 Box: Cast iron with arch polymer plastic boot adjustable for 2.5 m to 3.0 m cover.
- .2 Lid: Ribbed cast iron, tapped for a 25 mm brass plug with ACME thread and a pentagon nut 22 mm flat-to-point.

- .3 Stationary Rod: All stainless steel minimum 12 mm diameter, all welding fully passivated. Stem length 1.8 to 2.1 m long, upper end forged to 13 mm x 19 mm section to fit operating key and shaped to position the rod in a central position in the box.
- .4 Top forged section to be parallel to bottom yoke to provide positive indication of "on" or "off" position.
- .5 Yoke drilled for a 5 mm diameter stainless steel cotter pin located centrally on the yoke and no more than 10 mm from the center line of the hole to the extremity of the yoke.
- .6 Anchoring: Base of the service box with holes to secure the base to the blocking or use "U-rods" to secure curb stop valves to pressure treated wood base.
- .7 Top to be marked "Water" required.
- .8 Suitable for a depth that has a field adjustable range of 2.4 m to 3.0 m.

2.8 WOOD

- .1 Wood base supporting the curb stop - use pressure treated wood.
- .2 Wood marker - 38 mm x 89 mm extending from pipe level to 600 mm above grade.

2.9 COUPLERS

- .1 Coupler: Compression type ends suitable for CTS (ASTM D2737) sized HDPE plastic or copper tube.
- .2 Material types:
 - .1 Low-lead alloys as stated above.
 - .1 Use compression end to connect to HDPE consisting of 2 pieces to make a seal to the outside of the pipe, a "gasket and gripper" and a nut.

2.10 COUPLING

- .1 Water Service:
 - .1 Do not use couplers to join two pipe ends of service line tubing unless repairs are required or a connection to an existing length of pipe is required.

2.11 TEFLON TAPE

- .1 Min. 99.5% PTFE with a minimum specific gravity of 1.20g/cm³.
- .2 Minimum thickness: 0.09mm (3.5 mils) with a minimum tensile strength of 5,500 kPa.
- .3 For stainless steel: Tape to be high density with a minimum thickness of 0.10 mm (4.0 mil) rated by manufacturer for use with stainless steel threads.
- .4 Meets Mil Spec MIL-T-27730A or AA-58092.

2.12 RIGID INSULATION

- .1 Conform to CAN/ULC S701 type 4 extruded polystyrene foam as manufactured by Dow Chemical (blue in color) or approved equal with a compressive strength of 240 kPa.

Part 3 Execution

3.1 PREPARATION

- .1 Clean pipes, fittings, valves and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

3.2 TEFLON TAPE

- .1 Use Teflon tape on all threaded connections.
- .2 Always wrap the tape in the same direction that the fitting will be tightened.
- .3 Apply Teflon one thread back from the end and wrap tape away from the pipe end. Double the first turn over the end of the tape and cover it completely.
- .4 Overlap each course of tape over the one before it by about half the width of the tape.
- .5 Cover the entire threaded part of the fitting.

3.3 COPPER TUBING SIZED HDPE FITTING CONNECTIONS

- .1 Use brass fittings for all connections.
- .2 Complete compression connections in accordance with manufacturer's recommendations.
- .3 Use stainless steel inserts at pipe ends.
- .4 Do not use couplers to join two pipe ends, use continuous pipe lengths.

3.4 RIGID INSULATION

- .1 Supply insulation (min. 50 mm) where indicated on the plans..

3.5 SERVICE CONNECTIONS

- .1 Complete compression connections to pipe ends in accordance with manufacturer's recommendations. In general:
 - .1 Use a tube or pipe cutter to assure a square end.
 - .2 Ensure the pipe is round, clean and there are no nicks in the surface.
 - .3 Install a rigid, solid tubular stainless steel liner (insert stiffener) in HDPE pipe used with compression type fittings.
 - .4 Stab tube through nut into the socket until it bottoms out.
 - .5 Tighten nut to the stop.
- .2 Do not use couplers to join two pipe ends, use continuous pipe lengths.
- .3 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and connecting of pipes.
- .4 Do not use any pipe sections that have surface scratching, gouges, cuts or scarring that exceed a maximum depth of 10% of the pipe wall thickness.
 - .1 Be responsible to provide and maintain onsite a digital type caliper suitable to measure the depth of surface scratching, gouges, cuts or scarring. Allow Departmental Representative to use caliper.
- .5 Tap main between 2:00 and 3:00 o'clock or 9:00 to 10:00 o'clock position only; not closer to a joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater.

- .6 Leave corporation stop valves fully open. Implement procedure to provide confirmation that corporation stop is open.
- .7 To relieve strain on connection, install service pipe in "Goose Neck" form "laid over" into horizontal position.

3.6 TRENCHING AND BACKFILL

- .1 Do trenching, backfill and compaction work to Section 31 23 10 – Excavating and Backfilling for Trenching.
- .2 Alignment, site determined and approved by Departmental Representative.
- .3 Allow Departmental Representative to obtain record information prior to placing bedding material or pipe as obtaining record drawing measurements is a designated activity as outlined in Section 01 45 00 Heading "Inspection".

3.7 BEDDING

- .1 Place bedding materials to Section 33 23 10 – Excavating and Backfilling for Trenching.

3.8 PIPE INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications.
- .2 Join pipes in accordance with applicable manufacturer's recommendations.
- .3 Prior to installation, the interior and joining surfaces of all pipes and appurtenances shall be cleaned of dirt and foreign material and wiped dry.
- .4 Do not drag pipes on surfaces which may cause scratches to the pipe surface.
- .5 Cut pipes to leave a smooth end at right angles to axis of pipe.
- .6 Service lines to be continuous no joints from main to curbstop, and curbstop to building.
- .7 Do not lay pipe on frozen bedding.
- .8 Hand place bedding and backfill material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping of material on pipe is not permitted.
- .9 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

3.9 GRADING AND CLEAN-UP

- .1 Finish grading to the original ground lines and grade.
- .2 Remove all excess excavated material, trash and other debris from the site.
- .3 Repair any damage to roads or ditches.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings in accordance with 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Pipe and fittings (include plugs and caps).
 - .2 Joints – all materials, qualifications and procedure as applicable.
 - .3 Procedures and equipment used to maintain quality control on main and service line piping grades (ie. electronic digital box level).
 - .4 Cleaning and video inspection equipment, procedures and reporting.

1.2 REFERENCES

- .1 ASTM D698-12(2021); Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 ASTM D3034-21; Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and fittings.
- .3 ASTM F1760-16(2020); Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.
- .4 CAN/CSA B181.2-21; Polyvinylchloride (PVC) and chlorinated polyvinylchloride (CPVC) drain, waste, and vent pipe and pipe fittings.
- .5 CAN/CSA B182.2-21; PSM type polyvinylchloride (PVC) sewer pipe and fittings.
- .6 CSA B182.7-97; Multilayer PVC Sewer Pipe (PSM Type) Having Reprocessed-Recycled Content.
- .7 BNQ 3624-130 (2015); Unplasticized Poly(Vinyl Chloride) (PVC) Rigid Pipe and Fittings, 150 mm in Diameter or Smaller, for Underground Sewage Applications.
- .8 BNQ 3624-135 (2012); Unplasticized Poly(Vinyl Chloride) [PVC-U] Pipe and Fittings - Pipes of 200 mm to 600 mm in Diameter for Underground Sewage and Soil Drainage - Characteristics and Test Methods.

1.3 MATERIAL CERTIFICATION

- .1 At least 2 weeks prior to commencing work submit manufacturer's test data and certification that pipe materials meet requirements of this section.
- .2 At least 2 weeks prior to commencing work provide sample of bedding materials to be used.

Part 2 Products

2.1 SEWERMAINS – PIPE

- .1 PVC Pipe: Conforming to all the requirements of ASTM Specification D3034 or ASTM F1760, certified to NQ 3624-130/135 and third party certified to CSA Standards B182.2.

- .1 SDR: minimum 35
- .2 Standard pipe lengths: 4 or 6 metres nominal.
- .3 Joints - Locked-in elastomeric type gasket and integral bell system. In accordance with ASTM D3034 or ASTM F1760, CSA B182.2 or B182.7. In addition joints must be able to withstand a minimum hydrostatic pressure of 345 kPa without leakage.
- .4 Use lubricant as supplied and labelled by the pipe manufacturer.

2.2 GRAVITY SEWER SERVICE CONNECTION

- .1 Pipe: Third party certified to CSA Standards B182.2 or B182.7.
 - .1 PVC PSM SDR 28.
 - .2 Minimum size: 150 mm.
- .2 Fittings and accessories manufactured and furnished by the pipe supplier and have bell and/or spigot configurations to match that of the pipe.
 - .1 Use long-sweep type fittings for 45 & 90 degree bends.
- .3 Service connections to sewer mains:
 - .1 Use an injection moulded SDR 28 PVC service tee (Tee or Tee-Wye) with prefabricated gasket joints on the main wherever the existing service can be located or staked prior to backfilling or is shown on the plans.
 - .1 CSA certified to CSA B182.1 and/or B182.2 and meet the requirements of ASTM D3034, F679 and F1336.
 - .2 Use saddle clamps where a service location has not been identified prior to the main being backfilled.
 - .1 PVC type with two all stainless steel clamps and a male insert stub that extends through the mainline wall which is flush with inside of main to ensure centering of the saddle over the drilled hole in the main
 - .2 Complete with a full face rubber gasket to provide a positive seal and a gasketed bell similar to the mainline pipe that provides positive method to connect service piping to the main. The bell shall have a positive stop which prevents the pipe from penetrating the mainline wall under any circumstances.

2.3 PIPE BEDDING AND SURROUND MATERIAL

- .1 Bedding sand as specified in Section 31 23 10 Excavating and Backfilling for Trenching.

2.4 INSULATION

- .1 Refer to Section 07 21 13.

2.5 BACKFILL MATERIAL

- .1 Backfill material in accordance with Section Excavating and Backfilling for Trenching.

2.6 MAINLINE VIDEO INSPECTION

- .1 Provide a digital format color video inspection system for all sewer pipe works. The lighting and equipment used shall be specifically designed for use in pipe and shall

provide a clear picture of the entire periphery of the pipe for the purpose of determining general condition, features and upcoming defects.

- .1 On-screen digital footage counter.
- .2 White LED lighting as required to illuminate the inspection area.
- .2 Self leveling rotate and pan type camera on a suitable plastic skid guide suitable to provide a clear picture of the entire periphery of the pipe.
 - .1 Video resolution minimum: 480 Lines Color OR 460 lines horizontal, 400 lines vertical resolution (NTSC) 450 h x v 450 (PAL).
- .3 Counter to record location of camera head based on distance from insertion location.
- .4 Monitor: to provide a clear visual information source for the live camera feed that is easily accessible for viewing by the Departmental Representative.
- .5 Recording: Suitable for recording to hard drive, USB or SD memory card c/w information on location of inspection as part of recording.
- .6 Ensure mandrel is in the clear field of view and can be used as a reference to determine any ponding depth.
- .7 Log results of the inspection and bound as an inspection report:
 - .1 Provide sample and obtain Departmental Representative approval at least 2 weeks prior to scheduling any CCTV works.
 - .2 Include pictures that clearly state the position of the camera and related background data.
 - .3 Report shall clearly identify and describe all points of significance such as locations of building sewer connections, water ponding locations and depths, debris location and type, protruding gaskets, unusual conditions, etc.
 - .4 Use manhole numbers that match those on the plans, provide a measured depth for each manhole.
 - .5 Provide 3 copies of the video recording and inspection report on clearly labelled and indexed DVD's.

2.7 MANDREL

- .1 Mandrel (mainline): Cylindrical in shape, constructed of 9 evenly spaced arms with a proving ring suitable for 5.25% deflection of SDR35 PVC pipe.
- .2 Allowable deflection to be no greater than 0.15 times the pipe SDR and based on the table below. Deflection is expressed as a percent of the base inside diameter of the sewer pipe as defined in the ASTM standard to which the pipe is manufactured.
- .3 Provide and check the mandrel with a go-no-go proving ring sized. The proving ring shall have a diameter equal to the computed deflected diameter ± 0.1 mm. An acceptable ring shall be fabricated from 6 mm thick steel.
- .4 Mandrel and proving ring dimensions for SDR 35 flexible sewer pipe are shown in the following table:

Nominal Pipe Size (mm)	Mandrel Arm Radius (mm)	Mandrel Contact Length Inside Diameter (mm)	Proving Ring (mm)
200	92.74	150	185.48
250	115.70	200	231.40
300	137.46	250	274.92

Part 3 Execution

3.1 SEWAGE FLOWS

- .1 Maintain sewage flows during construction period such that interruption to residents is minimized. Ensure mainline system is operational for at least 16 hours or more per day.
- .2 Use barriers and screens as required to prevent dirt and stones from entering the piping to remain and potentially adversely effecting the lift station.
- .3 Be responsible to clean and service lift station if debris enters station.

3.2 PREPARATION

- .1 Pipes and fittings to be clean and dry before installation.
- .2 Remove defective material from site.
- .3 Prior to installation, obtain Engineer's approval of pipes and fittings.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section – Excavating and Backfilling for Trenching.
- .2 Complete units as pipe laying progresses.
- .3 Install as per alignment and depth indicated on the plans and within line and grade tolerance as specified.

3.4 GRANULAR BEDDING

- .1 Place granular bedding materials as per Section – Excavating and Backfilling for Trenching.

3.5 INSTALLATION

- .1 Lay and join pipes in accordance with manufacturer's recommendations.
- .2 Handle pipe using methods that do not damage the pipe and as per manufacturer's recommendations. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Commence laying at inlet to manhole and proceed in upstream direction with bell ends of pipe upgrade. Use longest pipe size manufactured where practicable to reduce total number of joints on sewer.

- .1 Manhole connections: Provide a pipe joint located 1.0 to 1.2 m from side of manhole to mitigate minor manhole settlement.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by Departmental Representative. Protect exposed pipe ends with an approved stopper to prevent excess amount of water, earth and debris from entering pipe as work proceeds.
- .7 Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Position and join pipes by methods recommended by manufacturer.
- .9 Install PVC pipe and fittings in accordance with CSA B181. 2.
- .10 Pipe jointing:
 - .1 Clean gaskets in accordance with manufacturer's recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes carefully before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing gasket or gasket contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Apply lubricant to pipe spigot end only that has been cleaned. Extend lubricate coating back 50-75 mm from the spigot end, cover the entire pipe circumference.
 - .7 Insert (push) spigot end into bell until the reference mark on the pipe barrel is even with the edge of the bell.
 - .1 For pipe up to 375 mm diameter assemble joint by hand means using a bar and blocking.
 - .2 If undue resistance is felt to the assembly or it is pushed past the reference mark: disassemble and remake the joint.
 - .8 Minimize joint deflection after joint has been made to avoid joint damage.
 - .9 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
 - .10 Cut pipes as required for special inserts, fittings or closure pieces in a neat manner, as recommend by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
 - .1 For field cut pipe ensure spigot end is chamfered to a thickness of about 50% of the pipe wall at a bevel angle of 15°. Place a reference line at the correct insertion depth.
 - .11 Make watertight connections to manholes. Use grout adapter and non-shrink grout when suitable gaskets are not available.
 - .1 Grout adapter: fitting manufacturer from a stub of pipe that has been coated externally with sand, epoxy and a cement mortar mixture.

3.6

PIPE SURROUND

- .1 Upon completion of pipe laying, surround and cover pipes as indicated.

- .2 Hand place surround material in uniform layers not exceed 150mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Compact each layer from mid height of pipe to underside of backfill to at least 90% maximum density to ASTM D698.

3.7 BACKFILL

- .1 Complete backfilling operations in accordance with Section Excavation and Backfilling for Trenching.

3.8 LINE AND GRADE

- .1 Install sewer pipe to the line and grade shown on the drawings.
- .2 Ensure vertical variance from grade **does not** exceed the following limits for mainline piping:
 - .1 Invert 12 mm below the design grade.
 - .2 Invert more than 12 mm above the design grade.
 - .3 Allowable ponding in the pipe due to combined variance above and below grade not to exceed 25 mm.
- .3 Horizontal variance from line shall not exceed 100 mm.
- .4 Manholes, tees, wyes, reducers and bends shall be installed to the grades and at the locations shown on the Plans. The allowable tolerance from the line and grade shall not exceed those specified for sewer pipe.
- .5 Sharp bends will not be permitted even though the sewer pipe remains within these tolerances.
 - .1 For piping following a radius in the road allowance use 4 m pipe lengths and ensure deflection does not exceed 4%.

3.9 MANDREL TESTING

- .1 Complete a mandrel test of mains after installation works are complete.
- .2 If the mandrel does not readily pass through the sewer, repair or replace the defective sewer and repeat the test.

3.10 MAINLINE CLEANING

- .1 Cleaning: Remove all dirt, sand, rocks, grease and other solid and semisolid material at the downstream manhole of the section being cleaned prior to or during video inspections. Do not pass material from manhole section to manhole section.
- .2 Flush and clean sewer pipe before the video inspection is completed utilizing high-velocity sewer cleaning equipment capable of removing all dirt, sand, rocks, grease and other solid and semisolid material. All dirt, sand, rocks, grease and other solid and semisolid material shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section will not be permitted.

3.11 CLEANING

- .1 Flush and clean mainline sewer before the video inspection is completed utilizing high-velocity sewer cleaning equipment capable of removing all dirt, sand, rocks, grease and other solid and semisolid material and all debris.
- .2 Provide a water based cleaning system to flush and clean the pipe and manholes to be free of all dirt, sand, rocks, grease and other solid and semisolid material and all debris.
- .3 Do not pass material from manhole section to manhole section.
- .4 Remove all water and debris from manholes.

3.12 MAINLINE VIDEO INSPECTION

- .1 Complete video inspection by personnel skilled and qualified in the use of video inspection equipment.
- .2 Use procedures to keep the piping and manholes clear of fog during video inspection operations. Keep the camera lens clean and in focus.
- .3 The camera speed shall not exceed 9 m per minute.
- .4 Take pictures at areas of significance, pictures shall clearly state the position of the camera and related background data. Include such pictures in inspection report.
- .5 Inspection shall be in the direction of flow and between manholes or other appropriate locations where the equipment may be installed or removed. Reference for zero reading for location to be the center of the start manhole, ensure location measurement value is accurate..
- .6 Provide a constant water flow and video recording methods such that any potential ponding in the pipe can be clearly identified and recorded as to location, length of affected area and depths throughout the affected area where ponding occurs.
- .7 Stop the camera to provide a steady 2 second perpendicular view of all points of significance such as locations of building sewer connections or other fittings, water ponding locations, debris location and type, protruding gaskets, unusual conditions, etc.
 - .1 Rotate and pan the camera a full 360⁰ at the locations identified above.
- .8 Clean manholes as required, provide video confirmation that manholes are clean.
- .9 Provide inspection report and copies as outlined in Part 2 products above.
- .10 Rectify any deformation, misalignment, excess ponding, deformed gaskets, etc. which are deemed as a deficiency.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Complete works as required to complete a natural gas service entrance into the building and complete piping as required between heaters and genset.
- .2 Co-ordinate works with Gas Company.
- .3 Be responsible to provide demand to Gas Company and size piping within building to code.

1.2 REFERENCES

- .1 ASME B16.5-2020, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24, Metric/Inch Standard.
- .2 ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings
- .3 ASME B16.22-2018, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .4 ASME B18.2.1-2012 (R2021), Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series), Includes Errata (2013).
- .5 ASTM A47/A47M-99(2018)e1, Standard Specification for Ferritic Malleable Iron Castings.
- .6 ASTM A53/A53M-20, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .7 ASTM B32-20, Specification for Solder Metal.
- .8 ASTM B75/B75M-20, Specification for Seamless Copper Tube.
- .9 CSA B149.1:20, Natural gas and propane installation code, Includes Errata (2020), Ontario Amendments (2021), and Administrative Update (2021).
- .10 CSA B149.2:20, Propane Storage and Handling Code.
- .11 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 23.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 30.

Part 2 PRODUCTS

2.1 PIPE

- .1 Steel pipe: to ASTM A53, Schedule 40, seamless as follows:
 - .1 NPS 12 mm to 50 mm, screwed
 - .2 NPS 62 mm and over, plain end.
- .2 Copper tube: to ASTM B75M.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste
- .2 Welded fittings: CSA W47.1
- .3 Flange gaskets: nonmetallic flat
- .4 Soldered: to ASTM B32, tin antimony 95:5.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150
 - .2 Steel pipe flanges and flanged fittings: ANSI/ASME B16.5
 - .3 Steel butt-welding fittings
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47M
 - .5 Bolts and nuts: to ANSI B18.2.1
 - .6 Nipples: Schedule 40, to ASTM A53
- .2 Copper fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ANSI B16.18
 - .2 Wrought copper fittings: to ANSI/ASME B16.22.

2.4 VALVES

- .1 Provincial Code approved, lubricated plug type.

2.5 GAS METER

- .1 Coordinate with utility for suitable gas meter for the exterior of the building.

Part 3 EXECUTION

3.1 GENERAL

- .1 Complete all clearances to natural gas utility regulator as per Manitoba Gas Notice 25.
- .2 Field locate existing gas mains.

3.2 PIPING

- .1 Install in accordance with applicable Provincial Codes
- .2 Install in accordance with CSA B149.1
- .3 Assemble piping using fittings manufactured to ANSI standards
- .4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated
- .5 Slope piping down in direction of flow to low points
- .6 Install drip points:
 - .1 At all low points in piping system
 - .2 At each connection to equipment
- .7 Use eccentric reducers at pipe size change installed to provide positive drainage

- .8 Provide clearance for access and for maintenance
- .9 Ream pipes, clean scale and dirt, inside and out
- .10 Install piping to minimize pipe dismantling for equipment removal.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
- .2 Install valves at all branch take-offs to isolate each piece of equipment, and as indicated.

3.4 TESTING

- .1 Test system in accordance with CSA B149.1.

3.5 PURGING

- .1 Purge after pressure test in accordance with CSA B149.1.

END OF SECTION

DIVISION 40

PROCESS PIPING, EQUIPMENT AND INSTRUMENTATION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data to Section 01 33 23 Shop Drawings, Product Data, and Samples.
- .2 Submit shop drawings for process equipment including valves, piping, instrumentation and wastewater trash removal equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating operation for each type of equipment supplied for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.3 QUALITY OF MATERIALS

- .1 Materials shall be best suited to resist corrosion, be neat in appearance, meet best modern mechanical and electrical practices and be to Departmental Representative's satisfaction.
- .2 Material delivered to the site not in accordance with the specifications will be rejected.
- .3 Use precautions necessary to protect materials from damage. Damaged equipment shall be repaired or replaced to manufacturer's directions.

1.4 QUALITY OF WORKMANSHIP

- .1 Employ trained and experienced personnel familiar with the Work requirements.
- .2 Layout the Work and be responsible for any damage caused through the improper location of materials and through poor workmanship.
- .3 Perform Work in a competent manner in accordance with the best practices ensuring the finished Work is neat in appearance and to the satisfaction of the Departmental Representative.

1.5 PLANS AND SPECIFICATIONS

- .1 Process drawings do not show details of work to be done by other Divisions. Contractor responsible to coordinate the work of this Division with all others involved in the project.

1.6 DRAWINGS

- .1 Submit drawings to the Departmental Representative for layout Work involving special approvals.

1.7 CODES

- .1 Equipment to be procured or fabricated and installed to meet safety codes for intended use. Where regulations and specifications conflict, the most stringent applies.
- .2 Equipment and materials to carry CSA, ULC or cUL approval and conform with applicable standards, **no exceptions or alternatives.**
- .3 Factory assemble control panels and components. Panel assembly and internal components shall be CSA approved. Cabinet construction to be by a panel manufacturer

who shall comply to all building codes, regulations and CSA certification applicable to work. Local approvals for panel construction including CSA will not be accepted.

- .4 Install process equipment to drawings and specifications and to the latest applicable Federal, Provincial and Municipal Codes, Regulations and By-laws. The standards established by the drawings and specifications are not to be diminished by any of the Codes, Regulations or By-laws referred to above.

1.8 CHANGES

- .1 Departmental Representative shall have the right to make changes in the drawings for correction or clarification. Changes shall in no way affect or void the obligations of the contract.
- .2 If changes alter the cost of work, an adjustment will be made by the Departmental Representative in accordance with procedures outlined in these documents.
- .3 Location of pipe runs may be altered without extra charge, provided that the change is approved by the Departmental Representative before installation and does not require additional materials.

1.9 CUTTING AND PATCHING

- .1 Leave and/or provide such openings as required for the installation of piping and equipment including the provision of templates and/or location of holes, recesses or other openings. Provide all inserts, anchors, hangers, etc. to be placed in the concrete or set in masonry.
- .2 No holes other than those shown on the drawings shall be made in structural steel without the written permission of the Departmental Representative.
- .3 Any errors or omissions in the location of the aforementioned holes, etc. shall be corrected at the Contractor's expense.

1.10 RECORD DRAWINGS

- .1 Refer to Section 01 78 00 – Closeout Submittals.

1.11 TESTS

- .1 Provide and document tests on equipment, systems and materials as stated in these specifications.
- .2 Carry out tests, verifying performance, for duration stated in other specification sections and as stated by Departmental Representative before final completion and acceptance of Work.
- .3 Calibrate and verify online instrumentation values obtained with results from supplied field equipment, standard solutions and lab verification where applicable.
- .4 Verify residuals fed into the water supply meet all applicable standards and obtain approval from Departmental Representative for proposed residuals.
- .5 Document testing, solution strength and feed rates into an operator manual and duplicate.
- .6 Completion of tests is not evidence of acceptance of tested part of contract.
- .7 No claim for damage will be made for injury or breakage of parts due to tests.

1.12 SYSTEM START UP

- .1 After completion of installation of the equipment and prior to final inspection by the Departmental Representative, retain qualified operators to start up all systems as required by the Departmental Representative.
- .2 See "tests" above.
- .3 Systems and equipment shall include but not be limited to the following:
 - .1 Instrumentation including level measurement, etc.
 - .2 Air quality monitors.
 - .3 Equipment listed in this specification.
- .4 Coordinate integration to SCADA system.
- .5 Start up to include:
 - .1 Complete commissioning per Section 01 91 13 Commissioning.
 - .2 Ensure that all equipment is completely functional meets all requirements as stated herein.
 - .3 Where adjustment devices, throttling devices, and gauges are installed, record the readings required for the intended performance of the system.

1.13 TRAINING

- .1 Be responsible to review Section 01 79 00 Demonstration and Training and include training requirements as outlined in Section 01 79 00 in scope of Work.

Part 2 Products

2.1 MATERIALS

- .1 For ease of maintenance and parts replacement, use equipment of a single manufacturer for similar equipment, to the maximum extent possible.

2.2 GROUT FOR MOUNTING EQUIPMENT OF BASES

- .1 Material for grouting equipment to concrete bases shall be non shrink grout.

Part 3 Execution

3.1 EQUIPMENT

- .1 Ensure concrete bases are suitable for equipment installation, are to manufacturer's requirements and are as per drawings. Bases may not restrict future equipment servicing.
 - .1 Raise all equipment off floor minimum 100 mm.
- .2 Locate all anchor bolts in accordance with equipment manufacturer's recommendations.
- .3 Align all equipment to one another and with connecting piping before grouting in place.
- .4 Install and handle all equipment in accordance with the manufacturer's recommendations.
- .5 See Division 26 to install electrical conduit and wiring for equipment.
- .6 Align adjust and lubricate all equipment, before trial operations are attempted.

- .7 Commission all equipment in the presence of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All products listed in Item 1.1.1 above.
 - .2 Spare Parts (if applicable).
 - .3 Include material data sheets, dimensional and layout data of equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 ASTM A240/A240M-20a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .2 AWWA C513-05, Open Channel, Fabricated Metal Slide Gates.
- .3 AWWA C561-21, Fabricated Stainless Steel Slide Gates.
- .4 BS 7775:2005, Penstocks for use in Water and Other Liquid Flow Applications. Specification

1.4 MANUFACTURER

- .1 Provide valves of the same type and same manufacturer throughout.
- .2 Provide valves with manufacturer's name and pressure marked on the valve body.

Part 2 Products

2.1 SLUICE GATE VALVES

- .1 316 Stainless steel fabricated modular design with stainless steel fasteners, meeting ASTM A240.
- .2 Bi-directional sealing, with maximum leakage rate of 1.24 L/min per meter as per AWWA C561-14.
 - .1 Provide EDPM seals. Seals to be accessible for maintenance without removing the frame from the channel.
- .3 Provide rising stem for Sluice Gate Valves 101 and 102. Provide non-rising stems for Sluice Gate Valves 103 and 104.
- .4 Valve to be suitable for electric actuation.
- .5 Rated to withstand water pressure equal to the full height of the valve.

- .6 Provide field adjusting bolts suitable to install the valve embedded in a 610 mm wide by 900 mm tall concrete channel. Slide height of valve to be 900 mm.
- .7 Provide 4 units.

Part 3 Execution

3.1 EQUIPMENT

- .1 Install valves to the manufacturer's recommendations and as shown on the drawings.
- .2 Tighten adjustment bolts on frame and ensure valve opens and closes properly prior to grouting frame.
- .3 Co-ordinate Work with concrete installation in accordance with Division 3.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 All products listed in Item 1.1.1.1 above.
 - .2 Spare Parts (if applicable).
 - .3 Include material data sheets, dimensional, electrical and layout data of all equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 REFERNECES

- .1 AWWA C542-16, Electric Motor Actuators for Valves and Slide Gates.
- .2 National Electrical Manufacturers Association (NEMA).

1.4 MANUFACTURER

- .1 Provide actuators of the same type and same manufacturer throughout.

Part 2 Products

2.1 ELECTRIC ACTUATORS

- .1 120 VAC, single phase, explosion proof, multi-turn electric actuator. Rated for use in Class I, Division 2 environment.
- .2 Rated for IEC S4-30% for open/close duty.
- .3 Size and equip each actuator with sufficient closing torque to suit its intended application.
- .4 Provide minimum 450 mm diameter mechanical hand wheel override.
 - .1 Provide local controls as required to disable remote control to use handwheel.
- .5 Local interface: provides local / remote selector and open /close switches and screen for position indication.
- .6 Provide open and closed limit switches (SPDT) that indicate open end of travel and closed end of travel for communication with SCADA.
- .7 Fail position on loss of input signal to be closed.
- .8 Provide motor running contact.
- .9 Provide relay alarm contact.
- .10 Fail position on loss of input signal to be closed.

- .11 Provide 2 year warranty
- .12 Applies to the following valves, SLUICE GATE VALVE-101, SLUICE GATE VALVE 102.

Part 3 Execution

3.1 ACTUATOR INSTALLATION

- .1 Cycle valve operation from fully closed to fully open then back to fully closed.
- .2 At same time, check travel stop settings for proper alignment.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to all:
 - .1 Products listed above in Item 1.1.1.
 - .2 Electrical wiring diagrams and installation drawings.
 - .3 Material data sheets, dimensional and layout data of all equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 IEC 60529 Ed. 2.2 b:2013, Degrees of Protection Provided by Enclosures (IP Code) CONSOLIDATED EDITION.
- .2 National Electrical Manufacturers Association (NEMA).

Part 2 Products

2.1 ULTRASONIC LIQUID LEVEL TRANSMITTER AND DISPLAY

- .1 Utilize ultrasonic level controller display c/w remote level transmitter. Provide four level controller display and the following remote level transmitters:
 - .1 Sewage Level – Building Entrance (US-101).
 - .2 Sewage level – Upstream of Grinder 1 (US-102)
 - .3 Sewage level – Upstream of Grinder 2 (US-103).
 - .4 Sewage level – Between Grinder 1 and Auger 1 (US-104)
 - .5 Sewage level – Between Grinder 2 and Auger 2 (US-105).
 - .6 Sewage level – After Auger 1 (US-106)
 - .7 Sewage level – After Auger 2 (US-107).
- .2 Level Transmitters:
 - .1 Hermetically welded PVDF sensors.
 - .2 Process connection: NPT threaded.
 - .3 Maximum beam angle of sensor not to exceed 12°.
 - .4 Blocking distance: 70 mm
 - .5 Measuring depth: 3 m
 - .6 Approval: CSA C/US CL .I, II, III Div.1+2 Gr.A-G, zone 1,2.
 - .7 Unit(s) to be have sufficient false target buffering and be rated by Manufacturer for use in a limited space with false targets as shown on the plans. Transmitter to

have built in temperature compensation. Provide certification from Manufacturer that transmitter will operate satisfactory for this application prior to ordering.

- .3 Level Controller Display:
 - .1 CSA approved.
 - .2 IP 66/NEMA 4X field mounted enclosure.
 - .3 6-line plain text illuminated LCD display.
 - .4 Inputs: 1 or 2 level transmitter sensors as noted in Item 2.1.1. Output: 4-20 mA HART or PROFIBUS DP. Coordinate with PLC supplier.
 - .6 Automatic detection of level transmitter sensors.
- .4 Supply sufficient cable to mount depth display module(s) as shown on the plans.
- .5 Controller unit to continuously display liquid levels:
 - .1 Display Line 1: mm of actual liquid in channel.
- .6 Provide SCADA control, set and operate as per levels identified on the plans.
- .7 Provide loss of echo detection which through the SCADA system activates the auto dialer and activates an alarm light.
- .8 Provide stilling well as required to prevent interference from other piping and level floats in the chamber.

Part 3 Execution

3.1 START UP AND ADJUSTMENT

- .1 Manufacturer's factory representative to check installation and complete calibration.
- .2 Start up and train to provide an operating system and as outlined in specifications.

3.2 ULTRASONIC LIQUID LEVEL CONTROL

- .1 Locate transmitters in locations as indicated on the plans. Locate transmitter to allow the ultrasonic signal to be unaffected by surrounding appurtenances. Ensure that 70 mm "deadband" distance is considered in vertical mounting position.
- .2 Make all electrical connections as shown on electrical drawings and as per manufacturer's recommendations.
- .3 Mount transmitters as per manufacturer's instructions. As a guide:
 - .1 Inside a conduit - to have minimum 150 mm clearance from all obstructions i.e. mount unit in a 200 mm one length vertical pipe. If mounted in a pipe cut two 75 mm x 75 mm notches in bottom of pipe.
 - .2 Cast in place conduits for transmitter and level sensors through building floor.
 - .1 Cast in place conduit to allow transmitter and level sensor wiring to be brought back to a wall location.
- .4 Turn on loss of echo signal detection and tie into PLC.
 - .1 Ensure each transducer is independently monitored.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to all:
 - .1 Products listed above in Item 1.1.1.
 - .2 Electrical wiring diagrams and installation drawings.
 - .3 Material data sheets, dimensional and layout data of all equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 IEC 60529 Ed. 2.2 B2013, Degrees of Protection Provided by Enclosures (IP Code) CONSOLIDATED EDITION.
- .2 National Electrical Manufacturers Association (NEMA).
- .3 NSF/ANSI/CA 61-2021, Drinking Water System Components – Health Effects.
- .4 ASME B40.100-2013, Pressure Gauges and Gauge Attachment.

1.4 QUALIFICATIONS

- .1 Employ trained and experienced personnel familiar with the Work requirements.

Part 2 Products

2.1 AIR DIFFERENTIAL PRESSURE

- .1 Provide a differential pressure transmitter and sensor.
- .2 Sensor temperature range to be between -40°C and 85°C with an accuracy of $\pm 0.1\%$.
- .3 Provide LCD display.
- .4 Minimum pressure range from 0.01 kPa to 10 kPa. Set up display in kPa.
- .5 Transmitter to produce 4-20mA analog input signal for SCADA with HART protocol.
- .6 Provide 24VDC power supply and related wiring circuit to operate transmitter.
- .7 Rated for Class I, Division 2 environment.
- .8 Identified as DPG-101. Initial calibration to be 0 to 0.5 kPa.

Part 3 Execution

3.1 AIR DIFFERENTIAL PRESSURE

- .1 Coordinate with Division 8 and Division 4 to ensure wall penetrations are sealed.
- .2 Complete on site calibrations.
- .3 Make all electrical connections as shown on electrical drawings.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to the following all:
 - .1 Products listed above in Item 1.1.1.
 - .2 Electrical wiring diagrams and installation drawings.
 - .3 Material data sheets, dimensional and layout data of all equipment.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 IEC 60529 Ed. 2.2 b:2013, Degrees of Protection Provided by Enclosures (IP Code) CONSOLIDATED EDITION.
- .2 National Electrical Manufacturers Association (NEMA).

Part 2 Products

2.1 BUILDING TEMPERATURE/HUMIDITY SENSOR (BTH)

- .1 Provide air temperature and humidity transmitters for thermocouples identified below.
- .2 Transmitter and sensor, to monitor air temperature and/or humidity outside the building.
- .3 Units to be field mounted temperature transmitters with and 4-20 mA signal.
- .4 24 VDC nominal.
- .5 Range.
 - .1 Temperature: -40°C TO 60°C.
 - .2 Humidity: 0-100%.
- .6 Accuracy:
 - .1 Temperature: $\pm 0.2^{\circ}\text{C}$ at 25°C.
 - .2 Humidity: $\pm 2\%$ relative humidity.
- .7 Include calibration kit for humidity: 11% and 75% RH standards.
- .8 Provide thermocouples with a 4-20 mA output and pipe connections rated as follows:
 - .1 Building exterior air temperature: -40°C TO 40°C.
 - .1 Include 4-20 output for humidity.

- .2 Include sunshield.
- .3 Identified on plans as BTH-101.

2.2 GAS MONITOR

- .1 Provide two (2) single or dual channel transmitter units suitable for monitoring methane (CH₄) and hydrogen sulfide (H₂S) by using interchangeable electrochemical sensors.
 - .1 Supply voltage: 10-30VDC.
 - .2 Provide sensors with minimum 3 year warranty.
 - .3 Sensor range:
 - .1 Methane: 0 – 100% LEL.
 - .2 Hydrogen Sulfide: 0 - 50 ppm, with minimum 0.1 ppm resolution.
 - .4 Location: Refer to Plans for mounting heights
- .2 Each transmitter unit to transmit gas levels to the PLC.
- .3 Indicators for power, sensor fault, invalid sensor configuration, calibration faults.
- .4 Enclosure: Stainless steel with 19 mm NPT conduit entries. NEMA 4X enclosure, suitable for Class I, Division 2 environment and rated for all gases indicated.
- .5 Unit to be CSA approved.
- .6 Provide 4-20 mA HART analog output of concentration to SCADA for each unit.
- .7 Calibration: Sensor and system to be able to be field calibrated. Supply the following for field calibration (a minimum of 20 calibrations each gas).
 - .1 Minimum 58 L disposable cylinder of gas, air balance in a concentration as required for calibration.
 - .1 Methane (CH₄), 2.5% LEL.
 - .2 Hydrogen sulfide (HCL), 40 ppm.
 - .2 Minimum 0.25 LPM regulator for gas cylinder and minimum 2 m of tubing.
 - .3 Minimum 58 L disposable cylinder of zero air.
 - .4 Any other equipment required for easy field calibration.
 - .5 Provide storage case for calibration kits.
- .8 Provide one spare sensor for each monitor after a minimum time period of one –two years has elapsed (as depending upon observed life of sensor after a one year operating period) in a sealed PVC bag with note on bag saying do not open until ready to replace expired sensor.

2.3 BUILDING FLOOD SWITCH (BFS)

- .1 Oscillating tuning fork type which monitors the resonance frequency and indicates whether the tuning fork is oscillating freely or whether fluid is covering it.
 - .1 Provide two (2) units.
 - .1 BFS-101.
 - .2 BFS-102.
- .2 CSA approved, suitable for Class I, Division 2 environments.
- .3 19 mm NPT process connection.

- .4 316L stainless steel sensing element.
- .5 Close contacts when tuning forks sense liquid.
- .6 3 wire DC-PNP output.
- .7 Provide protective sleeve over contacts for open mounting.

2.4 STROBE

- .1 Refer to Section 26 50 00

2.5 HANGERS AND SUPPORTS

- .1 Brackets and hangers to be rust proof materials ie. stainless steel, plastics or fiberglass.

Part 3 Execution

3.1 EXECUTION GENERAL

- .1 Furnish approved manufacturer's drawings and instructions for equipment installation.
- .2 Follow manufacturer's installation instructions for the installation of all equipment.
- .3 Supplier representative to check installation and complete calibration of all equipment.
- .4 Start up and train to provide an operating system and as outlined in specifications.

3.2 START UP AND ADJUSTMENT

- .1 Upon completion of installation, test, adjust and regulate controls or safety equipment provided under this and other sections.
- .2 Adjust and place in operating condition.

3.3 HANGERS AND SUPPORTS

- .1 Install sufficient hangers to support all piping and equipment to restrain movement.
- .2 Secure to the wall, floor and ceiling in a firm manner.
- .3 Hangers shall be as specified in Part 2 of this section.
 - .1 Ensure all brackets and hangers used are constructed of rust proof materials- stainless steel, plastics or fiberglass.

3.4 BUILDING FLOOD SWITCH

- .1 Install switch(es) in the locations as indicated on the plans.
- .2 Protect from water spray by installing switch in protective coupling with top vent.
- .3 Set to activate overflow channel switch, BFS-101, when any wayer is passing over the overflow weir.
- .4 Set to activate switch basement flood switch, BFS-102, with a 25 mm floor water level (probe bottom 10 mm above floor).

3.5 GAS MONITOR INSTALLATION

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

- .2 Mount gas sensors on wall as shown on the plans.
- .3 Connect power to unit.
- .4 Calibrate sensors.
- .5 Demonstrate as sensor operation in presence of Departmental Representative with calibration gas.

3.6 IDENTIFICATION

- .1 Provide lamicoid identification labels as specified in Section 22 05 54 "Identification".

END OF SECTION

DIVISION 41

MATERIAL PROCESSING AND HANDLING EQUIPMENT

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data per Section 01 33 00 - Submittal Procedures.
 - .1 Provide drawings sealed by an Engineer registered in Manitoba of structural requirements and design loads.
 - .2 Indicate (a) capacity, (b) span, (c) lifting height including to bottom of hook, (d) weight of bridge and end trucks, (e) structure finish and color, (f) welding standard, (g) reactions and moments considered, (h) safety factors used, (i) safe loading, (j) details on anchor bolt attachment, (k) trolley type (l) details on structural bolts and (m) description of components and materials, of construction.
 - .3 All dimensions as related to lifting heights are to the bottom of the hook whether specifically stated on the plans or specifications and indicate such on shop drawing submissions. Pieces of the overall assembly can be shown however this does not relieve the requirement to provide a "system" with minimum lifting heights to the hook as required.
 - .1 Utilize the most stringent lifting height shown on the plans or within these specifications in the overall assembly of building and crane.
 - .4 Submittals required under this section include, but are not limited to the following:
 - .1 Hoists.
 - .2 Crane Bridge.
 - .3 End trucks, runway rail and bus bar.
 - .4 Radio.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for hardware with details, colour charts, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 - Closeout Submittals.

1.3 REFERENCES

- .1 CSA B167-16, Overhead Cranes, Gantry Cranes, Monorails, Hoists, and Jib Cranes.
- .2 CSA C22.2 No. 33:19, Electrical Safety Requirements for Cranes and Hoists, Includes Update No.1 (2021).
- .3 Hoist Manufacturers Institute (HMI).

1.4 DESIGN/BUILD

- .1 Conform to the requirements of CSA B167 where applicable.
- .2 Be responsible to design, supply and erect all components/equipment indicated within this specification to meet the intent of all specifications sections and the plans.
- .3 The plans and specifications herein do not indicate all/any required beams dimensions, support specifics, cross bracing, attachment devices, etc. Be responsible to design, co-ordinate and integrate any and all such requirements with other Divisions.

1.5 MINIMUM HEIGHT

- .1 Design system to utilize the maximum height as available within the building structure proposed and these specifications.

Part 2 Products

2.1 MATERIALS/DESCRIPTION

- .1 Process Room:

Crane Hoists	Two hoists on one bridge, 5,000 kg capacity each
Mount	Prefabricated support to building floor designed and engineered to support the full crane load comprising track, hoists, supports and rated load.
Hook Elevation (Lower)	Equal to basement floor elevation, not including channel.
Hook Elevation (Upper)	Maximum available height within building.
Hoist Operation	Electric.
Trolley Operation	Electric.
End Truck Operation	Electric.
Power Supply	Bridge, trolley and hoist - 575 V, 3 phase, 60 Hz Radio Controller – 115 V, single phase.

- .2 Drawings and specifications for crane and hoist system are to be sourced through a certified material handling company. See 1.5.2 above.
- .3 All controls to be certified to CSA C22.2 No. 33
- .4 Distance from the top of the bridge beam to the hoist hook not to exceed 1016 mm.

2.2 SUPPORT POSTS TO BUILDING FLOOR

- .1 See Section 05 50 00

2.3 CRANE BRIDGE

- .1 Crane Track: Structural beam, to profiles and size for trolley operation, and to support design loads indicated on the drawings. Maximum allowable deflection with the weight of track, trolley, hoists and rated load not to exceed 5 mm/m.
- .2 Affix capacity plates showing manufacturer on both sides of the crane bridge.
- .3 Provide independent sliding pendant control system.

2.4 CRANE TROLLEY

- .1 Dual drive wheel trolley. Under running with pinion drive and gear covers. Design frame to hold gears and bearings in perfect alignment.
- .2 VFD controlled for 2 speed operation.
- .3 Low headroom type
- .4 Trolley Wheels: Metal wheels contoured to fit track. Provide permanently lubricated, anti-friction type roller bearings to trolley wheels.

2.5 CRANE HOIST

- .1 5,000 kg capacity
- .2 Two speed wire rope hoist, single reeved 4/1.
- .3 3 phase, TEFC motor, rated for Class I, Division 2 environment.
- .4 FEM Hoist duty rating 2m/M5
- .5 DC magnetic break, which activates in the event of power loss.
- .6 Overweight protection switch.
- .7 Minimum lift height 7.0m
- .8 Hook and Hook block: Single standard hook of forged steel construction, swivel bearing, complete with safety catch and fully enclosed hook block with grooved sheaves and journalized ball bearings.
- .9 Provide two (2) units.

2.6 END TRUCKS

- .1 Top running.
- .2 VFD controlled for 2 speed operation.
- .3 Provide end of travel and anti-collision limit system.

2.7 RADIO CONTROLLER

- .1 Push-button transmitter type, radio remote control designed for the remote control of hoists and cranes. Complete system will consist of a transmitter, receiver and battery charger.
- .2 Response time maximum 100 ms.
- .3 Operating temperature range -20°C to 70°C.
- .4 Transmitter and receiver rated for Class I, Division 2 environment.
- .5 Transmitter
 - .1 Provide LED lights to indicate status, including power supply, faults, signal status.
 - .2 Provide buttons to start, stop, and maneuver the crane bridge and both trolleys and hoists.
 - .3 Provide contact key to operate transmitter.
- .6 Transmitter Batteries
 - .1 Minimum 750 mAh
 - .2 Discharge Temperature: -20°C to 50°C.
 - .3 Provide 2 sets of batteries.
- .7 Receiver
 - .1 115 V, 60 Hz
 - .2 Complete with sufficient output commands to completely control end trucks, hoists and trolleys.
- .8 Battery charger

- .1 Provide 115 V, 60 Hz battery charger c/w two charging compartments capable of simultaneously charging.

Part 3 Execution

3.1 INSTALLATION

- .1 Install crane, hoist and support structures in accordance with reviewed shop drawings and manufacturer's instructions.
- .2 Repair or replace all damaged components and finishes to Departmental Representative's satisfaction.
- .3 Coordinate breaker sizes with Division 26.
- .4 Coordinate with Division 26 regarding the clearance to the lights. Ensure minimum 77 mm separation above the top of the bridge.
- .5 Coordinate with Division 23 regarding HVAC placement. Provide minimum 0.78 m clearance on the ends of the crane, from the hoist hook to the wall. Provide minimum 0.90 m on the sides of the crane, from the bridge to the walls.

3.2 PAINTING AND FINISHING

- .1 Factory prime and paint, except rubbing parts, with baked enamel "Safety Yellow".
 - .1 Includes structural bolts, washers and nuts.
 - .2 Label load rating on crane bridge.
 - .3 Do not paint area in contact with trolley or end truck wheels.
- .2 After installation touch up all scratches with enamel paint.

3.3 TESTING

- .1 Ensure trolleys and end trucks operate smoothly throughout entire length of track.
- .2 Load test all components. Provide written verification of load testing to Departmental Representative.

3.4 ORIENTATION AND INSTRUCTIONS

- .1 Once installed and tested provide operating instructions to Owner's staff.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - .1 Review the existing collection truck to ensure compatibility with selected cart dumper.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for hardware complete with pertinent details, colour charts, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 ANSI Z245.60-2008, Waste Containers – Compatibility Dimensions.

Part 2 Products

2.1 BUCKETMOUNTED CART DUMPER

- .1 Provide cart dumping apparatus capable of lifting and unloading 360 Litre collection bins.
 - .1 Apparatus to be connected to the existing collection truck's side collection bucket and use the truck's hydraulic system.
 - .2 Coordinate with Section 44 51 13. Collection bins will be ANSI Z245.60, Type B.
- .2 Minimum 180 kg lifting capacity.
- .3 The complete lifting, dumping, and return cycle must not exceed 15 seconds in duration.
- .4 The cart dumper shall have a dumping angle of 45 degrees and shall extend the cart sufficiently enough to empty refuse into the centre of the refuse body without spillage.
- .5 The cart dumper shall operate in conjunction with the compaction cycle of the refuse body.
- .6 Provide equipment from the same manufacturer as the existing collection truck or approved equal. Existing collection truck is Haul-All ML-Class.

Part 3 Execution

3.1 BUCKETMOUNTED CART DUMPER

- .1 Use qualified workers who are fully familiar with this work and have a working knowledge of the system components.
- .2 Be responsible to review the existing collection truck prior to submitting shop drawings.

- .3 Coordinate with the Departmental Representative and institution staff on truck modifications to ensure that no disruptions occur to regular waste collection.
 - .1 Provide 7 days written notice for any collection truck works.
 - .2 Waste collection truck may be out of service for a maximum of 36 hours to complete modifications. If waste collection truck is out of service for longer than 36 hours, provide temporary waste collection services to the institution.

END OF SECTION

DIVISION 43

GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

Part 2 Products

2.1 PRESSURE TANKS

- .1 Provide precharged sealed membrane type pressure tanks.
- .2 Tank to be precharged to 415 kPa.
- .3 Tanks to be rated for a minimum operating pressure of 700 kPa.
- .4 Tanks to have a minimum capacity of 76 Litres.
- .5 Tank assembly to be complete with a 50 mm pressure relief valve suitable for operating at 700 kPa.
- .6 Tank exterior to be pre-painted with a blue acrylic rust resistant paint.
- .7 Provide brass check valve on upstream side of pressure tank (CHV-101 on plans).

Part 3 Execution

3.1 PRESSURE TANK BASE

- .1 Provide concrete housekeeping pad to raise pressure tank a minimum 100 mm above the floor.
 - .1 Concrete bases: Ensure new concrete is “tied” to existing concrete with drilled in place anchors.
- .2 Apply epoxy coating to equipment base prior to placement of equipment. See Section 09 96 56.

3.2 PRESSURE TANK INSTALLATION

- .1 Set pressure tank on pressure tank base.
- .2 Set tank pre-charge as per manufacturer’s recommendations.

3.3 HYDROSTATIC TESTING

- .1 Pressure test entire assembly to 100 psi.

END OF SECTION

DIVISION 44

POLLUTION CONTROL EQUIPMENT

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Submittals to include but not limited to:
 - .1 Drum Scrubber unit.
 - .2 Scrubber headloss-flowrate curves for new and exhausted media.
 - .3 Media lifespan estimates
 - .4 Chemical media specifications, with minimum performance and physical characteristics, and MSDS information.
 - .5 Supply of all related accessories and spare parts.
 - .6 Include material data sheets, dimensional and layout data of all equipment.
 - .7 Installation and start-up instructions.
 - .8 Clearly identify material and options with an identification arrow.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of the drum scrubber equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Use a separate set of drawings to mark the variations from original drawings, as the work progresses, to complete record plans as specified in 01 78 00 Closeout Submittals.

1.3 MANUFACTURER'S REPRESENTATIVE

- .1 Use qualified workers who are fully familiar with this work and have a working knowledge of the system components.
- .2 Manufacturer shall have minimum 5 years experience in design, fabrication and testing of similar air purification systems. Supplier shall provide a list of names and dates of installations, if requested, for verification by the Departmental Representative.

1.4 CODE REGULATION

- .1 Install equipment according to the Manitoba Building Code.

1.5 EXTRA MATERIALS

- .1 Provide list, in operating manual, of manufacturer's recommended spare parts (i.e. bearings, seals), supplier addresses and special tools for adjusting, repairing or replacing.
- .2 Spare filters: In addition to filters installed for start-up and commissioning and prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

Part 2 Products

2.1 DRUM SCRUBBER

- .1 Provide a self contained, blow through style, dual bed, drum scrubber complete with media suitable for the adsorption of methane and hydrogen sulfide gas.
 - .1 The media shall be able to be removed from the scrubber by vacuum truck through a 400 mm diameter top mounted access cover.
 - .2 Drum 600 mm diameter, and of fiberglass construction, with vertical upward airflow direction. Provide 38 mm sample ports to check media. Provide 38 mm drain on bottom of the drum.
 - .3 Maximum drum scrubber skid dimensions to be 1.27 m wide by 1.34 m long by 1.55 m tall.
- .2 Provide mist/grease prefilter section.
- .3 The system shall include a fan blower with a 600V, 2hp, three phase, TEXP motor, providing minimum 71 L/s of air flow. Air flow to enter through the side of the fan enclosure, flow through the media drum and exit through the top of the drum through a 150 mm diameter exhaust connection.
- .4 All doors to have closed cell neoprene gasketing.
- .5 Unit to be class I, Division 2 rated. Provide explosion proof disconnect on wall beside unit.
- .6 Base frame to be epoxy coated mild steel
- .7 Provide remote mount control panel with Hand/Off/Auto control.
- .8 Electrical and control components shall be in NEMA 4X stainless steel enclosures for hydrogen sulfide protection

2.2 DRUM SCRUBBER MEDIA

- .1 Provide dual media system for treatment of hydrogen sulfide and methane gas. First media to be monitored by monitoring rod inserted in the drum. Second media to be a high efficiency media that changes colour once spent.

Part 3 Execution

3.1 DRUM SCRUBBER

- .1 Co-ordinate delivery of equipment with supplier.
- .2 Install in accordance with manufacturers recommendations.
- .3 Install Drum Scrubber on housekeeping pad. Co-ordinate with Division 3 on Housekeeping pad size.
- .4 Electrical installation to be by Division 26. Provide installation instruction to Division 26 as required.
- .5 Co-ordinate with Division 22 on placement of drain piping.
- .6 Install flexible duct connector between unit and galvanized ductwork.

3.2 TESTING AND BALANCING

- .1 Adjust and balance unit air flow delivery rate to manufacturer's balancing procedure.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data and revised shop drawings for hardware complete with pertinent details, colour charts, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 Closeout Submittals.

1.3 REFERENCES

- .1 ANSI Z245.60-2008, Waste Containers – Compatibility Dimensions.

Part 2 Products

2.1 PORTABLE WASTE CONTAINERS

- .1 Provide polyethylene roll out portable waste container with 360 Litre capacity, complete with lid, rear handle and heavy duty wheels, suitable for indoor and outdoor use.
- .2 Bins to meet ANSI Z245.60, Type B for compatibility for automatic lifters.
 - .1 Coordinate with bin lifting equipment. Refer to Section 41 23 23.
- .3 Provide 5 units.

Part 3 Execution

3.1 PORTABLE WASTE CONTAINERS

- .1 Deliver Waste Containers prior to startup of trash removal equipment.
- .2 During commissioning, position waste containers under each auger discharge and paint yellow lines around container to guide operators. Paint to be suitable for application over epoxy flooring.

END OF SECTION

DIVISION 46

WATER AND WASTEWATER EQUIPMENT

Part 1 General

1.1 GENERAL

- .1 This Section specifies the supply and installation of the sewage grinder, spiral screen and motor controller.
 - .1 Grinder, screen and motor control assembly designed to reduce and remove solids normally found in a correctional system sewage system.
 - .2 Provide 2 units, each suitable for a peak flow of 52.7 L/s, with a maximum headloss of 406 mm at a downstream water depth of 121 mm.
- .2 All equipment supplied under the Trash Grinding and Screening Equipment specification shall be supplied as a complete package from one supplier.
- .3 All components supplied shall be of the same manufacturer, be of the manufacturer's latest design, and under no circumstances shall system consisting of components be compiled by a manufacturer's distributor be accepted.

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples. Include all electrical wiring diagrams and installation drawings as well as the following:
 - .1 Equipment assembly schematics.
 - .2 A complete electrical wiring listing of all wiring to be completed by others between the various components.
 - .3 Component manufacturer's instructions and manuals.
 - .4 Spare part list.
 - .5 Job specific drawings.
 - .6 Provide specific information on the following items:
 - .1 Grinder
 - .2 Auger and Fine Screen
 - .3 Spray Cleaning System
 - .4 Control Panel
- .2 Include the shop drawing information in O&M manuals.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide detailed maintenance and operating instructions complete with schematic drawings diagrammatically illustrating the operation of equipment and system for incorporation into manual specified in 01 78 00 Closeout Submittals.
- .2 Obtain separate set of drawings and mark the variations as the Work progresses to complete record plans of equipment and services installed at variance with locations and methods shown on original drawings as specified in 01 78 00 Closeout Submittals.

1.4 REFERENCES

- .1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel.

- .2 ASTM A536-84(2019) e1, Standard Specification for Ductile Iron Castings.
- .3 CSA C22.2 No. 52-17; Underground secondary and service-entrance cables.
- .4 National Electrical Manufacturers Association (NEMA).

1.5 IDENTIFICATION

- .1 Identify each unit of equipment with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name and location

1.6 MANUFACTURER'S REPRESENTATIVE

- .1 Use qualified workers who are fully familiar with this work and have a working knowledge of the system components.
- .2 Manufacturer and control panel programmers shall have minimum 5 years experience manufacturing and supporting two-shafted grinding equipment, inclined augers and motor controls with a minimum of 500 installations of similar equipment. Supplier shall provide a list of names and dates of installations, if requested, for verification by the Departmental Representative.
- .3 Factory test all components to ensure satisfactory operation prior to shipping.
- .4 Be thoroughly familiar with governing regulations having jurisdiction on this project.
- .5 Commissioning.
 - .1 Refer to Section 01 91 13 Commissioning.
 - .2 Refer to Section 01 79 00 Demonstration and Training.
 - .3 Commissioning to include a trained manufacturer's representative to:
 - .1 Inspect all wiring and tagging
 - .2 Verify correct operation and control of equipment. Simulate high levels to start both augers.
 - .4 Training after commissioning and follow-up training.
 - .1 Utilize the O&M manual in the training sessions.
 - .2 Provide a written report after each training trip on:
 - .1 Operating conditions and parameters upon arrival at site.
 - .2 Instruction provided.
 - .3 Comparison of present operation to past observations with related recommendations.

1.7 SHIPPING

- .1 Coordinate timing of shipment of equipment with General Contractor. Units are to be shipped to in accordance with Section 01 00 00.
 - .1 Others will inspect equipment and advise if there is any damage is due to manufacture or shipping. If there is any damage, complete all required recoating in accordance to manufacturer's instructions to provide the same durability as factory coating. Provide detailed records of all repair locations and procedures.
 - .2 Offloading from truck and placing units into position by others.
 - .3 Provide detailed off loading, placement and assembly instructions.

- .2 Indicate clearly which equipment must be protected against physical damage, corrosion, dampness, precipitation, etc.
 - .1 Wrap equipment during shipping for protection from weather including rain, bugs, spray, etc.
 - .2 Crate electrical panels separately off unit.
 - .3 Provide suitable packaging/crating to protect equipment and to facilitate loading and off-loading.
 - .4 Tag all packages and crates.
 - .5 Indicate all crates which require indoor storage.
- .3 Shipping to be in accordance with the following:
 - .1 Provide a Bill of Materials to Departmental Representative and General Contractor prior to shipping to site.
 - .2 Deliver equipment and appurtenances in a condition satisfactory to the Departmental Representative and any omissions, discrepancies or damage evident on delivery shall be "repaired" and "made good".
 - .3 The General Contractor's representative at the job site shall sign the carrier's pro bill to indicate receipt of the required number of crates, packages, skid, etc., and shall note thereon any apparent shortages of or visible damages to the crates, packages, skid, etc. In the event of shortages or damages in the equipment delivered, The General Contractor shall notify the treatment unit supplier of related notations in writing.
- .4 The General Contractor shall be responsible for storage of the material and equipment delivered to the site. Be responsible for providing the General Contractor with full instructions in writing of all precautions to be observed in connection with the storing and protection of the equipment. Provide a copy of such instruction to the Departmental Representative.
- .5 Loading of skids, equipment and accessories by others. Provide qualified personnel on call by phone during mechanical works.
- .6 After unit is installed, inspect unit inside and out for any damage including scratches.

1.8 OTHER TRADES

- .1 Examine specifications and drawings relating to work of other trades which may affect installation of this work.
- .2 Where contradictions in specifications and drawings are implied, obtain ruling from Departmental Representative. Where ruling is not obtained, include the item or arrangement of better quality, greater quantity, or higher cost.

1.9 ACCESSIBILITY

- .1 Install equipment under this contract with adequate clearances for head room, passage, operation and service.

1.10 TESTS

- .1 Provide and document tests on equipment, systems and materials as may be requested by the Departmental Representative.

- .2 Carry out tests for such reasonable lengths of time and at such a time as determined by Departmental Representative before final completion and acceptance of work to verify performance requirements.
- .3 Completion of tests is not evidence of acceptance of tested part of contract.
- .4 No claim for damage will be made by the Supplier for injury or breakage of parts during tests if caused by the negligence or willful misconduct of the Supplier or its subcontractors. No claim for damage will be made by the Departmental Representative against Supplier for injury or breakage of parts during tests unless caused by the negligence or willful misconduct of the Supplier or its subcontractors.

1.11 ELECTRICAL

- .1 Electrical equipment supplied under this section shall be CSA approved and bear CSA labels. Motors shall be tested to NEMA standards or CSA C22.2 No. 52 and shall conform to insulation and dielectric strength.
- .2 Motors shall have conduit terminal boxes and adequate starting protective equipment as defined by the local power utility.
- .3 Use equipment compatible to 600V three phase service for motors larger than 2 hp.
- .4 Control circuit to be 120 V single phase.

Part 2 Products

2.1 SUPPORT SYSTEM

- .1 The support frame and additional supports shall be of welded square tube, angle, and plate construction. The construction material shall be 304 stainless steel.
 - .1 Grinder will be placed a 610 mm wide by 900 mm deep concrete channel.
 - .2 Auger will be placed in a 610 mm wide by 900 mm deep concrete channel within a 3550 mm deep basement. Pivot arm for auger will be placed on the floor above the basement.

2.2 GRINDER

- .1 Grinder assembly shall include cutters, spacers, shafts, bearings and seals, side rails, end housings, covers reducer and motor.
 - .1 Suitable to grind the incoming organic and inorganic material to a typical shred size that would not exceed 13 mm by 13 mm by 10 mm.
- .2 The grinder shall be of two-shaft design and be capable of continuous operation, processing wet or dry. Bar screens or single shaft devices utilizing a single rotation cutter bar with stationary cutters shall not be accepted. Grinder designed with cutter and spacer cartridges rather than individual cutters shall not be accepted.
 - .1 Two (2)-shaft design shall consist of two (2) parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The two (2) shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft. Cutter diameters on the drive and driven shafts shall be of equal diameter.
- .3 Individual Cutters and Spacers.

- .1 Shall be a nominal height of 457 mm.
 - .2 Shall be AR500 abrasion resistant alloy steel, surface ground for uniformity with a hardness of 50-52 HRC.
 - .3 The inside configuration of both the individual cutters and the individual spacers shall be hexagonal so as to fit the shafts with a total clearance not to exceed 0.38 mm across the flats to assure positive drive, minimize wear on the cutters.
 - .4 Cutter configuration shall consist of individual 11 tooth cam cutters on both shafts. To maintain particle size, the height of the tooth shall not exceed 13 mm above the root diameter. Cutter to cutter root diameter overlap shall be not less than 1.6 mm or greater than 6 mm to maintain the best possible cutting efficiency while incurring the least amount of frictional losses. Clearance between overlapping cutters of opposing shafts shall be no greater than 0.28 mm.
 - .5 The cutters shall exert a minimum force at the tooth tip of 9,658 N/kW during momentary load peaks.
- .4 Shafts
- .1 Grinder drive and driven shafts shall be made of 4140 heat treated hexagon steel with a tensile strength rating of not less than 1,027 MPa.
 - .2 Each hexagonal shaft shall measure a nominal 64 mm across parallel surfaces.
- .5 Shaft Bearings and Seals
- .1 The radial and axial loads of the cutter shafts shall be borne by sealed, oversized, deep-groove ball bearings at each end.
 - .2 The bearings shall be protected by a combination of a replaceable and independent tortuous path device and mechanical seals.
 - .3 Face materials shall be of tungsten carbide to tungsten carbide.
 - .4 O-rings shall be made of Buna-N elastomers.
 - .5 Products requiring continuous or occasional lubrication or flushing shall not be accepted. The mechanical seal shall be rated at 620 kPa continuous duty by the seal supplier.
 - .6 The bearings shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The seal elements shall be independent of the stack height; therefore cutter stack tightness shall not affect seal performance. The seal elements shall maintain their factory set preload independent of the cutter stack tightness.
 - .7 Seals shall meet required pressure rating regardless of cutter stack fit. The seal cartridge shall provide seal protection against axial loading on shafts and bearings during shaft deflection.
 - .8 Each seal element shall be positively locked to its corresponding rotating or static cartridge element. This positive lock on the seal elements is critical to long seal life in applications where grit or other abrasive materials are present.
- .6 Side Rails
- .1 The inside profile of the side rails shall be concave to follow the radial arc of the cutters.
 - .2 Clearance between the major diameter of the cutter and the concave arc of the side rails shall not exceed 7.9 mm.

- .3 The side rails shall have evenly spaced slots that increase flow and decrease head loss.
- .4 The side rails shall be cast of A536-84 ductile iron.
- .7 End Housings and Covers
 - .1 Grinder end housings shall be of cast A536-84 ductile iron with a cast-in-place flow deflector, designed to protect the bushings while guiding particles directly into the cutting chamber.
 - .2 Top covers shall be A536-84 ductile iron and bottom covers shall be A36 hot rolled plates.
- .8 Reducer
 - .1 The speed reducer shall be a grease-filled planetary-type reducer with a 500% shock load capability. The reduction ratio shall be 43:1.
 - .2 The input shaft of the reducer shall be directly coupled to the motor using a three-(3) piece coupling, and the output shaft of the reducer shall be directly coupled with the grinder using a two (2)-piece coupling.
- .9 Motor
 - .1 The motor shall be 7.5 kW, TEFC, 1725 rpm, 575 volt, 3 phase, 60 Hz.
 - .2 Motor service factor shall be 1.15, the efficiency factor not less than 85% at full load and the power factor not less than 80% at full load.
 - .3 Required Running Torque per kilowatt:
 - .1 At Momentary Load Peaks: 922 Nm/kW.

2.3 AUGER

- .1 General
 - .1 The auger(s) shall be comprised of a perforated screen segment, transport segment, discharge segment, and drive segment with an internal rotating spiral.
 - .2 Each auger shall be installed at an inclination of 45 degrees from horizontal immediately downstream of the grinder.
 - .3 The auger screen segment trough with a rotating spiral shall provide particle capture and transport to the discharge segment outlet.
 - .4 A wiper/brush shall be affixed to the outer edge of the spiral in the screen segment trough to provide trough cleaning and particle transport. The wastewater shall be permitted to pass through the screen segment and flow downstream.
 - .5 Particles shall be washed both by the highly-agitated passing wastewater and by the discharge of a spray wash system. Dewatering shall occur as the rotating spiral conveys the washed screenings.
 - .6 A spray wash assembly shall be provided to rinse the organic material from the processed solids back into the waste stream. The spray wash system shall consist of a set of nozzles proving a covering spray of water for cleaning the captured solids along with a set of nozzles providing an impact spray to hold the solids against the screen trough for transportability. A spray wash solenoid valve shall be automatically energized by the system controller allowing wash water to spray into the screen segment whenever the auger spiral is in operation. The spray

wash solenoid shall be automatically de-energized, stopping the flow of wash water whenever the auger spiral is stopped.

- .7 Starting of auger run cycles shall be initiated by signals from an ultrasonic level sensor.

- .2 Components

- .1 Spiral

- .1 The 480 mm diameter spiral shall be made of high wear-resistant, alloy carbon steel.
 - .2 The spiral shall have a groove designed into the outside diameter of the spiral for the mounting of the brush. The groove shall securely position the brush so that constant contact is maintained with the screen segment for the purpose of cleaning the perforations and the free passage of soft organics and liquids. Spirals that mount the brush to the face of the spiral shall not be acceptable.
 - .3 The spiral shall have a welded drive plate for connection to the drive shaft.
 - .4 The spiral tip speed shall not be more than 0.27 m/s.
 - .5 The spiral transport speed shall not be more than 0.03 m/s.

- .2 Screen Segment

- .1 The screen segment trough shall be a replaceable, perforated stainless steel assembly. The perforated area of the segment shall be constructed of 1.98 mm sheet.
 - .2 The screen trough perforations shall be 6 mm for separation of the liquids from the solids. The sharp edges of the perforations shall be removed.

- .3 Transport Segment

- .1 The transport segment shall be a stainless steel assembly with inspection port(s). The segments shall be constructed of 3.57 mm sheet.
 - .2 The transport segment shall have stainless steel wear bars to support the rotating spiral.

- .4 Discharge Segment

- .1 The discharge segment shall be a stainless steel assembly with an inspection port and a full-width bottom discharge flange. The segment shall be constructed of 3.57 mm sheet.
 - .2 The discharge segment shall have a stainless steel endplate for mounting the drive segment.

- .5 Drive Segment

- .1 The drive segment shall be comprised of a drive shaft with welded drive plate, shaft seal, drive adapter spool, speed reducer and electric motor.
 - .2 The shaft seal shall consist of a packing housing; four (4) PTFE impregnated packing cords, and adjustable packing ring.
 - .3 The drive adapter spool shall be cast A536-84 ductile iron coated to inhibit corrosion.
 - .4 The speed reducer shall have a reduction ratio of 160:1.

- .5 The electric motor shall be of 1.5 kW, TEFC, 1725 rpm, 575 volt, 3-phase, 60-Hz.
- .6 Spray Wash Assembly
 - .1 Spray Wash Assembly shall consist of a one (1) inch spray wash manifold, solenoid operated valve, manually operated ball-valve, and a remotely installed basket strainer.
 - .2 The spray wash manifold shall be of stainless steel pipes and fittings. The spray nozzle shall consist of 40° "V" spray nozzles rated for 0.094 L/s @ 275 kPa and high impact 50° spray nozzles rated for 0.063 L/s @ 275 kPa.
 - .3 The solenoid valve shall be of bronze construction, fitted with an explosion proof enclosure, housing a 120 volt, ac coil.
 - .4 The manually operated ball valve shall be of 316 stainless steel and shall provide adjustment for the spray wash water flow.
 - .5 A 25 mm NPT strainer shall be of SST material, with an 80 mesh 304 stainless steel screen and a threaded drain.

2.4 LEVEL SENSORS

- .1 Refer to Section 40 72 00

2.5 MOTOR CONTROLLERS

- .1 General
 - .1 The controller shall provide independent control both grinders, augers and spray washes.
 - .1 Valves are sluice gate type with electric actuators, and will be supplied by Sections 40 05 51 and 40 05 57. Control of valves will by Division 25.
 - .2 The control panel will receive inputs from ultrasonic level sensors that measure level in the channel
 - .1 US-102 – Level before Grinder 1.
 - .2 US-103 – Level before Grinder 2.
 - .3 US-106 – Level after Fine Screen 1.
 - .4 US-107 – Level after Fine Screen 2.
 - .3 The control panel will receive run signals from the building PLC to operate the grinder and augers when the control panel is in remote mode. The control panel will send all run statuses and fault outputs to the PLC. The PLC will operate the grinders and augers in both channels on high water level.
 - .1 PLC by Division 25.
 - .4 Controller shall be UL/cUL listed.
- .2 Operation
 - .1 The controller shall be equipped with a GRINDER ON-OFF/RESET-REMOTE three (3) position selector switch for each grinder.
 - .1 In the OFF/RESET position the grinder shall not run.
 - .2 In the ON position the grinder will run.

- .3 In the REMOTE position the grinder shall start and stop as controlled by a remotely located contact in the control panel.
- .4 The grinder shall only be reset by switching the GRINDER ON-OFF/RESET-REMOTE switch to the OFF/RESET position.
- .2 The controller shall be equipped with an AUGER ON-OFF/RESET-LEVEL three (3) position selector switch for each auger.
 - .1 In the OFF/RESET position the auger shall not run.
 - .2 In the ON position the auger shall continuously initiate Auger Run Cycles.
 - .3 In the LEVEL position, auger run cycles shall be initiated by the ultrasonic level sensors or the Level Sensor Backup Timer. Auger Run Cycles in the LEVEL position shall only be enabled when the grinder is running.
 - .4 The auger shall only be reset by switching the AUGER ON/OFF/RESET-LEVEL switch to the OFF/RESET position.
- .3 The controller shall be equipped with a digital operator interface.
 - .1 The operator interface shall display grinder and auger run times, elapsed times, reversals, jams, motor overloads and over-temperature occurrences.
 - .2 The operator interface shall display Fail, Service Reminder, and Operational Messages.
 - .3 Operator interface function keys shall select the following displays: Date and Time, Auger Run Cycle, Auger Start Time Interval, and System Monitor.
 - .4 The Auger Cycle Run times, and Level Sensor Backup Timer shall be programmable. Settings shall be entered at the operator interface using panel keys to initiate a desired run sequence.
- .4 The controller shall be equipped with a programmable Level Sensor Backup Timer.
 - .1 The Level Sensor Backup Timer shall initiate an auger run cycle if the ultrasonic sensor fails to start an auger cycle within a preset interval of 0 to 999 minutes.
 - .2 The Level Sensor Backup Timer shall run the system continually when the timer is set to 0.
- .5 Control Sequence
 - .1 Under normal flow conditions, operate each grinder and auger train will be operated in a lead lag configuration.
 - .2 When a grinder jam condition occurs in the grinder ON or REMOTE mode the controller shall stop the grinder and reverse grinder rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. Up to two additional reversing cycles (3 times total) may occur within 30 seconds before the controller de-energizes the grinder motor and activates the grinder fail indicator and relay. On grinder failure the PLC will also shut down the auger and switchover to the lag grinder and auger train.
 - .3 When an auger jam condition occurs in the auger ON or LEVEL modes the controller shall stop the auger, and reverses auger rotation to clear the

obstruction. If the jam is cleared, the controller shall return the auger to normal operation. One additional auger reversal (2 times total) may occur within 30 seconds before the controller de-energizes the auger motor and activates the auger fail indicator and common fail relay. On auger failure the PLC will shut down stop the grinder and switchover to the lag grinder and auger train.

- .4 If a power failure occurs while a grinder or auger is running, operation will resume running when power is restored.
- .5 If a power failure occurs while the grinder or auger is in a fail condition the fail indicator shall be reactivated when power is restored.
- .6 The controller shall provide overload protection for the motor through an overload relay mounted directly on the grinder and auger starters.
- .7 The controller shall be equipped with a main power disconnect switch. Motor branch circuits shall be short circuit protected.
- .8 Controller reset shall be from the local panel controls only.

.3 Components

.1 Enclosure

- .1 Enclosures shall be minimum NEMA 12 and shall be suitable for wall mounting.
- .2 Enclosure shall house the control devices, relays, terminal blocks and reversing motor starters.

.2 Control Devices

- .1 Operator interface and pilot devices shall be mounted on the enclosure front panel door.
- .2 The controller shall have indicator lights for GRINDER RUN, AUGER RUN, and common FAIL.
- .3 POWER ON, GRINDER JAMMED, AUGER JAMMED, GRINDER MOTOR OVERLOAD, AUGER MOTOR OVERLOAD, GRINDER MOTOR OVERTEMP, and AUGER MOTOR OVERTEMP, LEVEL SENSOR 1 FAILED, LEVEL SENSOR 2 FAILED and HIGH LEVEL ALARM shall be displayed by the operator interface.
- .4 Control devices are mounted in the front panel of the enclosure. Indicator lights shall be LED type pilot lights. Lights and the selector switches shall be heavy duty NEMA 4X type.
- .5 Control transformer shall be protected by two primary fuses and one secondary fuse. The 120 volt secondary shall have one leg grounded.
- .6 Relay contacts shall be included for GRINDER RUN, AUGER RUN, and common FAIL signal outputs. The contacts shall be rated 10 ampere, 240 VAC, resistive load.
- .7 Provide required communication components to send all alarms to the Trash Removal Building PLC.

.3 Motor Starters

- .1 Starters shall be a full-voltage reversing type with 120 volt operating coils.
- .2 Forward and reverse contactors on the starters shall have both mechanical and electrical interlocks.

- .3 Overload relays (OL) shall be adjustable so that the range selected includes the full load amperes (FLA) rating and service factor.

Part 3 Execution

3.1 GENERAL

- .1 Support system, grinders, augers, and motor controller shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, local, state, and federal codes and regulations.
- .2 Coordinate delivery of all material with treatment unit supplier.
- .3 Be responsible to record any damage during off loading.
- .4 Obtain approved manufacturer's drawings and instructions for the installation of the equipment.
- .5 Assemble and install all electrical and mechanical connections to the skid supplied equipment and components and fittings.
- .6 Start up and training. Utilize the most stringent as outlined in specifications.

3.2 CONTROL PANELS

- .1 Obtain manufacturer's drawings and instructions for the installation of the equipment.
- .2 Install all control systems as specified.
- .3 Mount all control panels.
- .4 Make all mechanical and electrical connections to the various skid and unit mounted components.
- .5 Coordinate between the different contractors in the connection of components.
- .6 Complete connections for wiring connections as outlined above.
- .7 Integrate treatment unit and all panels and controls with all related SCADA components.

3.3 START UP AND ADJUSTMENT

- .1 Coordinate installation with treatment unit supplier.
- .2 Upon completion of installation, operate equipment as required to test, adjust and regulate controls and equipment provided under this and other sections.
- .3 Adjust and place in operating condition.
- .4 Simulate water levels as required to test operation under high flow conditions.

3.4 TRAINING

- .1 Coordinate and schedule training schedules with other systems and equipment agents as required to complete overall contractual requirements to ensure there is no overlap between various systems and operator time as available (i.e. do not schedule training systems from different personnel at the same time).

END OF SECTION

APPENDIX A

Geotechnical Report

**SMI Sewer Trash Removal System
Stony Mountain Penitentiary, Manitoba**

14 August 2018



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Geotechnical Report
SMI Sewer Trash Removal System
Wood Project Number – WX18547



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Appendix A

Test Hole Logs
Explanation of Terms and Symbols

1.0 Introduction

At the request and authorization of Mr. Jason Cousin of J.R. Cousin Consultants (JRCC), Wood Environment & Infrastructure Solutions, and division of Wood Canada Limited (Wood), completed the geotechnical investigation outlined in this report for design and construction of the proposed new sewer trash removal system at the Stony Mountain Penitentiary in Stony Mountain, Manitoba. The purpose of the geotechnical investigation was to investigate subsurface soil and groundwater conditions at the Site in order to provide geotechnical recommendations for the following:

- Design and construction of suitable foundation alternatives (ultimate limit state and serviceability limit state parameters), anticipated to consist of shallow strip or pad footings, raft slab, or drilled cast-in-place end bearing piles;
- Lateral earth pressures on permanent below grade walls,
- Drainage and subdrainage;
- Subsurface concrete requirements;
- Construction Monitoring and Testing; and
- Comments on unusual conditions or potential construction difficulties.

This investigation was completed in accordance with the scope of work and terms and conditions outlined in Wood Proposal No. WPG2017.663 dated 24 November 2017. Signed authorization to proceed with the scope of work was received from J.R. Cousin Consultants on 28 May 2018, Purchase Order Reference R-325.56.

2.0 Site and Project Description

2.1 Existing Site Conditions

The proposed site of the new SMI Sewer Trash Removal System (the 'Site') illustrated in Figure 1 is located within the minimum security grounds of the Stony Mountain Penitentiary, approximately 40 m west of the existing gravity sewer. The Site is located within the northwest quadrant of Section 2, Township 13, Range 2 east of the primary meridian (SE2 13 2EPM). At the time of the geotechnical investigation, the Site was vacant with relatively flat topography and approximate grade elevations of 239.2 to 239.3 m as determined at the test hole locations.

2.2 Project Description

Based on discussion with JRCC, Wood understood that the proposed Sewer Trash Removal building will include a cast-in-place chamber extending to the existing gravity sewer located at approximate elevation 235.5 m. In this regard, it is anticipated that the chamber will be founded at approximate elevation 234.5 m. Following preliminary discussions of the findings at the test hole locations, JRCC, with the support of Wood, identified shallow footings on bedrock as the preferred foundation alternative for support of the chamber, and shallow footings on undisturbed till as the preferred foundation alternative for support of the building. A structurally supported slab on footings was also selected as the preferred main floor alternative so as to mitigate slab performance risks associated with potential settlement of backfill beneath the slab used in backfill the excavation required for construction of the chamber. The total and differential self-weight settlement potential of compacted silt till and/or gravel fill could be expected to range from 1 to 4 percent of the fill thickness, depending on compaction level achieved.

3.0 Geotechnical Investigation

Prior to initiating drilling, Wood notified public utility providers (i.e. Manitoba Hydro, MTS, Shaw, etc.) of the intent to drill in order to clear public utilities, and where required, met with said representatives on-site. Wood also retained McCaine Electric to scan the selected test hole locations for private utilities prior to drilling.

On 22 June 2018, Wood supervised the drilling of three test holes (TH01 through TH03) at the approximate locations illustrated in Figure 1. All test holes were advanced to auger refusal between 2.7 and 3.2 m below grade (El. 236.0 to 236.5 m) using a truck mounted drill rig equipped with 125 mm diameter solid stem augers; operated by Maple Leaf Drilling Ltd. of Winnipeg, Manitoba.

Given refusal depths above existing gravity sewer invert elevation 235.5 m, and above the anticipated foundation elevation for the below grade chamber for the new trash removal system, Wood advised JRCC that coring should be undertaken adjacent to any one of the three test hole to further investigate the refusal mechanism (i.e. refusal in very dense till, or bedrock) and to aid in the selection of the preferred foundation options for the proposed structures. On 27 June 2018 and on receipt of approval from JRCC, coring to approximately 7.4 m below grade (El. ± 231.8 m) was undertaken approximately 1.0 m south of TH01 (TH01A) after rapidly advancing the test hole to auger refusal approximately 3.4 m below grade.

During drilling and coring, Wood field personnel visually classified the soil stratigraphy within the test holes in accordance with the Modified Unified Soil Classification System (MUSCS); as well as noted observed seepage and/or sloughing conditions. Soil sampling at TH01 through TH03 consisted of grab samples of the auger cuttings and split spoon samples of the glacial till which were collected in conjunction with in-situ Standard Penetration Tests (SPTs). Soil sampling at core hole TH01A consisted of recovered core below 3.4 m grade only. The relative density of glacial till was evaluated during drilling at TH01, TH02, and TH03 using standard penetration tests (SPTs), where the number of blows to drive the split spoon sampler 0.3 m into the soil was recorded. The recorded SPT results are shown on the test hole logs as the SPT (N) value where the standard sampler was driven 450 mm (i.e. three full consecutive sets). In instances where full penetration of the standard sampler was not achieved, the number of blows per each complete 150 mm increment and each partial increment are shown on the logs, accompanied by the penetration (in mm) of the partial increment. All grab samples and split spoon samples were retained in sealed plastic bags and shipped to Wood's Winnipeg laboratory. Similarly, recovered core was retained in a wooden core box and shipped to Wood's Winnipeg laboratory for review and classification of Rock Quality Designation (RQD).

Upon completion of drilling at each of test holes TH01, TH02, and TH03, the test hole was left open for 5 to 10 minutes and the depths to accumulated slough and groundwater level were measured prior to backfill. Upon obtaining the measurement, all test holes were subsequently backfilled to grade with bentonite and auger cuttings. TH01A was backfilled immediately upon completion of coring.

Following completion of the field drilling program, a laboratory testing program was conducted on selected soil samples obtained from the test holes. The laboratory testing program consisted of moisture content determinations.

Detailed test hole logs summarizing the sampling, field testing, laboratory test results, and subsurface conditions encountered at the test hole locations are presented in Appendix A. Actual depths noted on the test hole logs may vary by ± 0.3 m from those recorded due to the method by which the soil cuttings

are returned to the surface. Summaries of the terms and symbols used on the test hole logs and of the Modified Unified Soil Classification System are also presented in Appendix A.

4.0 Subsurface Conditions

4.1 Stratigraphy

Consistent with the regional geology and anticipated conditions, the stratigraphy at the test hole locations consisted of the following, in descending order from grade level:

- Topsoil
- Glacial Till
- Limestone Bedrock

A brief description of each of the soil layers bulleted above is presented in the following sub-sections. For detailed descriptions, Wood's test hole logs in Appendix A should be consulted.

4.1.1 Topsoil

Approximately 150 mm of topsoil was encountered at the surface of each of the test holes, and was described as consisting of moist, highly plastic clay. It should be noted that the thickness of topsoil may vary from that encountered at the test holes.

4.1.2 Glacial Till

Silt till was encountered beneath the topsoil at each of the test hole locations, and was confirmed through auger refusal at each of the test holes locations between 2.7 m to 3.4 m below existing grade (El. 235.8 to 236.5 m). Coring beyond auger refusal was undertaken at TH01A only, with only 12 percent sample recovery between 3.4 m and 4.6 m below grade, and based on the nature of the fragments, it is possible till extended to first rock core recovery approximately 4.6 m below grade (El. 234.6 m).

The silt till was described as containing trace clay and trace sand and gravel with occasional high plastic clay inclusions, and was low plastic, damp to moist, compact to very dense, and light greyish brown to light brown. Moisture contents in the till predominantly ranged from 4 to 14 percent, with moisture contents in the range of 17 to 22 percent observed where frequent highly plastic clay inclusions were observed. SPT results ranged from 21 to 23 blows to SPT refusal of 25 mm of penetration for 20 blows.

4.1.3 Limestone Bedrock

Bedrock beneath the till was confirmed at TH01A at an approximate depth of 4.6 m below grade (El. 234.6 m). The bedrock was comprised of biomicritic limestone (a form of limestone consisting of fossil fragments in a sedimentary matrix derived from calcite mud) described as strong (inferred), slightly weathered, and of fair quality with RQD values of 62 to 63 percent assessed for the recovered core. Embedded within the limestone at approximately 5.5 m below grade (El. 233.7 m) was a completely weathered, medium plastic, moist, very stiff to hard, reddish brown mudstone layer.

4.2 Auger Refusal

Solid stem auger refusal occurred in each of the test holes advanced at the site at depths of between 2.7 m to 3.4 m below existing grade, or between elevations 235.8 to 236.5 m.

4.3 Groundwater and Sloughing Conditions

Seepage and sloughing conditions were noted during drilling, and the depth to the accumulated slough and water levels about ten minutes after completion of each of test hole TH01, TH02 and TH03 were measured prior to instrumentation and/or backfilling. Recorded observations are summarized in Table 4-1. Due to the introduction of casing and water for coring at TH01A, measurements were not undertaken at TH01A.

Table 4-1 Summary of Sloughing and Groundwater Observations

Test Hole ID	Surface Elevation	Drill Depth (m)	During Drilling		Upon Completion	
			Sloughing Zone	Seepage Zone	Depth to Slough (m)	Depth to Groundwater (m)
TH01	239.2	3.2 (AR)	Below 2.1 m	None	2.3 m	None above slough level
TH02	239.3	2.9 (AR)	Below 2.3 m	None	2.3 m	None above slough level
TH03	239.3	2.7 (AR)	Below 1.2 m	None	2.0 m	None above slough level

It should be noted that only short-term seepage and sloughing conditions were observed and that groundwater levels can fluctuate annually, seasonally, or as a result of construction activity.

Wood undertook a review of available GWD drill water well records for additional groundwater information. Where grade elevation and pump test information were reported, groundwater levels in wells located within a radial distance of 1 km from the site varied between approximate elevation 232.2 m and 233.3 m prior to pumping.

5.0 Temporary Excavations

5.1 Sloped Excavations

Generally, conventional trench excavations with cut slopes are considered to be appropriate for the soil conditions encountered at the test hole locations, however, it should be noted that the silt till is considered highly sensitive to erosion and 'wash-out' in the presence of run-off or flowing groundwater conditions. In this regard, additional precautions to protect the slopes from exposure to precipitation and run-off is required to maintain excavation stability and reduce the potential for over steepening of the excavation slopes. Furthermore, construction planning should be directed at minimizing the length of time an excavation is left open. Risks associated with sloped excavations should consider the proximity of excavations to surrounding property lines and adjacent structures including utilities, and the potential impacts to the project should a temporary slope fail or need to be stabilized during construction.

Regulations set forth by Manitoba Workplace Health & Safety must be followed for all excavations. Excavation works should be undertaken by an experienced contractor, and workers should not be allowed into open excavations without proper protection and appropriate confined space training. As a minimum requirement, the side walls of short term temporary excavations extending to a maximum excavation depth of 5 m below grade should be cut no steeper than 1H:1V where entrance into the excavation is required. Flatter sideslopes (i.e. 2.5H:1V or flatter) or benching may be required if the silt becomes saturated or erodes during construction, or if the duration of excavation is exceedingly long. 'Short term'

is generally defined as excavations with a duration of approximately one month or less; however, the specific duration is dependent on the soil and groundwater conditions encountered. Therefore, it is important that, all excavations be reviewed by Wood periodically throughout the duration of construction to confirm that they are behaving as anticipated and to provide revised recommendations if required.

All excavations should be monitored on an ongoing basis and inspected regularly by the geotechnical engineer of record for signs of instability. If sloughing of the sidewalls is observed, the cut slope angle should be flattened until a stable angle of repose for the soil has been attained. Alternatively, if sloughing of the upper soils somewhere within the excavation depth is an issue, a benched excavation could be maintained at the interface of the unstable and stable soils to allow a collection area for sloughing of the upper soils. If space is insufficient to allow for a sloped excavation, or if the duration of the excavation is exceedingly long, Wood should be contacted to provide geotechnical design values for shored excavations. Where signs of instability (i.e. tension cracks, sloughing soils, toe bulging, etc.) are detected, these conditions should be brought to the immediate attention of Wood so that appropriate solutions to the problem areas can be determined.

Surface drainage should be directed away from the crest of the excavations and the side slopes should be protected from exposure to precipitation and surface run-off. Furthermore, all temporary surcharge loads, including stockpiles of materials and excavated soil, should be kept back from the excavated faces a distance of at least the depth of the excavation. Likewise, wheel loads should be kept back at least 1 m from the crest of the excavation.

Based on the seepage observations and review of water levels at nearby wells (GWDrill records) discussed in Section 4.3, excavation dewatering during construction is not considered to be a significant issue at this site. If water bearing sand or other soil lenses or stringers are encountered within the till, it is anticipated dewatering of sloped excavations extending no more than 5 m below existing grade can be accomplished through sloping excavations to localized sumps.

5.2 Backfill

Backfill material and quality requirements for excavations should be assessed during design from the standpoint of performance requirements, such as bedding and support requirements for underground utilities, drainage requirements along foundation walls, and long term settlement limits of fill required to mitigate risks and impacts to grade supported structures (i.e. grade supported slabs, pavements, etc.) and/or surface grading and drainage. For this project, it was anticipated backfill requirements will be mostly limited to backfill along the perimeter of the cast-in-place chamber, footings, grade beams, and within utility trench installations.

Excavations at the perimeter of the structure (grade beams, pile caps, etc.) should be backfilled with moderately to well compacted fill compacted to between 95 percent and 100 percent of Standard Proctor Maximum Dry Density (SPMDD). Backfill material selection and compaction specifications should consider the following:

- All backfill should be free of excessive (i.e. greater than 6% by weight) organic content and of any deleterious material such as tree roots, litter, silt pockets, etc.
- Common fill at the Site resulting from anticipated excavation depths of up to 5 m below existing grade is expected to consist of a mix of topsoil (highly plastic organic clay) and silt till, with silt till comprising the predominate soil type.

- Silt till encountered at the site should be avoided for use as fill material. Primary issues with using silt till as fill material include frost susceptibility and high sensitivity to rutting, shoving, and loss of stability due to changes in moisture level during placement and compaction.
- The permeability of the in-situ very dense silt till at the site is expected to be one or more orders of magnitude lower (i.e. slower) than that of gravel fill. In this regard, use of gravel fill below final grade creates a “bathtub” effect. Measures should be taken to direct surface drainage from gravel fill, and sub-drainage should be provided to maintain drained conditions where there is potential for groundwater accumulation within gravel fill.
- The upper 0.3 m of all excavations subject to overland flow should be backfilled with a moderately to well compacted clay cap to reduce the potential for surface water infiltration into the underlying backfill.
- To mitigate potential settlement, trench backfill should be compacted to a minimum 95 percent of SPMDD within landscaped areas and to a minimum of 98 percent of SPMDD within the upper 1 m of areas requiring subgrade support, at soil moisture contents at or slightly above Optimum Moisture Content to achieve the desired compaction target. More stringent backfill criteria may be required for pipe support, and the pipe manufacturers specifications should be referenced in this regard.
- For granular fill materials, settlement due to self-weight is expected to be in the range of 1 to 2 percent of the fill thickness for fill compacted to 95 percent of SPMDD; and in the range of 0.5 to 1 percent of the fill thickness for fill compacted to 98 percent or more of SPMDD.

6.0 Foundations

6.1 General Discussion

The stratigraphy and soil conditions encountered within the test holes advanced at the Site are considered typical of conditions within the geologic setting (i.e. within the Lake Agassiz Basin). Geotechnical conditions considered by Wood to be ‘unusual’ based on local experience and local construction practices were not encountered. Shallow spread footings bearing on till and/or bedrock are considered suitable for support of the CIP chamber and Trash Removal Building.

6.2 Spread Footings

6.2.1 Geotechnical Bearing Resistance

The bearing pressure available for use in determining the unfactored geotechnical resistance of a spread footing is a function of various factors, including footing geometry, embedment depth, and the amount of foundation movement that can be accommodated prior to development of an ultimate limit state condition within the supported structure/building. In this regard, variable bearing pressures can be used for specific footing configurations where required. For current design purposes, the bearing pressures recommended here-in conservatively assume a strip footing of infinite length having a minimum width of 0.6 m.

Assuming final grades will not vary by more than 0.3 m from existing grade, conventional spread footings may be designed on the basis of embedment depth and anticipated soil bearing conditions using the unfactored (ultimate) bearing pressures presented in Table 6-1, subject to inspection and approval of all bearing surfaces by a qualified geotechnical engineer at the time of construction. It should be noted that some of the embedment depths presented in Table 6-1 are shallower than the depth of frost (i.e. 2.4 m below grade), and that footings bearing at depths shallower than the depth of frost will require insulation

for protection from frost. Further discussion on frost is provided in Section 8.0. Wood can provide recommendations for insulation upon request.

It should be strictly noted that the recommended design bearing pressures has been provided assuming an Ultimate Limit State defined by plastic soil deformation and geotechnical failure of the footing. In other words, no reduction has been applied to the bearing pressure value to maintain deformations within the zone of elastic or elastic-plastic deformation, nor to ensure a maximum level of tolerable deflection. Reduced bearing pressures may be required where the ultimate limit state (ULS) of the footing is to be defined by a specified deformation of foundation subgrade that could lead to the ULS state being induced in the superstructure.

Table 6-1 Ultimate Bearing Pressure for Spread Footings - ULS

Embedment Depth (m), as measured from lowest adjacent grade	Assumed Bearing Soil	Unfactored Bearing Pressure (kPa)
0.6	Compact Till	700
0.9	Compact Till	950
1.2	Compact Till	1200
1.5	Compact Till	1500
1.8	Compact Till	1780
2.4	Compact Till	2340
As Required to achieve Bedrock	Biomicritic Limestone	7500

Minimum Footing Width 0.6 m.

Based on the 2015 National Building Code of Canada (NBCC), a geotechnical resistance factor, $\Phi = 0.5$ should be applied to the unfactored bearing resistance of a footing to obtain the factored geotechnical bearing resistance at the ULS.

6.2.2 Serviceability and Settlement

The bearing pressure at the Serviceability Limit State (SLS) can only be determined from settlement analyses which in turn can only be evaluated once the final foundation configuration, including both depth and footing size, is known. Furthermore, a footing settlement tolerance (or limit) was not specified by the structural agent for use in developing geotechnical resistance limits for the serviceability limit state design criterion. Notwithstanding, assuming good workmanship and clean bearing surfaces, the serviceability limit bearing pressure for an assumed maximum **elastic settlement** of 25 mm for spread footings bearing on compact till may be selected from Table 6-2 on the basis of footing width and the length to width ratio of the footing. The serviceability limit pressures may be increased by an additional 80 percent for footing bearing on bedrock having an RQD of 50 percent or better. Wood can provide revised bearing values for other specific footing sizes upon request. The recommended serviceability limit pressures are subject to inspection and approval of all bearing surfaces by a qualified geotechnical engineer at the time of construction.

Table 6-2 Serviceability Limit Bearing Pressures for Spread Footings on Compact Till - SLS

Footing Width (m)	L/B = 1	L/B = 2	L/B = 3	L/B = 5	L/B = 10
0.6	750	575	490	400	310
0.76	590	455	390	320	270
0.9	500	380	330	270	210
1.2	375	290	245	205	155
1.5	300	230	195	160	125

Bearing Pressures are for 25 mm of elastic settlement.

6.2.3 Construction Recommendations for Footing

Additional recommendations for footing construction are as follows:

1. Shallow foundations must not be founded on un-compacted fill, loosened or disturbed soil, or organic soils.
2. To create a uniform base condition and reduce the potential for total and differential settlements, excavation should continue to final design elevation, ensuring that the exposed soils consist of native, undisturbed, compact till.
3. Excavation should proceed with care using an excavator equipped with a smooth bucket operating from the edge of the excavation to reduce the potential for disturbance of the bearing surface. All loosened and disturbed soils should be removed from the final bearing surface by hand. Care should be taken to ensure that the bearing surface is not subject to frost, inundation, desiccation or heavy equipment, or disturbed in any way prior to or after casting the footings.
4. Once the bearing surface has been prepared, it should be inspected by qualified geotechnical personnel to verify the suitability of the proposed bearing soils and to confirm that the soils are uniform and consistent with the conditions presented in this report.
5. Any soft, weak or otherwise unsuitable areas identified at the bearing elevation should be excavated and replaced under the direction of the geotechnical engineer.
6. Where excavation below design footing elevation is required for removal of unsuitable soils, fill material used to backfill to the design footing elevation should consist of lean-mix concrete or approved granular fill placed in maximum 200 mm thick uncompact lifts, and uniformly compacted to 100 percent of SPMDD.
7. Bearing surfaces should be protected from environmental effects (i.e. precipitation and freezing temperatures) at all times, including during the period between completion of excavation and casting of the footings. Water should not be allowed to pond on the bearing surface to reduce the potential for disturbance. Seepage controls should be undertaken as required using trenches, sumps and pumps located outside the bearing surface areas.
8. Lean mix or mud slabs may be used to protect the bearing surface from being disturbed, particularly during placing of the rebar cages.
9. Footing excavations and backfilling should follow the recommendations provided in Section 5.2.

10. All footings should be steel reinforced and suitably designed by a structural engineer to act as rigid foundations. Regardless of bearing capacity considerations, all footings should have a minimum width of 0.6 m.
11. A minimum 150 mm thick void form is recommended under the grade beams.

7.0 Lateral Earth Pressure on Rigid Chamber

Rigid retaining structures, inclusive of the proposed tank chamber, should be designed to resist unbalanced lateral pressures imposed on the structure by surrounding soil, water, and any additional surcharge loading (i.e. vehicles, live surface loads, etc.). The degree of pressure imbalance should consider all possible loading conditions through the life of the structure, including construction conditions (i.e. equipment loads) and temporary conditions.

7.1 Lateral Earth Pressure

Selection of lateral earth pressure coefficients and the apparent earth pressure distribution for the design of rigid (i.e. non flexible) retaining structures depends on such factors as the properties of the retained soil/backfill; the level of compaction of the backfill against the structure; the slope of the wall and the structure/soil interface; the slope of final grades surrounding the structure; the degree of horizontal movement of the structure; and the subsurface drainage and groundwater conditions over the depth (or height) of the structure. In the case of un-yielding walls, the at-rest (K_o) earth pressure coefficient should be used, and increased to 1.0 in cases where the wall will potentially be exposed to potential frost. Where the top of the wall is not fixed and horizontal displacement of up to 2 percent of the wall height can be tolerated, mobilization of the 'active' earth pressure condition can be assumed and K_a and K_p may be used in design.

Table 7-1 provides recommended design values for the bulk unit weight, angle of internal friction, and 'at rest', active, and passive lateral earth pressure coefficients for various retained soils and/or backfill soils assuming a rigid vertical wall and horizontal grade surrounding the structure. The earth pressure coefficients should be reviewed during detailed design for alternate soil types, walls and support faces inclined from vertical, and/or final grades within a horizontal distance, H , of the structure exceeding 4% slope, where H is the height of the structure.

Table 7-1: Earth Pressure Coefficients and Soil Unit Weights

Soil Type	Compaction ⁽¹⁾	Active Pressure Coefficient K_a	"At Rest" Earth Pressure Coefficient K_o	Passive Pressure Coefficient $K_p / 1.5$	Total Soil Unit Weight (kN/m ³)	Friction Angle (deg) Between Soil and Concrete
Granular Fill	Moderately to Well Compacted (35°)	0.27	0.43	2.46	22	23
	Light to Moderately Compacted (30°)	0.33	0.50	2.00	21	20
Till	In-situ (35°)	0.27	0.43	2.46	22	23
	Moderately to Well Compacted (30°)	0.33	0.50	2.00	21	20

	Light to Moderately Compacted (25°)	0.41	0.58	1.64	20	17
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Notes:

- (1) Moderately to Well Compacted = Compacted to 95% or more of SPMDD.
Light to Moderately Compacted = Compacted to minimum 90% of SPMDD, but less than 95% SPMDD.
- (2) The values of K_p include a reduction factor of 1.5 to approximate strain compatibility between K_a and K_p .

Where moderate to heavy compaction is not required immediately adjacent to the wall, the earth pressure distribution used to design rigid retaining structures may adopt the triangular distribution illustrated in Figure 2. Where backfill adjacent to the wall is moderately to well compacted (i.e. 95% of SPMDD or higher) and the wall is unyielding (i.e. the 'active' earth pressure condition cannot develop), the earth pressure distribution should be modified to include additional earth pressure induced by compaction as illustrated in Figure 3. The recommended earth pressure distributions assume sub-drainage will be provided behind the wall to prevent build-up of hydrostatic pressure on the wall. If a sub-drainage system is not provided and drained conditions cannot be assured, the hydrostatic component should be added to the earth pressure diagrams to account for potential hydrostatic pressure. A conservative groundwater table of 2.0 m below grade is recommended based on slough levels discussed in Section 4.3.

7.2 Surcharge Loads

In addition to earth pressures, lateral stresses generated by live surcharge loads (if applicable) also need to be evaluated in the design. For line or point surcharge loads, the lateral pressures should be determined using the relationships given in Figure 4. In the case of uniformly distributed surcharge loads, such as those acting on the surface of the retained soil, the induced lateral earth pressure may be determined by multiplying the surcharge load by the appropriate earth pressure coefficient.

7.3 Load Factors

For the Limit States Design procedure for walls, the following Load Factors should be applied to loads calculated from the pressure distributions given above.

- For earth loads acting on walls, a Load Factor of 1.25 is recommended for sustained loads.
- For hydrostatic loads acting on walls, a Load Factor of 1.1 is recommended.
- For live surcharge loads acting on walls, the Load Factor of 1.5 should be used.

The above load factors should be applied to loads leading to instability of the walls.

8.0 Frost Design Considerations

8.1 Frost Penetration Depth

The upper stratigraphy at the Site is considered moderately to highly frost susceptible in the presence of a free supply of water. As such, frost effects should be considered for foundations or surface structures sensitive to movement. Based on historical temperature data for the area, a design frost penetration of 2.4 m below final grade is recommended in areas that will not have regular snow or vegetative ground cover. It should be noted that this recommended frost penetration depth extends both vertically and laterally behind final grades and surfaces exposed to ambient temperatures below 0°C.

8.2 Frost Forces

Foundation elements supporting unheated structures and perimeter foundation elements supporting heated structures should be designed to resistance the frost forces discussed here-in. Similarly, interior foundations for heated structures should be designed for the unheated condition if they are going to be exposed to freezing conditions during construction. Potential frost forces acting on foundation elements include adfreeze pressures acting along the sides of foundation elements (i.e. footings, grade beams, piles and pile caps, etc.) extending through the frost zone, as well as frost heave forces acting on the undersides of such elements or connecting supports located above the anticipated depth of frost penetration.

Adfreeze forces acting on buried structures and foundation elements may be determined assuming an unfactored unit adfreeze stress of 65 kPa applied only to the exterior surface area of the portion of the structure or foundation element located within the zone of frost penetration. A load factor of 1.25 should be applied to obtain the factored adfreeze stress. The adfreeze stress could be reduced by fixing of a 'bond-break' or 'friction reducer', such as greased poly-wrap or geosynthetic liner material, to portions of the structure or foundation element located within the zone of frost penetration.

With respect to frost heave, the potential for frost heave pressures to develop on the underside of foundation elements should be mitigated by one or more of the following options:

- If possible, foundation elements such as shallow spread footings, grade beams, and pile caps should be designed to extend below the frost penetration depth. Alternatively, insulation may be used to establish a minimum equivalent depth of soil cover. Wood can provided a recommended insulation configuration upon request.
- Where the underside of the grade beams, pile caps, and any other connecting elements are located above the depth of frost penetration, a void-forming product should be installed beneath the underside of the foundation element. Alternatively, and provided the material will be located above the groundwater table and protected from potential saturation, a compressible material may be used in lieu of a void forming material, and the uplift pressure on the underside of the foundation elements may be taken as the crushing strength of the compressible medium. It is recommended that a frost heave of 150 mm be assumed in determining the required thickness for the void -filler and the associated uplift pressures associated with the thickness used.
- The finished grade adjacent to all structures and foundation elements should be capped with well compacted clay and sloped away so that the surface runoff is not allowed to infiltrate and collect in void spaces or saturate the compressible medium. Where either the void of the compressible medium is allowed to become filled or saturated with water, resulting frost heave pressures and movements may be significant and therefore this condition should be avoided.

9.0 Final Site Grading, Surface Drainage, and Subdrainage

Sufficient gradients should be provided to promote surface drainage away from structures in order to reduce the potential for moisture percolation to the foundation elements. Site grading should provide positive drainage away from structures at a minimum gradient of 4 percent for landscaped areas within 3 m of the perimeter of the building; and at a minimum gradient of 2 percent for all pavement areas as well as landscape areas outside of 3 m of the building perimeter. All downspouts from the roof of the structure should be discharged away from the building and proper measures (i.e. splashguards) should be

provided where necessary to reduce the potential for erosion and ponding water at the perimeter of the structure.

Excavations at the perimeter of the structure (grade beams, footings, etc.) should be backfilled with moderately to well compacted fill, and topped with a clay cap a minimum of 0.3 m thick to reduce the potential for surface water infiltration into the slab subgrade or backfill against grade beams. As a recommended minimum, the clay cap in landscape areas along the perimeter of the foundation should extend a minimum of 3.0 m from the foundation perimeter. Where pavement and/or concrete slabs meet the structure, these should be sealed against abutting structural components with a flexible seal, such as an asphaltic bead, to reduce the potential for surface water infiltration.

Subdrainage systems are recommended where the risk for groundwater accumulation and build-up of hydrostatic pressure on buried structures, such as the perimeter footings and along the CIP chamber, cannot be tolerated by design. Wood cautions that permeability differences between the undisturbed silt till and material used to backfill the excavation for the chamber could create a 'bath-tub' effect for potential accumulation of groundwater infiltration, particularly during abnormally wet seasons or where site grades are not maintained and do not adequately promote run-off away from the structure.

If implemented, the subdrainage system should consist of a perimeter drain along the exterior perimeter of the building to reduce potential groundwater accumulation along foundation elements as well as to reduce the ingress of percolating run-off into the void beneath the structural slab. Furthermore, an interior drainage collection system consisting of a minimum of one central collection line should be installed beneath the structural slab to collect potential seepage. The interior drainage collection system should be independent of the perimeter drain system. In order to facilitate gravity drainage of seepage into a crawlspace, grades within a crawlspace should be sloped towards collection lines at a minimum of 2 percent, and ideally, 4 percent.

Perimeter drains and interior collection lines should consist of a minimum 100 mm diameter filter-wrapped perforated PVC pipe placed in trenches backfilled with free draining 40 mm minus drainage gravel. The trenches should be of sufficient width and depth such that a minimum 150 mm thick layer of drainage gravel is maintained above and along the sides of the drain pipe below the finished surface of the crawlspace. Drainage gravel used to backfill the trenches should consist of natural gravel or crushed stone having clean, hard, strong, durable, uncoated particles free from injurious amounts of soft, friable, thin, elongated or laminated pieces, alkali, organic or other deleterious matter, and should meet the following gradation requirement:

Table 9-1: Drainage Material Grading Requirement

Sieve Size (mm)	Percent Passing by Weight
40	100
25	50 – 80
20	5 – 20
12.5	0 – 5
0.080	0 – 3

Drainage from subdrainage lines should be directed to one or more positive outlets such as a central collecting sump(s); or by gravity flow directly into the sewer system assuming applicable authorities permit. Where drainage is directed to a sump located below the building footprint, interior lateral drainage lines passing beneath the building should consist of solid pipe. Depending on final elevations and site configuration, grading of the crawlspace may necessitate installation of numerous interior drain lines and/or drainage outlets (i.e. sumps) to control slope lengths and drainage line lengths.

10.0 Foundation Concrete

Where concrete elements outlined in this report and all other concrete in contact with the local soil will be subjected in service to weathering, sulphate attack, a corrosive environment, or saturated conditions, the concrete should be designed, specified, and constructed in accordance with concrete exposure classifications outlined in the latest edition of CSA standard A23.1, Concrete Materials and Methods of Concrete Construction. In addition, all concrete must be supplied in accordance with current Manitoba and National Building Code requirements.

Based on significant data gathered through previous work in the Winnipeg area, water soluble sulphate concentrations in the soil are typically in the range of 0.2% to 2.0%. As such, the degree of sulphate exposure at the site may be considered as 'severe' in accordance with current CSA standards, and the use of sulphate resistance cement (Type HS or HSb) is recommended for concrete in contact with the local soil. Furthermore, air entrainment should be incorporated into any concrete elements that are exposed to freeze-thaw to enhance its durability.

It should be recognized that there may be structural and other considerations, which may necessitate additional requirements for subsurface concrete mix design.

11.0 Construction Monitoring and Testing

In accordance with Section 4.2.2.3 Field Review of the 2010 NBCC, all engineering design recommendations presented in this report are based on the assumption that an adequate level of testing and monitoring will be provided during construction by either the designer or other suitably qualified personnel. Furthermore, it is assumed that all construction will be carried out by a suitably qualified contractor experienced in foundation and earthworks construction. An adequate level of testing and monitoring is considered to be:

- For earthworks:
 - Full-time monitoring of fill quality and subgrade conditions and compaction testing.
- For shallow foundations:
 - Design review and inspection of all bearing surfaces prior to forming and pouring of concrete.
- For concrete construction:
 - Testing of plastic and hardened concrete in accordance with the latest editions of CSA A23.1 and A23.2; and
 - Review of concrete supplier's mix designs for conformance with prescribed and/or performance concrete specifications.

On the basis of the above, and given Wood's familiarity with the subsurface conditions at this site as the Geotechnical Engineer of Record, Wood requests the opportunity to review the design drawings, and the

installation of the foundations, to confirm that the geotechnical recommendations have been correctly interpreted. Wood would be pleased to provide any further information that may be needed during design and to advise on the geotechnical aspects of specifications for inclusion in contract documents. Wood can provide design modifications as required at the time of construction should subsurface conditions be found to vary from those described herein.

12.0 Closure

The findings and recommendations presented in this report were based on geotechnical evaluation of the subsurface conditions and limited groundwater data observed during the site investigation described in this report. If conditions other than those reported in this report are noted during subsequent phases of the project, or if the assumptions stated herein are not in keeping with the current and/or future design stage, this office should be notified immediately in order that the recommendations can be verified and revised as required. Recommendations presented herein may not be valid if an adequate level of inspection is not provided during construction, or if relevant building code requirements are not met.

The site investigation conducted and described in this report was for the sole purpose of identifying geotechnical conditions at the project Site. Although no environmental issues were identified during the fieldwork, this does not indicate that no such issues exist. If the owner or other parties have any concern regarding the presence of environmental issues, then an appropriate level environmental assessment should be conducted.

Soil conditions, by their nature, can be highly variable across a site. The placement of fill and prior construction activities on a site can contribute to the variability especially in near surface soil conditions. A contingency should always be included in any construction budget to allow for the possibility of variation in soil conditions, which may result in modification of the design and construction procedures.

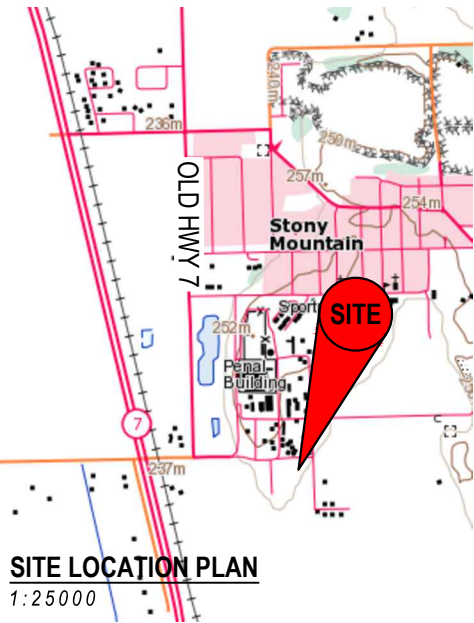
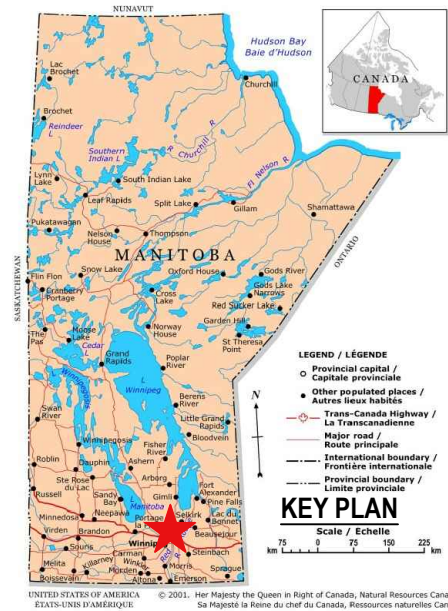
This report has been prepared for the exclusive use of J.R. Cousin Consultants, and their agents, for specific application to the project described in this report. The data and recommendations provided herein should not be used for any other purpose, or by any other parties, without review and written advice from Wood. Any use that a third party makes of this report, or any reliance or decisions made based on this report, are the responsibility of those parties. Wood accepts no responsibility for damages suffered by a third party as a result of decisions made or actions based on this report.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, either expressed or implied, is made.

Respectfully submitted,

**Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Ltd.**

Figures



LEGEND:
TEST HOLE



NOTES: SITE FEATURES AND LOCATIONS ARE APPROXIMATE ONLY. IMAGES FROM GOOGLE EARTH PRO AND TOPO MAPS.

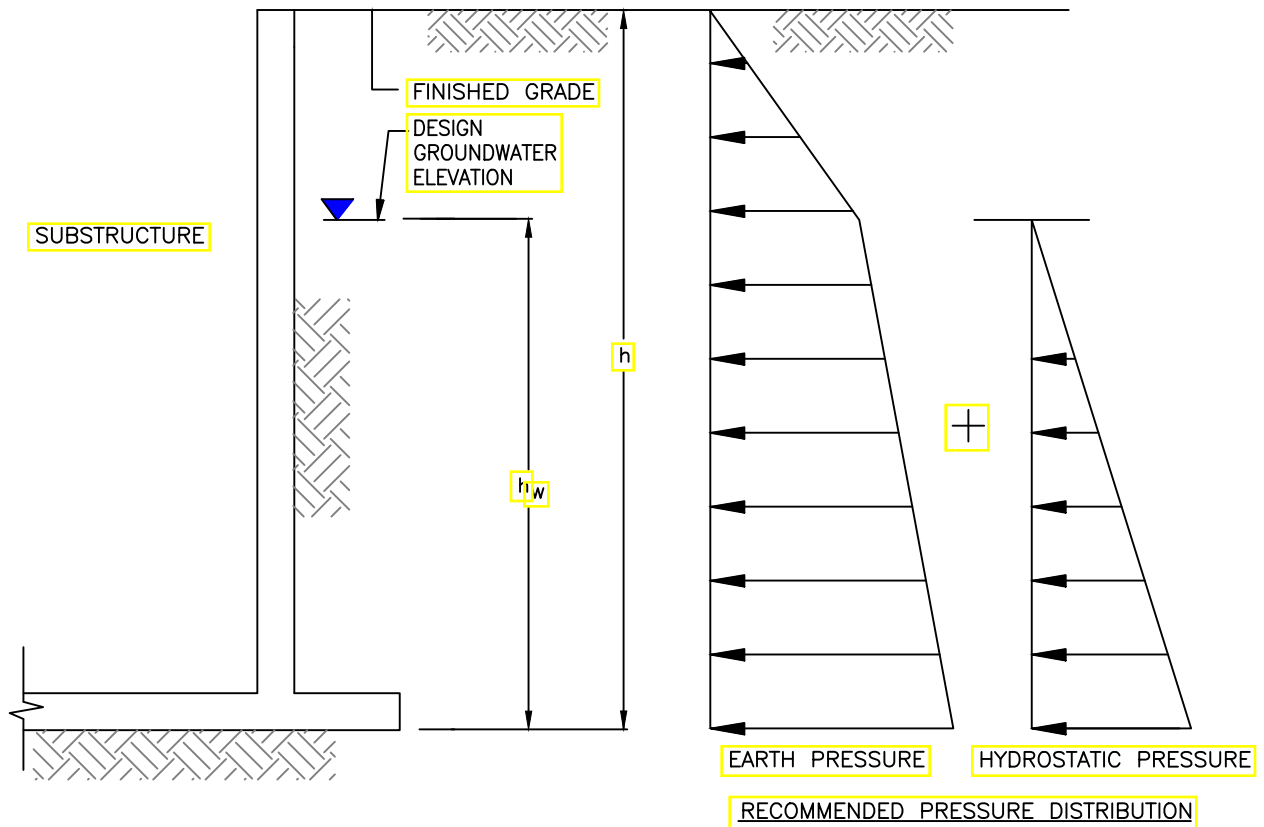
REVISION	BY	DATE
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CLIENT:
J.R. COUSIN CONSULTANTS

wood.
440 DOVERCOURT DRIVE WINNIPEG, MANITOBA R3Y 1N4 PHONE: 204.488.2997 FAX:204.489.8261

DWN BY:	MD
CHK'D BY:	KJ
DATUM:	NAD83
PROJECTION:	UTM Zone 14 U
SCALE:	AS SHOWN

GEOTECHNICAL INVESTIGATION SMI SEWER TRASH REMOVAL SYSTEM STONY MOUNTAIN PENITENTIARY	DATE: JULY 2018
SITE AND TEST HOLE LOCATION PLAN	PROJECT NO: WX18547
	REV. NO.: ---
	FIGURE NO: FIGURE 1



$$P_h = K\gamma(h-h_w) + K\gamma'h_w + \gamma_w h_w$$

WHERE: P_h = LATERAL EARTH PRESSURE (kPa)
 γ = UNIT WEIGHT OF SOIL (SEE TEXT OF REPORT)
 γ' = BUOYANT UNIT WEIGHT OF SOIL (SEE TEXT OF REPORT)
 γ_w = UNIT WEIGHT OF WATER (USE $\gamma_w = 9.8 \text{ kN/m}^3$)
 h = HEIGHT OF WALL FROM FINISHED GRADE TO BASE OF WALL (m)
 h_w = HEIGHT OF GROUNDWATER TABLE ABOVE BASE OF WALL (m)
 K = LATERAL EARTH PRESSURE COEFFICIENT (K_a OR K_o - SEE REPORT TEXT)

NOTES:

- SEE TEXT OF REPORT FOR UNIT WEIGHTS AND LATERAL EARTH PRESSURE COEFFICIENTS.
- A HYDROSTATIC COMPONENT NEED ONLY BE INCLUDED WHERE A PERCHED GROUND WATER TABLE WERE TO OCCUR WITHIN THE LEVEL OF SUB-STRUCTURE IN COMBINATION WITH NO SUB-DRAINAGE.

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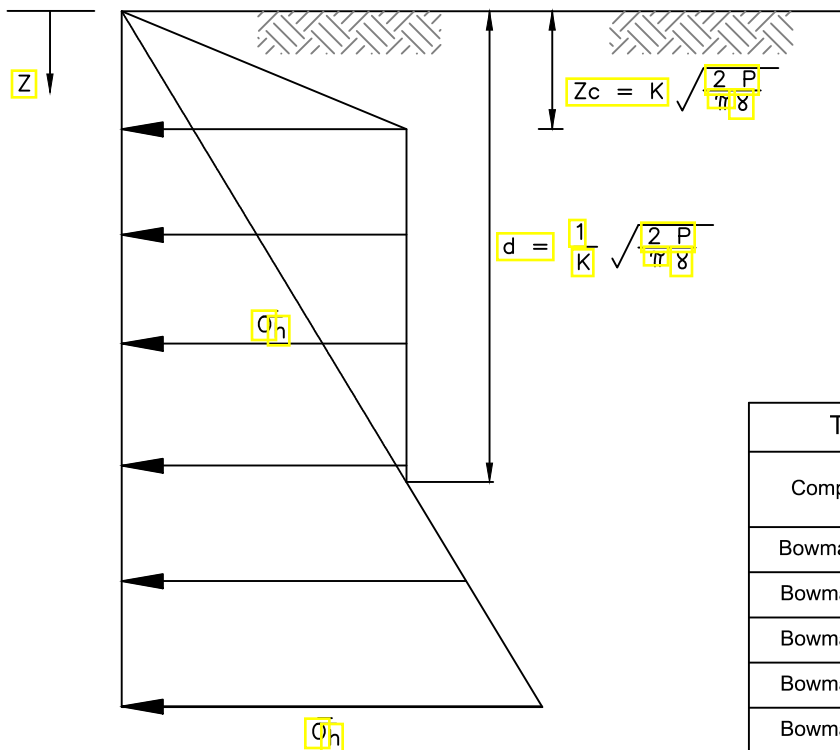
440 DOVERCOURT DRIVE
WINNIPEG, MANITOBA R3Y 1N4
PHONE: 204.488.2997 FAX: 204.489.8261

DWN BY: MD
CHK'D BY: KJ
DATUM: -
PROJECTION: -
SCALE: NOT TO SCALE

GEOTECHNICAL INVESTIGATION
SMI SEWER TRASH REMOVAL SYSTEM
STONY MOUNTAIN PENITENTIARY

LATERAL EARTH PRESSURE DISTRIBUTION
FOR LIGHTLY COMPACTED BACKFILL

DATE: JULY 2018
PROJECT No.: WX18547
REV. No.: A
FIGURE No.: FIGURE 2



EARTH PRESSURE DISTRIBUTION

FOR $Z_c \leq Z \leq d$

$$Q_h = \sqrt{\frac{2P\gamma}{\pi}}$$

FOR $Z > d$

$$Q_h = K \cdot \gamma \cdot Z$$

TYPICAL COMPACTOR LOADS (P)

Compactor	LOAD (P) kN/m	Compactor	LOAD (P) kN/m
Bowmag TSE	31	Bowmag BW122PD	36
Bowmag 60S	32	Bowmag 142PDB	47
Bowmag 65S	22	Bowmag 172PDB	93
Bowmag 75S	33	Dynapac LR100	42
Bowmag 90S	39	Dynapac 2100V	93
Bowmag 75AD	20	Dynapac CA121D	53
Bowmag 100AD	20	Dynapac CA121PD	54
Bowmag 120AD	34	Dynapac CA151	80
Bowmag 130AD	36	Dynapac CA151D	80
Bowmag BW122D	30	Dynapac CA151PD	96

P (ROLLER LOAD) = $\frac{\text{DEAD WT. OF ROLLER} + \text{CENTRIFUGAL FORCE}}{\text{WIDTH OF ROLLER}}$

TYPICAL VALUES GIVEN IN TABLE

EARTH PRESSURE COEFFICIENTS

Q_h = HORIZONTAL EARTH PRESSURE AT DEPTH Z

$K = K_o$ ("AT REST") OR K_a (ACTIVE CASE)
(SEE TEXT OF REPORT)

γ = SOIL UNIT WEIGHT
(SEE TEXT OF REPORT)

REFERENCE: INGOLD (1980), INTERNATIONAL CONFERENCE ON COMPACTION

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DWN BY:

MD

CHK'D BY:

KJ

DATUM:

-

PROJECTION:

-

SCALE:

NOT TO SCALE

GEOTECHNICAL INVESTIGATION
SMI SEWER TRASH REMOVAL SYSTEM
STONY MOUNTAIN PENITENTIARY

LATERAL EARTH PRESSURES
INDUCED BY COMPACTION

DATE:

JULY 2018

PROJECT No.:

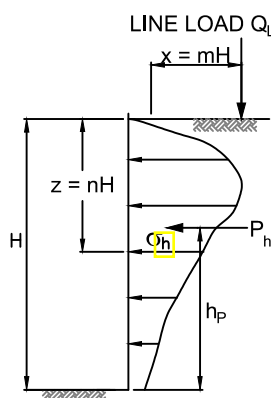
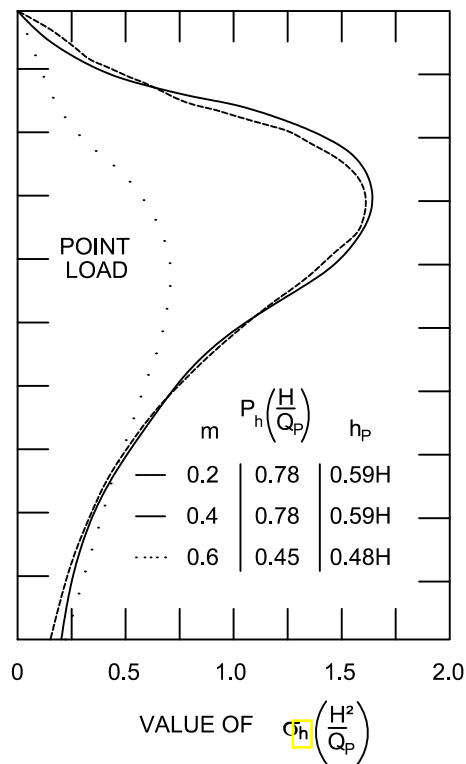
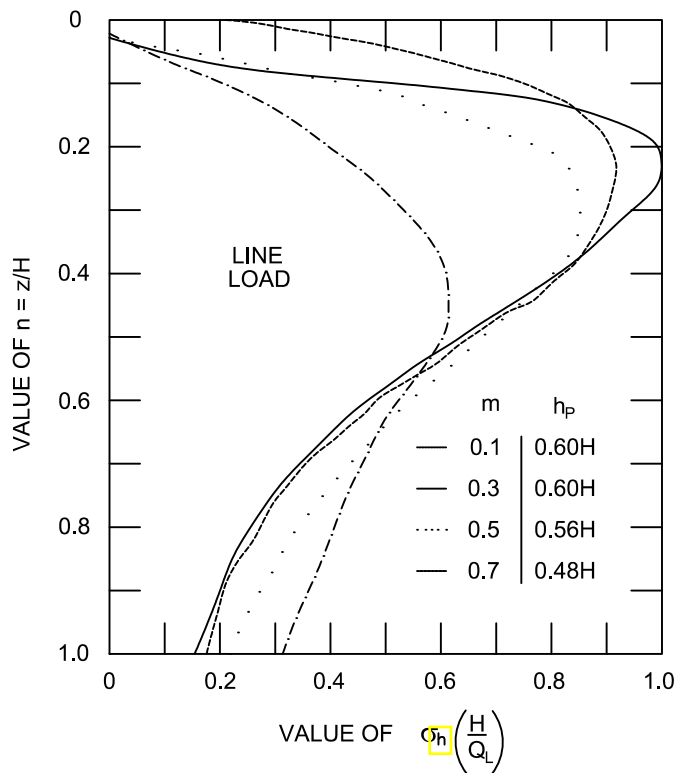
WX18547

REV. No.:

A

FIGURE No.:

FIGURE 3



FOR $m \leq 0.4$:

$$\sigma_h \left(\frac{H}{Q_L} \right) = \frac{0.20n}{(0.16 + n^2)^2}$$

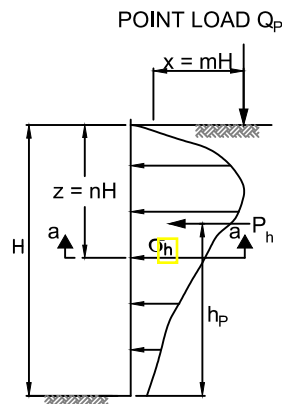
$$P_h = 0.55 Q_L$$

FOR $m > 0.4$:

$$\sigma_h \left(\frac{H}{Q_L} \right) = \frac{1.28m^2n}{(m^2 + n^2)^2}$$

$$\text{RESULTANT } P_h = \frac{0.64 Q_L}{(m^2 + 1)}$$

PRESSURES FROM LINE LOAD
(BOUSSINESQ EQUATION MODIFIED BY EXPERIMENT)



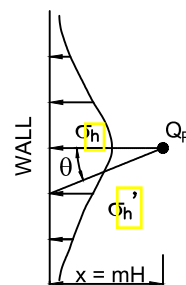
FOR $m \leq 0.4$:

$$\sigma_h \left(\frac{H^2}{Q_p} \right) = \frac{0.28n^2}{(0.16 + n^2)^3}$$

FOR $m > 0.4$:

$$\sigma_h \left(\frac{H^2}{Q_p} \right) = \frac{1.77m^2n^2}{(m^2 + n^2)^3}$$

$$\sigma_h' = \sigma_h \cos^2 (1.1\theta)$$



SECTION a-a
PRESSURES FROM POINT LOAD
(BOUSSINESQ EQUATION
MODIFIED BY EXPERIMENT)

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DWN BY: MD
CHK'D BY: KJ
DATUM: -
PROJECTION: -
SCALE: NOT TO SCALE

GEOTECHNICAL INVESTIGATION
SMI SEWER TRASH REMOVAL SYSTEM
STONY MOUNTAIN PENITENTIARY

LATERAL PRESSURES DUE TO SURCHARGE
POINT AND LINE LOADS

DATE: JULY 2018
PROJECT No.: WX18547
REV. No.: A
FIGURE No.: FIGURE 4

Appendix A


Test Hole Logs

Explanation of Terms and Symbols

WX18547 - JRCC SMI TRASH REMOVAL SYSTEM.GPJ 18/07/09 04:18 PM (WPG - GEOTECH LOG 1)

PROJECT: SMI Sewer Trash Removal Systym		DRILLER: Maple Leaf Drilling		TEST HOLE ID: TH01	
CLIENT: J.R. Cousin Consultants		DRILL RIG: Mobile B40		PROJECT No: WX18547	
LOCATION: UTM84-14N N5548733.8 E627243.7		DRILL METHOD: 125 mm Solid Stem Augers		ELEVATION: 239.18 m	
SAMPLE TYPE		<input checked="" type="checkbox"/> Shelby Tube	<input type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT (N)	<input type="checkbox"/> Grab Sample
BACKFILL TYPE		<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input checked="" type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout
				<input type="checkbox"/> Split-Pen	<input type="checkbox"/> Core
				<input type="checkbox"/> Slough	<input type="checkbox"/> Sand

DEPTH (m)	UNCONFINED COMPRESSION (kPa)		POCKET PENETROMETER (kPa)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
	100	200									
0						TOPSOIL (150 mm) - organic clay, high plastic, moist					239
						SILT (TILL) - trace clay, trace sand and gravel, low plastic, damp to moist, compact (inferred), light greyish brown		1			
								2			
								3			238
								4	21		
						- below 1.5m, trace to some clay, trace to some sand, low to medium plastic, moist, compact					
						- from 1.5m to 1.8m, occasional to frequent grey clay (high plastic) inclusions					
								5			237
						- below 2.3m, damp to moist, orange					
								6			
								7			
						- below 3.0m, damp		8			236
						AUGER REFUSAL AT 3.2m ON SUSPECTED BEDROCK					
						Notes:					
						- Caving of sidewalls below 2.1m observed during drilling.					
						- No seepage observed during drilling.					
						- Test hole remained open to 2.3m and was dry prior to backfilling.					
						- Test hole backfilled with auger cuttings and bentonite.					
									20		
									/25		
										SPT@3.0m; 20 bounces with no penetration	
											235
											234
											233
											232

 Wood Environment & Infrastructure Solutions a division of Wood Canada Limited	LOGGED BY: KE	COMPLETION DEPTH: 3.2 m
	REVIEWED BY: KJ	COMPLETION DATE: 22 June 2018
	Figure No.	Sheet 1 of 1

WX18547 - JRCC SMI TRASH REMOVAL SYSTEM.GPJ 18/07/09 04:18 PM (WPG - GEOTECH LOG 1)

PROJECT: SMI Sewer Trash Removal Systym		DRILLER: Maple Leaf Drilling		TEST HOLE ID: TH01A	
CLIENT: J.R. Cousin Consultants		DRILL RIG: Mobile B40		PROJECT No: WX18547	
LOCATION: 1 m South of TH01		DRILL METHOD: 125 mm Solid Stem Augers		ELEVATION: 239.18 m	
SAMPLE TYPE		<input checked="" type="checkbox"/> Shelby Tube	<input type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT (N)	<input type="checkbox"/> Grab Sample
BACKFILL TYPE		<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input checked="" type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout
				<input type="checkbox"/> Split-Pen	<input type="checkbox"/> Core
				<input type="checkbox"/> Slough	<input type="checkbox"/> Sand

DEPTH (m)	▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400 ☒ POCKET PENETROMETER (kPa) ☒ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0			OH	TOPSOIL (150 mm) - organic clay, high plastic, moist SILT (TILL) - See TH01 for characteristic soil description				TH01A drilled approximately 1 m south of TH01	239
1									238
2			ML						237
3									236
4			ML	... at 3.4m. auger refusal, switched to coring ... below 3.4m, suspected very dense cobbly till, return water reddish brown, less than 12% sample recovery consisting of washed angular gravel fragments		1		Core Run 1: 12% recovery 0% RQD	235
5				LIMESTONE - biomicritic, strong rock (inferred), slightly weathered, fair quality		2		Core Run 2: 95% recovery 63% RQD	234
6				... at 5.5 m, 150 mm thick mudstone layer, completely weathered, medium plastic, moist, very stiff to hard, reddish brown		3		Core Run 3: 12% recovery 0% RQD	233
7									232
8				TEST HOLE TERMINATED AT 7.4m BELOW GRADE - No seepage or sloughing observations were made due to the introduction of water for coring. - Test hole backfilled to grade immediately upon completion.					



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LOGGED BY: DC

REVIEWED BY: KJ

Figure No.

COMPLETION DEPTH: 7.4 m

COMPLETION DATE: 27 June 2018

Sheet 1 of 1

PROJECT: SMI Sewer Trash Removal Systm		DRILLER: Maple Leaf Drilling		TEST HOLE ID: TH02	
CLIENT: J.R. Cousin Consultants		DRILL RIG: Mobile B40		PROJECT No: WX18547	
LOCATION: UTM84-14N N5548717.7 E627245.9		DRILL METHOD: 125 mm Solid Stem Augers		ELEVATION: 239.28 m	
SAMPLE TYPE		<input checked="" type="checkbox"/> Shelby Tube	<input type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT (N)	<input type="checkbox"/> Grab Sample
BACKFILL TYPE		<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input checked="" type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout
				<input type="checkbox"/> Split-Pen	<input type="checkbox"/> Core
				<input type="checkbox"/> Slough	<input type="checkbox"/> Sand


DEPTH (m)	UNCONFINED COMPRESSION (kPa)		SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
	POCKET PENETROMETER (kPa)									
	PLASTIC	M.C.								
0					TOPSOIL (150 mm) - organic clay, high plastic, moist		1			239
					SILT (TILL) - trace clay, trace sand and gravel, low plastic, damp to moist, compact (inferred), light greyish brown, frequent clay inclusions (high plastic, grey)		2			
							3			
							4			238
					- below 1.5m, compact		5	23		
					- below 1.8m, some sand and gravel, greyish brown		6			
							7			237
					- below 2.3m, very dense, orange mottled grey		8			
					- below 2.4m, moist, some gravel		9	28-50 / 100	- below 2.3m, hard drilling	
					AUGER REFUSAL AT 2.9m BELOW GRADE					236
					Notes:					
					- Caving of sidewalls below 2.3m observed during drilling.					
					- No seepage observed during drilling.					
					- Test hole remained open to 2.3m and was dry prior to backfilling.					
					- Test hole backfilled with auger cuttings and bentonite.					
										235
										234
										233
										232

	Wood Environment & Infrastructure Solutions a division of Wood Canada Limited	LOGGED BY: KE	COMPLETION DEPTH: 2.9 m
		REVIEWED BY: KJ	COMPLETION DATE: 22 June 2018
		Figure No.	Sheet 1 of 1

WX18547 - JRCC SMI TRASH REMOVAL SYSTEM.GPJ 18/07/09 04:18 PM (WPG - GEOTECH LOG 1)

PROJECT: SMI Sewer Trash Removal Systm		DRILLER: Maple Leaf Drilling		TEST HOLE ID: TH03	
CLIENT: J.R. Cousin Consultants		DRILL RIG: Mobile B40		PROJECT No: WX18547	
LOCATION: UTM84-14N N5548717.6 E627233.7		DRILL METHOD: 125 mm Solid Stem Augers		ELEVATION: 239.28 m	
SAMPLE TYPE		<input checked="" type="checkbox"/> Shelby Tube	<input type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT (N)	<input type="checkbox"/> Grab Sample
BACKFILL TYPE		<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input checked="" type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout
				<input type="checkbox"/> Split-Pen	<input type="checkbox"/> Core
				<input type="checkbox"/> Slough	<input type="checkbox"/> Sand

DEPTH (m)	UNCONFINED COMPRESSION (kPa)		POCKET PENETROMETER (kPa)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
	100	200									
0						TOPSOIL (150 mm) - organic clay, high plastic, moist		1			239
						SILT (TILL) - trace clay, trace sand and gravel, low to non plastic, damp, compact (inferred), light brown		2			
								3			
								4			238
					ML	- below 1.5m, very dense		5	18-50 / 100	- below 1.5m, hard drilling	
								6			237
						- below 2.1m, orange		7			
						AUGER REFUSAL AT 2.7m BELOW GRADE					236
						Notes: - Caving of sidewalls below 1.2m observed during drilling. - No seepage observed during drilling. - Test hole remained open to 2.0m and was dry prior to backfilling. - Test hole backfilled with auger cuttings and bentonite.					
											235
											234
											233
											232

 Wood Environment & Infrastructure Solutions a division of Wood Canada Limited	LOGGED BY: KE	COMPLETION DEPTH: 2.7 m
	REVIEWED BY: KJ	COMPLETION DATE: 22 June 2018
	Figure No.	Sheet 1 of 1

WX18547 - JRCC SMI TRASH REMOVAL SYSTEM.GPJ 18/07/09 04:18 PM (WPG - GEOTECH LOG 1)

EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in these pages.

It should be noted that materials, boundaries and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained during the field investigation and from laboratory testing are shown at the appropriate depth interval.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

*C	Consolidation test	*ST	Swelling test
D _R	Relative density	TV	Torvane shear strength
*k	Permeability coefficient	VS	Vane shear strength
*MA	Mechanical grain size analysis and hydrometer test	w	Natural Moisture Content (ASTM D2216)
N	Standard Penetration Test (CSA A119.1-60)	w _l	Liquid limit (ASTM D 423)
N _d	Dynamic cone penetration test	w _p	Plastic Limit (ASTM D 424)
NP	Non plastic soil	E _f	Unit strain at failure
pp	Pocket penetrometer strength	γ	Unit weight of soil or rock
*q	Triaxial compression test	γ _d	Dry unit weight of soil or rock
q _u	Unconfined compressive strength	ρ	Density of soil or rock
*SB	Shearbox test	ρ _d	Dry Density of soil or rock
SO ₄	Concentration of water-soluble sulphate	C _u	Undrained shear strength
		→	Seepage
		▼	Observed water level

* The results of these tests are usually reported separately

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System¹ modified slightly so that an inorganic clay of "medium plasticity" is recognized.

The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual².

Relative Density and Consistency:

Cohesionless Soils		Cohesive Soils		
Relative Density	SPT (N) Value	Consistency	Undrained Shear Strength c _u (kPa)	Approximate SPT (N) Value
Very Loose	0-4	Very Soft	0-12	0-2
Loose	4-10	Soft	12-25	2-4
Compact	10-30	Firm	25-50	4-8
Dense	30-50	Stiff	50-100	8-15
Very Dense	>50	Very Stiff	100-200	15-30
		Hard	>200	>30


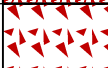



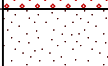
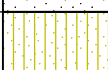
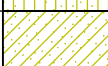

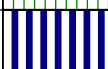
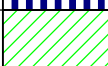
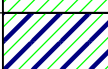
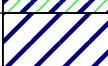
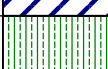
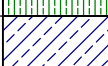
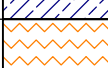
Standard Penetration Resistance ("N" value)







The number of blows by a 63.6kg hammer dropped 760 mm to drive a 50 mm diameter open sampler attached to "A" drill rods for a distance of 300 mm after an initial penetration of 150 mm.

¹ "Unified Soil Classification System", Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S. Army. Vol. 1 March 1953.

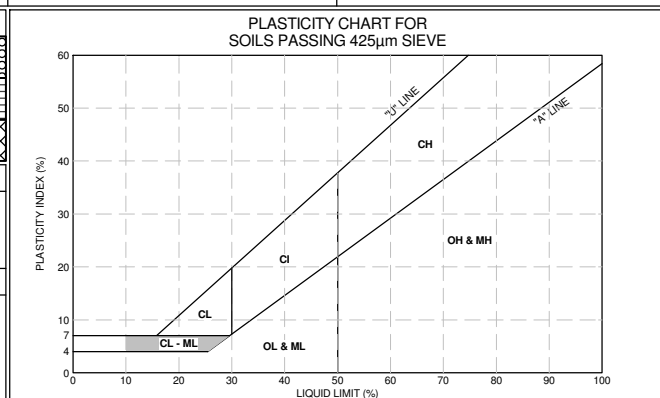
² "Canadian Foundation Engineering Manual", 3rd Edition, Canadian Geotechnical Society, 1992.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISIONS			SYMBOLS			TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
			USCS	GRAPH	COLOUR		
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW		RED	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u=D_{60}/D_{10} >4$; $C_c=(D_{30})^2/(D_{10} \times D_{60}) = 1 \text{ to } 3$
			GP		RED	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PI LESS THAN 4
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND PI MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW		RED	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u=D_{60}/D_{10} >6$; $C_c=(D_{30})^2/(D_{10} \times D_{60}) = 1 \text{ to } 3$
			SP		RED	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PI LESS THAN 4
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND PI MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLECTIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		$W_L > 50\%$	MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SAND OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLECTIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		$30\% < W_L < 50\%$	CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		$W_L > 50\%$	CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		$W_L > 50\%$	OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	
	HIGHLY ORGANIC SOILS			PT		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS

SPECIAL SYMBOLS			
LIMESTONE		OILSAND	
SANDSTONE		SHALE	
SILTSTONE		FILL (UNDIFFERENTIATED)	

SOIL COMPONENTS				
FRACTION	U.S. STANDARD METRIC SIEVE SIZE		DEFINING RANGES OF PERCENT BY WEIGHT OF MINOR COMPONENTS	
GRAVEL	PASSING	RETAINED	PERCENT	DESCRIPTOR
COARSE	76mm	19mm	35 - 50	AND
FINE	19mm	4.75mm		
SAND				
COARSE	4.75mm	2.00mm	30 - 35	Y / EY
MEDIUM	2.00mm	425µm	10 - 20	SOME
FINE	425µm	75µm		
FINES (SILT OR CLAY BASED ON PLASTICITY)	75µm		1 - 10	TRACE



NOTES:

1. ALL SIEVE SIZES MENTIONED ARE U.S. STANDARD ASTM E.11.
2. COARSE GRAINED SOILS WITH TRACE TO SOME FINES GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH TRACE TO SOME CLAY.
3. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

OVERSIZED MATERIAL	
ROUNDED OR SUBROUNDED: COBBLES 76mm to 200mm BOULDERS > 200mm	NOT ROUNDED: ROCK FRAGMENTS ? 76mm ROCKS > 0.76 CUBIC METRE IN VOLUME

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

Commissioning Plan

Project: RM of Rockwood – SMI Wastewater Trash Removal Building

Project number: R.118541

Revision no. 01- April 2022

1. Importance and Purpose of the Commissioning Plan

The Commissioning Plan is the master planning tool relating to commissioning, setting out scope, standards, roles and responsibilities, expectations, deliverables, etc. It provides an overview of commissioning, a general description of all elements that make up the Commissioning Plan, and sets out the process and the methodology for successful commissioning of the above-mentioned project.

The Commissioning Plan functions as a management tool, setting out the scope standards of commissioning, roles and responsibilities of each member of the Project Commissioning Team and deliverables

The Commissioning Plan also functions as a communications tool, addressed to all members of the Project Design, Design Quality Review, Construction, Commissioning and Property Management Teams and informing each member of each team, in general terms, of their own roles and responsibilities and those of all the other members of the teams.

2. Production of the Commissioning Plan

The Designer will produce the Commissioning Plan using input from the Project Commissioning Team.

3. Revisions to this Commissioning Plan

The Commissioning Plan will be reviewed, revised, refined and updated as detailed design and production of the working documents proceeds and, if required, every 6 months during construction.

Each time it is revised, the revision number and date will also be revised. The revised Commissioning Plan shall be submitted to the PWGSC Project Manager and PWGSC Commissioning Manager for review and approval.

4. Composition, Roles and Responsibilities

The Commissioning Plan is intended to be used by the:

- .1 PWGSC Project Manager: who has the overall responsibility for the project and is the sole point of contact between the Client, the Designer, the Commissioning Manager and all other members of the project team.
- .2 PWGSC Design Quality Review Team: who conducts detailed reviews from the functional perspective during all stages of the design to ensure appropriate design criteria, design intents, design solutions, that designs are well-developed, commissioning specifications are appropriate to this project, transmits technical design information to the Designer via the Project Manager. During construction, may conduct periodic site reviews to observe general progress.
- .3 PWGSC QA Commissioning Manager: who ensures that all commissioning activities are carried out

so as to ensure the delivery of a fully operational project complete in every respect. This includes reviews of all commissioning documentation from the operational perspective, reviews for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under all conditions of operation, protection of health, welfare, safety and comfort of occupants and O&M personnel. The PWGSC Commissioning Manager works closely with all other members of the Commissioning Team. The PWGSC Commissioning Manager is also responsible for monitoring all commissioning activities, training and development of commissioning documentation.

- .4 Designer (i.e. Consultant): who designs the facility to meet the Client's functional and operational requirements and budget, prepares all working documents, including incorporation of commissioning specifications in to construction specifications, organizing commissioning, monitoring commissioning activities, witnessing and certifying the accuracy of reported results, witnessing and certifying TAB and other tests, develops Building Management Manual, ensures the implementation of this Commissioning Plan, performing verification of performance of all installed systems, implementation of Training Plan.
- .5 Construction Team: which consists of Contractor, sub-contractors, suppliers and other support disciplines, The Contractor is responsible for construction/installation in accordance with the contract documents, including testing, performance of commissioning activities, delivery of training and all commissioning documentation. For administrative and co-ordination purposes, the Contractor assigns one person as the point of contact with the Designer and the PWGSC Commissioning Manager.
- .6 Contractor's Commissioning Agent: who implements all commissioning activities required by the specifications, including demonstrations, training, testing, preparation and submission of test reports. This is a responsibility that is distinct from that of the Contractor's site supervisor.
- .7 Property Manager: Has responsibility for receiving the renovated facility and is responsible for day-to-day operation and maintenance of the facility and represents the lead role in the Operation Phase and onwards.

5. Commissioning Participants

- .1 The following commissioning participants are employed as required in the following situations to verify performance of all equipment and systems (all as specified in greater detail in the commissioning specifications).
 - a. The installing contractor or installing subcontractor: All equipment and systems except as noted herein.
 - b. Equipment manufacturer: Equipment specified to be installed and started up by the manufacturer (e.g. trash grinding and screen equipment, generators). These will also require performance verification.
 - c. Specialist subcontractor: Equipment and systems supplied and installed by a specialist subcontractor (e.g. EMCS, fire alarm systems).
 - d. Specialist commissioning agency: possessing specialist qualifications e.g, environmental space conditions, indoor air quality (IAQ) and other installations providing environments which are essential to the Client's program but are outside the scope or expertise of other commissioning specialists on this project. If not specified in the commissioning specifications, the identity of this specialist will be provided at a later date.
 - e. Contractor's TAB agency: Equipment and systems involving the measurement and

adjusting of flow rates and pressures to meet indicated or specified values (e.g. Includes, but not necessarily limited to, ducted air and hydronic systems, fans, pumps).

NOTE: TAB is a construction contractor's activity which permits the Designer to certify the results of the performance verification tests of the installed design to the satisfaction of the Commissioning Manager.

- f. PWGSC Commissioning Manager: Some conditions or situations which fall outside the scope of this contract (e.g. emergency evacuation).
- g. Client: Intrusion and access security systems.

.2 Each commissioning participant will:

- a. have a work force large enough to complete the work (including all necessary remedial work) within the scheduled time frame
- b. be available for emergency and troubleshooting service during the first year of occupancy by the User for adjustments and modifications outside the responsibility of the O&M personnel. These include changes to ventilation rates to meet changes in off-gassing, re-balancing of electrical distribution services, changes to fire alarm systems as may become apparent, modifications to PA and voice communications systems, etc.
- c. The names of all commissioning personnel, details of instruments which will be used and commissioning procedures which will be followed will be provided at least 3 months prior to the scheduled starting date of commissioning so as to permit proper review and approvals.

6. Client's Move

- .1 The move from the existing accommodation into the new building, although not part of commissioning should be given serious consideration by the Designer so as to ensure only very minor interruption in his program activities.

7. Risk Assessment

- .1 The performance of the overall system will affect the performance of the lagoon downstream of the Wastewater Trash Removal Building. It is planned, therefore to verify the performance of all systems and equipment before acceptance by the user.
- .2 The SMI lagoon is operated by the RM of Rockwood. The Departmental Representative will update the RM as required with the status of the project.
- .3 The process systems in the Wastewater Trash Removal Building will be new for the existing facility maintenance staff. It is planned, therefore to complete a thorough commissioning and training of all equipment to sure that CSC will be able to successfully operate the system.

8. Objective of Commissioning

Commissioning will provide a fully functional facility:

- .1 whose systems, equipment and components have been proven to meet all User's functional requirements before the date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under all
 - a. whose systems, equipment and components have been proven to meet all User's

functional requirements before the date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under all normal loads

- b. in which the CSC O&M personnel will have been fully trained in all aspects of all installed systems
- c. having optimized life cycle costs
- d. having complete documentation relating to all installed equipment and systems

9. Extent of Commissioning

.1 General: This preliminary Commissioning Plan is based upon the RFP and has been prepared prior to the development of the Conceptual Design. It is possible, therefore, at this time to refer to systems only in very general terms. Systems to be commissioned shall include:

.1 The following components are to be commissioned

.1 Building Envelope

- .1 Exterior Walls/Building Envelope
- .2 Beam and Slab deflection
- .3 Doors and related hardware.

.2 Vertical/horizontal transportation system

- .1 Indoor crane.
- .2 Bucket mounted cart dumper.

.3 All electrical systems including:

- .1 Engine generator.
- .2 Automatic transfer switches.
- .3 SCADA.
- .4 PLC.
- .5 Lighting.
- .6 Emergency lighting.
- .7 Transformer.
- .8 Security system.
- .9 Video surveillance.
- .10 Energy Metering

.4 All mechanical systems

- .1 HVAC fans - process room. **
- .2 HVAC fans – all other rooms.
- .3 Louvers and dampers.
- .4 Unit heaters.
- .5 Natural gas furnace.
- .6 Heat energy recovery equipment.
- .7 Plumbing.

.5 All process systems

- .1 Valves.
- .2 Level measurement equipment.
- .3 Pressure measurement equipment.
- .4 Air quality and differential pressure measurement equipment. **
- .5 Miscellaneous measurement equipment.

.6 Trash grinding equipment.

** These systems are identified as life safety systems.

10. Deliverables relating to O&M Perspectives

.1 General requirements:

- a. The following list of deliverables may not be complete - others may have been added as detailed design develops.
- b. The following is a brief overview of the deliverables. A more detailed description of requirements will be provided as required.
- c. The Designer shall utilize a computer-based data management system. This will include the cost of all labour, material and EDP equipment to deliver the program (e.g. "as-built" drawings and specifications, PV and commissioning documentation, Building Management Manual, and Training Plan).
- d. Manuals shall be compiled in English.
- e. Deliverable will include three (3) USB's and three (3) hard copies.
- f. All documentation shall be transferred to the Property Manager in a computer-compatible format that can be readily inputted for data management.

.2 Operation and maintenance budget

A preliminary O&M budget will be established by the Designer with input from the PWGSC Design Quality Review Team, the Commissioning Manager, and Property Manager [CSC] during the Conceptual Design Report stage. It will include the number of O&M personnel, security staff, janitorial staff, O&M spatial requirements, organization relating to flow of materials into and out of the facility, etc, as the design develops, it will be updated to include breakdowns to show the various elements of operation and maintenance (e.g. cleaning, service contracts), etc.

.3 Design energy budget

Requirement for this budget will depend upon client requirements. This will be prepared by the Designer with input from the PWGSC Commissioning Manager and PWGSC Design Quality Review Team, and presented with the Conceptual Design Report. This budget shall be updated at the completion of the Working Documents.

.4 Warranties

A complete inventory will be provided by the Contractor to the Designer who will review same before submission to the Commissioning Manager who, in turn, recommends acceptance by the PWGSC Project Manager.

.5 "As-built" drawings and specifications

These will be produced by the Designer from the project record documents maintained on the site and kept up-to-date with all changes as they occur and marked thereon by the Contractor. Accuracy will be verified by the Designer before preparation of the "As-builts" and by the PWGSC Commissioning Manager after submission by the Designer. They shall be completed in time to be used during pre-start-up inspections. They will be refined and revised as required during commissioning.

.6 Inventory of spare parts, special tools, maintenance materials

Inventory will be identified as a requirement during the design stage by the Designer with input

from the PWGSC Commissioning Manager and the Property Manager, based upon consideration of the complexity of the project and immediacy of availability; specified by the Designer; checked by the Contractor immediately upon delivery to ensure each is complete with instructions for use; inventoried, packaged and identified by the Contractor; and stored by the Contractor in facilities to be designated by the PWGSC Project Manager and the PWGSC Commissioning Manager.

.7 Identification

The PWGSC MMS (Maintenance Management System) identification system will be incorporated into the working documents and implemented on all systems, equipment and components.

11. Deliverables relating to the commissioning process

.1 General

Start-up, testing and commissioning requirements, conditions for acceptance and specifications will be included in the Contract Documents

.2 Definitions

All references in this document to commissioning shall include commissioning of components, equipment, subsystems, systems and integrated systems.

.3 Performance verification tests and inspections conducted at factory

These will be witnessed by the PWGSC Design Quality Review Team and witnessed and certified by the Designer and reports of all results provided to the Project Manager. The Commissioning Manager may wish to participate.

.4 Start-up, pre-commissioning activities and related documentation

For every item, the extent of involvement of the members of the Commissioning Team will be determined (e.g. who reviews, performs, monitors, certifies). This schedule will be prepared by the Designer with input from the Commissioning Manager and will include, but not necessarily be limited to:

- a. Pre-start-up tests: These will include pressure, static, flushing, cleaning, "bumping", etc., conducted during construction and will be specified by the Designer to be performed by the Contractor and witnessed and certified by the Designer. Depending upon the size and complexity of the project the Commissioning Manager may monitor some or all of these inspections and tests. The completed documentation will be included in the Commissioning Report.
- b. Pre-start-up inspections conducted by the Designer prior to permission to start up and rectification of all deficiencies to the satisfaction of the Designer and Commissioning Manager. The Designer will use approved installation check lists (see below). Depending upon the size and complexity of the project the Commissioning Manager will monitor some or all of these inspections. The completed documentation will be included with the Commissioning Report.
- c. Start-up: This will be by the Contractor (may also include equipment manufacturer, supplier and/or installing specialist subcontractor) under the direction of the Designer. Depending upon the size and complexity of the project the Commissioning Manager may wish to monitor some or all of these activities. It will also include rectification of all start-up deficiencies by the Contractor to the satisfaction of the Designer and Commissioning Manager.

- d. Performance verification (PV) will be performed by the approved Commissioning Agent, repeated where necessary until results are acceptable to the Designer. Procedures will be as per generic procedures but modified to suit project requirements. Reported results will be witnessed and certified by the Designer using approved PI and PV forms (see below). The completed TAB and PV Reports will be approved by the Designer and provided to the PWGSC Commissioning Manager who reserves the right to verify up to 30% of all reported results. Any failure of randomly selected item shall result in the rejection of the TAB report or the report of system startup and testing. All activities will be monitored by the PWGSC Commissioning Manager
- .5 Pre-commissioning activities - ARCHITECTURAL
- a. Exterior walls: thermographic surveys will be conducted to ensure appropriate level of tightness after the exterior envelope has been completed, the permanent HVAC systems are able to provide appropriate negative or positive pressure, a temperature of at least 20°C can be maintained between inside and outside and the wind speed is less than 10 kph.
 - b. Beam and slab deflection tests: These tests will be carried out as soon as possible after removal of temporary supports and the concrete has cured, so as to ensure adequacy for raised floors.
 - c. Door hardware: Door and window hardware: confirm fit and operation of all doors and hardware.
- .6 Pre-commissioning activities - MECHANICAL
- a. HVAC equipment and systems: each item of equipment will be "bumped" in its "stand-alone" mode (i.e. without completion of controls, fire alarm, etc. interfaces). At this time, pre-start-up checks will be completed and relevant documentation completed. Emphasis at this time is on those items which might have a detrimental effect on the operation of the equipment (e.g. noise and vibration) and the safety of the operating personnel. It is recognized that TAB may affect some parameters. After equipment has been stru.ted, the related systems will be tested in conjunction with the control systems on a system-by-system basis.
 - b. Plumbing systems: Each item of equipment will be "bumped" in its "stand-alone" mode (e.g. without completion of controls, interfaces), pre-start-up checks completed and relevant documentation completed. Emphasis at this time is on those items that might have a detrimental effect on the operation of the equipment and the safety of the operating personnel. It is recognized that TAB may affect some parameters. After equipment has been stru.ted, the related systems will be tested in conjunction with the control systems on a system-by-system basis.
- .7 Pre-commissioning activities - LIFE SAFETY SYSTEMS
- These will include all of equipment and systems identified above and reports of test results witnessed and certified by the Designer before verification:
- .8 Pre-commissioning activities - ELECTRICAL
- a. Distribution system: This includes under 750 volts. It requires an independent testing agency to perform pre-energization and post-energization tests.
 - b. Lighting systems: includes all lights in hazardous location and emergency lighting systems.

- c. Low voltage systems: These include clock, communications, low voltage lighting control systems and data communications systems.
- d. Backup power generation systems:
 - i. Transfer switches: test by simulating loss of power. Verify availability of power at equipment requiring same.
 - ii. Uninterruptible power systems: test under full and partial load conditions.
 - iii. Availability of power at all equipment requiring same (e.g. emergency lighting, elevators, fire pumps) will be verified.
- e. Security, surveillance and intrusion alarm systems: to include verification by CSC, Designer, Commissioning Manager.

.9 Commissioning activities and related documentation

- a. Commissioning will be performed by the specified commissioning agent using procedures developed by the Designer and approved by the Commissioning Manager.
- b. Commissioning activities will be witnessed by, and results certified by, the Designer.
- c. Reported results will be witnessed and certified by the Designer using approved PV forms.
- d. Upon satisfactory completion, the commissioning agency performing the tests will prepare the required Commissioning Report which will be certified by the Designer and forwarded to the Commissioning Manager who reserves the right to verify a. percentage of all reported results at no cost to the contract (percentages to be prescribed in the commissioning specifications).
- e. The Commissioning Manager will monitor all commissioning activities.

.10 Commissioning of integrated systems and related documentation Commissioning will be performed by the specified commissioning specialist, using procedures developed by the Designer and approved by the PWGSC Commissioning Manager. They will be witnessed by, and results certified by, the Designer and documented on approved report forms. Upon satisfactory completion, the commissioning specialist will prepare a Commissioning Report which will be certified by the Designer and submitted to the PWGSC Commissioning Manager for review. The PWGSC Commissioning Manager reserves the right to verify a. percentage of reported results.

The schedule of integrated systems will be prepared conjointly by the Designer and the PWGSC Commissioning Manager and will identify integrated systems to be commissioned over and above those listed herein:

- a. HVAC and associated systems forming part of integrated HVAC systems,
- b. Indoor air quality,
- c. Voice communications systems,
- d. Emergency power generator,
- e. Transfer switch and controllers,
- f. Emergency lighting systems,
- g. Life safety systems identified above.

.11 Identification

The Commissioning Manager, in co-operation with the Property Manager, will establish, during the design stage, an identification system for all systems and equipment which will reflect final MMS (Maintenance Management System) identification requirements, to be provided to the Contractor.

This will be reflected in the identification system used in the Working Documents by the Designer. During the later stages of commissioning and before hand-over and acceptance, the Designer, Contractor, Property Manager and Commissioning Manager will cooperate to complete inventory data sheets and provide assistance to PWGSC forces in the full implementation of the MMS identification system.

.12 Commissioning specifications

Preliminary commissioning specifications will be developed and submitted at the same time as the Design Development Report for review by the Commissioning Manager and approval of the Project Manager. Final versions will be prepared by the Designer and submitted for review at each submission during the working document stage, using generic commissioning specifications provided by the Commissioning Manager and edited by the Designer so as to become project-specific. They will be supplemented by project-specific commissioning specifications prepared by the Designer, reviewed by the Commissioning Manager and approved by the Project Manager. They will also include samples of PI and PV report forms. Commissioning specifications will be incorporated into the construction specifications by the Designer.

.13 Installation Check Lists (ICL)

These are required to inform the Commissioning Manager of those systems which are ready for commissioning. A generic list is provided by the Commissioning Manager to the Designer, who will tailor them to meet the requirements of the project. Where these are not available, they will be developed by the Designer and approved by the Commissioning Manager. Where modifications are necessary, these will be completed no later than 10 weeks after approval of shop drawings.

.14 Product Information (PI) report forms

All product information relating to equipment and components supplied and installed on this project will be reported on approved PI report forms similar to the samples attached to the commissioning specifications. Some PI report forms already exist. Others will be prepared by the Designer, reviewed by the discipline specialists and approved by the Commissioning Manager no later than 10 weeks after approval of shop drawings for the equipment concerned. Instructions for use will be included in the commissioning specifications. All completed PI report forms will be certified by the Designer. After review and verification by the Commissioning Manager, these report forms will be included in the Building Management Manual.

.15 Performance Verification (PV) report forms

All results of commissioning will be entered on PV report forms. These will include the results of all commissioning tests and similar activities using approved PV report forms similar to the samples attached to the commissioning specifications. Some PV report forms already exist. Others will be prepared by the Designer, reviewed by the discipline specialists and approved by the Commissioning Manager no later than 10 weeks after approval of shop drawings for the equipment concerned. Instructions for use will be included in the commissioning specifications. All completed PV report forms will be certified by the Designer. After review and verification by the Commissioning Manager, these report forms will be included in the relevant Commissioning Reports.

.16 Commissioning reports

The completed PV report forms will be certified by the Designer and included in properly formatted Commissioning Reports. Before any reports are accepted, all reported results will be subject to verification by the Commissioning Manager.

.17 Activities during the Warranty Period

While all commissioning activities must be completed before the issuance of the Interim Certificate, it is anticipated that certain commissioning activities will be necessary during the Warranty Period, including:

- a. fine tuning of HVAC systems,
- b. adjustment of ventilation rates to promote good indoor air quality and reduce the deleterious effects of VOCs generated by off-gassing from construction materials and furnishings, etc,
- c. full-scale emergency evacuation exercises

.18 Tests to be performed by the Owner/User

None is anticipated on this project.

.19 Training Plans

a. General

The preliminary Training Plans will be developed in greater detail as design progresses and as the working documents are developed. These will be produced by the Designer and approved by the PWGSC Commissioning Manager to meet project-specific requirements and will include details provided by the Property Manager relating to numbers and prerequisite qualifications and skills of trainees, type of training (i.e. observation, hands-on, classroom), etc

b. Development

The Training Plans shall be completed before construction contract is 50% complete.

c. Commissioning training schedule

Will be prepared by the Contractor and will indicate in detail how training will be implemented, the duration of each training session, the trainers, trainees, etc.

d. Duration of training

Duration of training for each system, instruction aids, etc. will depend on complexity and PPM needs.

The minimum number of hours for training sessions will be identified in the commissioning specifications - particularly in Section 01 79 00.

e. Responsibilities

Training will be under the direction of the Designer and monitored by the Commissioning Manager. The Designer will also monitor all training activities including:

- i. Preparation of agenda and outlines,
- ii. Videotaping of all sessions as may be required, to be carried out by the Commissioning Manager

f. Instructors

Instructors and trainers will include the Designer, Contractor, specialist subcontractors, equipment manufacturers, suppliers and installers, factory-trained and certified equipment suppliers and manufacturers, factory-trained and certified maintenance specialist personnel and the service contractors holding service contracts for the following:

- i. security systems

- ii. broadcast systems
- iii. lighting control systems
- iv. elevators

and any other service contracts that may be implemented during this project.

g. Trainees

These will include the Property Manager, building operators, maintenance staff, security staff, technical specialists as necessary and facility occupants as necessary. The PWGSC Commissioning Manager will co-ordinate their attendance at agreed-upon times.

The following is a list of O&M personnel, property management staff and others requiring requisite training (NOTE: numbers to be confirmed):

Number

Facility Property Manager:

Operating Staff: Building Operators

Maintenance Staff: Building Maintenance

Service Contractors (e.g. Cleaning)

Security Staff:

h. Prerequisite skills and qualifications

Trainees will meet all identified qualification requirements of installed equipment and systems.

i. Details of training:

Training will include:

- i. Training sessions relating to the design philosophy: will be organized around the Building Management Manual and will include:

- 1. an overview of how each system is intended to operate
- 2. a description of design parameters and operating requirements
- 3. a description of operating strategies
- 4. information to assist in troubleshooting system operating problems.

These sessions are to be given by the Designer and shall be presented within three months after award of contract. This will permit all involved in the construction and future operation of this facility to become familiar with all aspects of the design philosophy. If the O&M personnel have not been identified or are not available at this time, these sessions will be repeated during the Contractor-led training sessions.

- ii. All aspects of operation under all normal, emergency and "what-if" modes, over the full range of operating ranges.
- iii. Detailed maintenance, troubleshooting, regular, preventive and emergency maintenance.

j. Organization of training:

Training will consist of the following elements, to be completed, with demonstration of completeness, before date of acceptance:

- i. Random on-site familiarization and observations during construction, installation,

layout of equipment, systems and components, start-up and testing of the work, access to approved shop drawings, equipment operating and maintenance data. On-site observations will include still-photo records as deemed necessary by the O&M personnel - particularly of concealed elements.

- ii. Hands-on instruction relating to start-up; shut-down; emergency procedures; features of controls; monitoring; servicing; maintenance; performance verification and commissioning; reasons for, results of and implications on associated systems of adjustment of setpoints of control, limit and safety devices; interaction among systems during integrated operation; and troubleshooting diagnostics. Other elements will include system operating sequences, step-by-step directions for operation of valves, dampers, switches, adjustment of control settings and other specialized training relating to installed systems.
 - iii. Formal classroom sessions relating to functional and operational requirements, system philosophy, limitations of each system, and operation and use of Building Management Manual. Duration of these sessions will be as specified in the commissioning specifications, using space to be identified.
- k. Timing of training:

Training shall be conducted only after commissioning and performance verification tests of all components, equipment, sub-systems, systems and integrated systems have been completed.

Training to be completed, with demonstration of completeness, before date of acceptance:
- l. Implementation of training:

The Contractor will be responsible for implementation of training activities, quality of instruction and training materials and for coordination among the instructors.
- m. Training materials

Training materials will be in a form permitting future training procedures to be in the same degree of detail and will include at least the following:

 - i. "As-built" contract documents
 - ii. Building Management Manual
 - iii. TAB and PV reports
 - iv. Transparencies for overhead projectors and 35 mm slides
 - v. Manufacturers' training videos (after prior screening for suitability)
 - vi. Equipment models.
- n. Completion of training

All training will be completed prior to issuance of the Interim Certificate.
- o. Videotaping

Hands-on and classroom sessions will be videotaped for future reference and retraining but will be held only after all systems have been fully commissioned.

Production will be of professional quality and organized into several short modules to permit incorporation of changes.

The Video may be recorded on a USB or CD-ROM to permit visualization on a PC by operations staff at a later date.

p. Standard of training

Training will be in sufficient detail and of sufficient duration to ensure:

- i. Safe, reliable, cost-effective, energy-efficient operation of all systems in normal and emergency modes and under all conditions
- ii. Effective ongoing inspection, measurements of system performance
- iii. Proper preventative maintenance diagnosis, troubleshooting
- iv. Ability to update documentation
- v. Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

q. Limitations

Long-term ongoing training will not be included. However, the training courses and training materials including video-taping will permit further ongoing training as well as training of new personnel.

r. Demonstrations

Training will include demonstrations by the trained personnel to show their confidence in, and depth of understanding of, all installed systems and equipment and to demonstrate completeness of their training.

s. Manufacturers' video-based training

Video will be used as training tool after Engineer's review of videos and written approval at least three months prior to static completion. To be included in Construction and Completion Schedule.

t. Evaluation Report

The final Commissioning (i.e. Evaluation) Report will be produced, assessing the overall quality of the commissioning process and results obtained. It will include recommendations for any additional commissioning activities as well as feedback information for use in future similar projects

u. Data management requirements

In delivering the Commissioning Program, the Designer shall utilize a computer-based data management system. This will include the cost of all labour, materials, and electronic data processing (EDP) equipment to deliver the program (e.g. "as-built" drawings and specifications, PV and commissioning documentation, Building Management Manual, Training Plan).

12. Deliverables relating to the administration of commissioning

.1 General

- a. As detailed design develops, the Commissioning Plan will be revised to include provisions for testing all parameters to the full range of operating conditions and to check responses of all such equipment and systems under all conditions. This is necessary because the proper installation and operation of all systems are of paramount importance to health, safety, comfort and welfare of occupants and users.
- b. Six months is included in the completion schedule for verification of performance in opposite seasons and weather conditions.

- c. Detailed requirements relating to the timing of the various commissioning activities relative to the commissioning of other systems will be included in the commissioning specifications.

.2 Commissioning Schedule

A detailed Commissioning Schedule will be prepared by the Contractor's Commissioning Agent and submitted to the Commissioning Manager and Project Manager for review and approval at the same time as the Construction and Completion Schedule. It will include all necessary time-points and milestones, testing, documentation, training and commissioning activities. After approval, it will be incorporated into the Contractor's Construction and Completion Schedule.

The Designer, the Contractor and his commissioning agent, and the Commissioning Manager will monitor progress of commissioning against this schedule. A separate detailed schedule in day-by-day format will be provided by the Contractor for commissioning of all components, equipment, subsystems, systems and integrated systems. This schedule will include a detailed training schedule so as to demonstrate that there will be no conflicts with testing. The commissioning schedule will include the following milestones (as appropriate):

- a. Design criteria, design intents to Contractor: 14 days after contract award
- b. Pre-TAB review: 28 days after contract award, before construction starts
- c. Commissioning agents' credentials: more than 60 days before start of commissioning.
- d. Commissioning procedures (if different from specs or TAB standards): less than 3 months after award of contract.
- e. Commissioning Report format: less than 3 months after contract award.
- f. Discussion of heating/cooling loads for commissioning: more than 3 months before start-up.
- g. Submission of list of instrumentation with relevant certificates: more than 21 days before start of commissioning.
- h. Notification of intention to start TAB: at least 21 days before start of TAB.
- i. TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
- j. Notification of intention to start commissioning: at least 14 days before start of commissioning.
- k. Notification of intention to start commissioning of integrated systems: after commissioning of related systems is completed and at least 14 days before start of integrated system commissioning.
- l. Identification of deferred commissioning.
- m. Implementation of training plans.
- n. Commissioning Reports: immediately upon successful completion of commissioning.

.3 Commissioning schedule for mechanical systems

- a. The schedule of commissioning activities will be produced in a bar chart format to a scale that will ensure legibility. This bar chart will show sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods. It will also show commissioning resources which will be committed to this project to ensure completion by prescribed dates, the Training Plan and the commissioning Documentation

Plan.

b. HVAC systems:

- i. Sections of ductwork, piping and conduit systems to be concealed will be tested and certified to be to specified standards before being concealed.
- ii. HVAC systems will be initially started up, "bumped" in a stand-alone mode (i.e. without controls, fire alarms or smoke detectors) and pre-start-up inspections completed.
- iii. They will be started only after all dust-producing construction procedures have been completed and all areas are dust-free.
- iv. At this point, they may be started to replace temporary heating systems.
- v. They will be operated so as to permit TAB and to ensure full compliance with the contract documents when weather stripping, caulking and sealing of the exterior envelope has been completed, partitions and doors are installed and ceiling return plenums are in place.

c. Plumbing systems:

- i. These will be filled, pressure booster pumps "bumped" in a stand-alone mode and pre-start-up inspections completed. Thereafter flushing, cleaning and disinfection processes will take place.
- ii. Plumbing and other piping systems will be tested in conjunction with related control systems.

d. Items which may have a detrimental effect on operation and maintenance (e.g. noise, vibration) will receive preliminary attention at this point. Further attention to these items will occur as commissioning proceeds.

e. Equipment and systems subject to specified codes and standards or subject to the approval of an authority having jurisdiction: All equipment and systems will be commissioned in accordance with those requirements.

f. Indoor air quality (IAQ): Tests will be carried out only if and when the need arises.

g. Space environmental conditions: Tests will be carried out only if and when the need arises.

h. Final commissioning activities: Upon completion of commissioning to the satisfaction of the Commissioning Manager, all control devices will be locked in their final positions, settings will be indelibly marked and included in TAB and PV Reports.

.4 Commissioning schedule for electrical systems

a. A schedule of commissioning activities will be produced in a bar chart format to a scale that will ensure legibility. This bar chart will show sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods. It will also show commissioning resources which will be committed to this project to ensure completion by prescribed dates, the Training Plan and the commissioning Documentation Plan.

b. Main distribution system: Testing and commissioning will be defined in the construction specifications. The Contractor will conduct "megger" tests of feeders. Commissioning will require the services of an independent testing agency to perform a series of pre-energization and post-energization tests.

- c. Low voltage systems: These include clock, PA communications, low voltage lighting and data communications systems.
- d. Emergency power systems: Testing and commissioning of emergency generator, transfer switch and controllers will be included in the construction specification. Transfer switches will be tested by simulating loss of normal power. Power availability will be verified at all equipment requiring emergency power (e.g. emergency lighting, certain defined elevators, fire pumps, certain defined fans).
- e. Uninterruptible power systems: These systems will be tested under load in accordance with procedures prescribed in the construction specifications.
- f. Emergency lighting systems: Tests will be performed by interrupting normal power. Thereafter adequacy of coverage will be verified.
- g. Commissioning requirements will be included in the construction specifications.
- h. Reports of these tests, witnessed and certified by the Designer, will be submitted to the Commissioning Manager who will verify reported results.
- i. Upon completion of commissioning to the satisfaction of the Commissioning Manager, all control devices will be locked in their final positions, settings will be indelibly marked and included in Commissioning Reports.

END OF COMMISSIONING PLAN

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Motorized Analog Actuator MOD-101

Specification Reference: 40 05 57

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Differential Pressure Gauge DPG-101

Specification Reference: 23 34 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Security System Control Panel

Specification Reference: 28 16 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Auger 1

Specification Reference: 46 21 39

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Auger 2

Specification Reference: 46 21 39

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Automatic Transfer Switch

Specification Reference: 26 36 23

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Bathroom Vanity and Counter

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Bucketmounted Cart Dumper

Specification Reference: 41 23 23

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Building Flood Switch BFS-101

Specification Reference: 40 79 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Building Temperature and Humidity Sensor (BTH-101)

Specification Reference: 40 79 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: HD Camera CCTV-6

Specification Reference: 28 23 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: CCTV Monitor

Specification Reference: 28 23 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Fire Damper D-11

Specification Reference: 23 33 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Office Diffuser S-5

Specification Reference: 23 37 13

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Double Check Valve Backflow Preventer (After Water Meter)

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Drum Scrubber

Specification Reference: 44 13 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Supply Air Electric Duct Heater DH-1

Specification Reference: 23 72 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Emergency Battery Bank EL-3

Specification Reference: 26 52 13.13

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Emergency Lighting EL-1

Specification Reference: 26 52 13.13

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Engine Generator

Specification Reference: 26 32 13

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Process Room Exhaust Fan EF-1

Specification Reference: 23 34 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Electrical Room Exhaust Fan EF-2

Specification Reference: 23 34 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Washroom Exhaust Fan EF-3

Specification Reference: 23 34 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Exit Light

Specification Reference: 26 52 13.13

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Eyewash Shower Station

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Fill Line Spill Containment

Specification Reference: 23 35 16

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Grinder 1

Specification Reference: 46 21 39

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Grinder 2

Specification Reference: 46 21 39

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Gas Monitor - Hydrogen Sulfide (H2S-103)

Specification Reference: 40 79 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Eyewash Shower Station

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Indoor Crane

Specification Reference: 41 22 23

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Process Room Inline Fan IF-1

Specification Reference: 23 34 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Process Room Inline Fan IF-2

Specification Reference: 23 34 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lavatory Sink

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type A

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type B

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type C

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type D

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type f

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type G

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Lighting Type H

Specification Reference: 26 50 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Process Room Air Intake Louver L-3

Specification Reference: 23 33 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Gas Monitor - Methane (CH4-103)

Specification Reference: 40 79 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Natural Gas Furnace

Specification Reference: 23 54 16

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Network Video Recorder

Specification Reference: 28 23 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: PLC

Specification Reference: 25 51 00.01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Process Room Wash up Sink

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Reduced Pressure Zone Backflow Preventer

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Hallway Return Air Grate R-5

Specification Reference: 23 37 13

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: SCADA

Specification Reference: 27 20 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Security System Control Panel

Specification Reference: 28 16 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Security System Control Panel

Specification Reference: 28 16 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Shower

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Sluice Gate Valve 101

Specification Reference: 40 05 51

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Smoke Deteector SD

Specification Reference: 28 16 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: SCADA

Specification Reference: 27 20 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Ultrasonic Level Sensor (US-107)

Specification Reference: 40 72 00

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Explosion Proof Suspended Unit Heaters UHA

Specification Reference: 23 82 39.23

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
Manufacturer's Certificates		

Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Vanity, Sink and Faucet

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
☐ / Needs Retesting

Support Documents

	Date	Comments
Manufacturer's Report		
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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____

Performance Verification Form

Stony Mountain Institution - Wastewater Trash Removal Building

TAG ID/PRODUCT: Water Closet

Specification Reference: 22 05 01

Test Purpose: _____

Test Prerequisites: _____

Testing Procedures: _____

Description	Manufacturer	Model #	Comments

Inspection Check List

<input type="checkbox"/>	ID Tags	<input type="checkbox"/>	Correctly Piped	<input type="checkbox"/>	Wiring Complete
<input type="checkbox"/>	Clean	<input type="checkbox"/>	Piped to Drain	<input type="checkbox"/>	Correctly Wired
<input type="checkbox"/>	Not Damaged	<input type="checkbox"/>	Service Space	<input type="checkbox"/>	Isolation valves
<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Safety Labeling	<input type="checkbox"/>	Insulation
<input type="checkbox"/>	No Leaks	<input type="checkbox"/>	Proper Mounting	<input type="checkbox"/>	Alarms
<input type="checkbox"/>	Proper Clearance	<input type="checkbox"/>	Proper Supports	<input type="checkbox"/>	SCADA and Reporting

☒ Completed
☐ * Not Applicable
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Support Documents

	Date	Comments
Manufacturer's Report		
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Comments

Sign Offs:

Contractor: _____
Departmental
Representative
e _____

Date: _____

Date: _____