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END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SUMMARY OF WORK

1.0 SUMMARY OF WORK

1.1 General

- 1.1.1 The list of *Work* covered herein provides an approximate summary of *Work* and does not constitute a complete list of the *Work* of this Contract.

1.2 Work Covered by the Contract Documents

- 1.2.1 The *Work* is defined in the *Contract Documents* and includes but is not necessarily limited to the following:

- (a) All required submittals, including work plans, procedures, shop drawings, qualification documentation, etc.
- (b) Quality control measures and testing.
- (c) Temporary measures.
- (d) Construction facilities.
- (e) Field verification and layout of fencing, civil works and site grading, structure and building, utility piping, process piping, electrical and mechanical, septic tank, etc.
- (f) Supply and installation of cast-in-place concrete including shoring, dewatering, formwork, and reinforcing steel for wet wells, shallow foundations, utility pads, and sidewalks.
- (g) Supply and installation of all piping, including:
 - (i) HDPE and/or PVC piping to and from the wet well, including all fittings, couplings, flanges, valves, etc.
 - (ii) Weeping tile drainage.
 - (iii) Fabricated stainless steel piping, including all fittings, couplings, flanges, valves, etc.
 - (iv) Supply and installation of all production and custom fabricated pipe supports. Fabricated piping supports require the *Contractor's* Engineer to provide sealed shop drawings.
 - (v) Supply and install all instrumentation and controls.
 - (vi) Pressure testing and CCTV recording of all new piping as needed.
- (h) Installation, functional testing, and commissioning of vertical turbine pumps and associated electrical and controls.
- (i) Supply and installation of electrical components, including integration with existing equipment.

SUMMARY OF WORK

- (i) Power, network and control cables, including glands/connectors.
- (ii) Cable Tray, including supports and transition pieces to the existing cable tray and temporary cable supports when upsizing the tray.
- (iii) Manual operator control panels including supports.
- (iv) Additions to existing control and VFD panels.
- (j) Install owner-supplied generator and motor control center.
- (k) Complete the testing, commissioning, programming, and SCADA integrations as needed.
- (l) Supply and install all mechanical components of the system and complete electrical integration with these components, including:
 - (i) HVAC system
 - (ii) Plumbing, including septic tank and emergency shower and eyewash station, and indoor cistern.

1.3 Work by Others

1.3.1 The following work is being completed by other contractors:

- (a) Supply of Generator. Refer to Section 01 64 01 Owner Supplied Equipment
- (b) Supply of the Motor Control Center. Refer to Section 01 64 01 Owner Supplied Equipment.

1.4 Work by the Owner

1.4.1 The following work is being completed by the *Owner*:

- (a) Town personnel will assist in the temporary isolation of existing water systems as needed.

END OF SECTION

WORK RESTRICTIONS

1.0 CONSTRUCTION EXECUTION PLAN

- 1.1 The *Contractor* must submit to the *Consultant* at least ten (10) *Working Days* prior to mobilization, a construction execution plan in an organized digital (pdf) format.
- 1.2 The construction execution plan must describe in detail the plan and schedule to complete the *Project* and manage potential risks and day to day activities, at a minimum, it must include:
 - 1.2.1 Site access, haul routes and constructions staging locations;
 - 1.2.2 Construction sequencing and scheduling, for each phase of *Work*;
 - 1.2.3 Notification templates for residents regarding access and service interruptions;
 - 1.2.4 Access plan for emergency services;
 - 1.2.5 Adherence to the noise bylaw;
 - 1.2.6 Control of dust and mud tracking during construction and non-construction times;
 - 1.2.7 Environmental Procedures as described in Section 01 35 43;
 - 1.2.8 Traffic Control, Vehicle Access and Parking as described in Section 01 55 27;
 - 1.2.9 Coordination with shallow utility companies.
 - 1.2.10 Complaint resolution plan with residents.
 - 1.2.11 Anticipated project cash flow; and
 - 1.2.12 Erosion and Sediment Control Plan.
- 1.3 The *Consultant* and *Owner* will review the construction execution plan and may require additions, increased detail and other edits prior to approval.
- 1.4 All *Work* must comply with the approved construction execution plan.

2.0 PRE-CONSTRUCTION REPORTING

- 2.1 The *Contractor* is responsible for completing thorough pre-construction documentation for each property adjacent to the *Place of the Work*. At a minimum, the pre-construction documentation shall include a digital (pdf) copy of the following:
 - 2.1.1 Photographs labeled with date, location, and direction of view.
 - 2.1.2 Photographs showing the road frontage, house, private property, landscape features, fences, and all other features that are subject to potential damage by the *Contractor*.
 - 2.1.3 Photographs shall clearly document the pre-existing condition of all features including any defects or degradation.

WORK RESTRICTIONS

- 2.2 A digital (pdf) copy of the pre-construction documentation is to be provided to the *Consultant* prior to mobilization for retention and distribution to the *Owner*.
- 2.3 Any features not clearly documented will be deemed to have been in pristine condition prior to construction.
- 2.4 The *Contractor* is responsible for all costs arising from claims by homeowners or landowners that can't be defended against due to inadequate or unclear pre-construction documentation.

3.0 NOTIFICATION OF PROPERTY OWNERS AND RESIDENTS

- 3.1 The *Contractor* must provide notification of all service and access disruptions to all property owners and residents affected by the *Work* in accordance with the *Owner's* policies.
- 3.2 Notify, in writing, all property owners and residents affected by proposed construction. The notice shall provide contact names and phone numbers of the *Contractor*. Notification shall be done on a parcel-by-parcel basis, with each occupied property parcel contacted one week (7 days) in advance of construction activities. Notification shall be provided by the *Contractor*, to the landowners and residents in advance of any access restrictions, or service interruption during the construction. The content and form of the written notification shall first be reviewed by the *Consultant*. The *Contractor* shall incorporate any modifications or comments made by the *Consultant* into the notification form, prior to issuance.
- 3.3 If the *Contractor* fails to provide timely notice as described in this article, the *Contractor* must not proceed with *Work* in the affected area without the *Consultant's* written permission. Any delays incurred by the *Contractor* for failure to notify the property owners and residents will not serve as a reason to extend the *Contract Time*.

4.0 CONSTRUCTION STAGING AREAS

- 4.1 The *Contractor* shall be responsible for the delivery, storage and security of products, Materials, and equipment.
- 4.2 The *Owner* is not providing any space, outside of the *Place of the Work*, for the *Contractor's* use.
- 4.3 The *Contractor* is to provide to the *Consultant* with proof of Provincial Approval or, Municipal Approval, and landowner agreement prior to using any crown land or private land for any purpose.

5.0 WORK ON PRIVATE PROPERTY

- 5.1 For all *Work* on private land, the *Contractor* must complete the following:
 - 5.1.1 Confirm site specific requirements as per the individual written agreements or easements,

WORK RESTRICTIONS

5.1.2 Meet with the landowner to confirm schedule and any site-specific concerns of the landowner, and

5.1.3 Restore the private property to conditions similar to the preconstruction conditions.

6.0 SHALLOW UTILITIES

6.1 The *Contractor* must coordinate the *Work* with the shallow utility companies and provide adequate notice to the shallow utility companies for lines to be disconnected and/or installed as required to complete the *Work*.

7.0 MATERIAL DISPOSAL

7.1 The *Owner* is not providing any location for offsite disposal of surplus material. It is the *Contractor's* responsibility to legally dispose of all surplus material offsite.

7.2 The *Contractor* is to provide to the *Consultant* proof of all approvals and agreements prior to using any offsite disposal areas or facilities other than a licensed landfill.

7.3 The *Contractor* is responsible for material management and to provide any required stockpile storage as necessary to undertake the *Work*.

8.0 TREE CLEARING

8.1 No tree clearing is permitted from April 15 through August 15 unless an active nest survey is conducted, at the *Contractor's* cost, by a qualified environmental professional.

9.0 STORMWATER MANAGEMENT

9.1 The *Contractor* is responsible for managing all stormwater on the Project for the duration of the *Work*.

9.2 Management of stormwater includes, but is not limited to the following:

9.2.1 Maintaining existing overland flow routes.

9.2.2 Controlling erosion and sediment during storm events.

END OF SECTION

PAYMENT PROCEDURES

1.0 PROGRESS PAYMENT PROCEDURE

- 1.1 *Contractor* to provide a payment application by the 30th day of each month for *Work* completed up to, and including, the 25th day of month.
- 1.2 The payment application must include by the following:
 - 1.2.1 the total quantity, or the percent complete, for each pay *Item* for which payment is being requested;
 - 1.2.2 a marked up drawing generally indicating the areas of work that are being claimed on the payment application; and
 - 1.2.3 all documentation, as required by the *Contract Documents*, in support of the completed *Work*, materials, and products covered by the payment application including inspection reports, invoices, weigh tickets, and daily *Force Account* records.
 - 1.2.4 Anticipated cash flow for the remaining project duration.
- 1.3 *Consultant* will issue a *Payment Certificate* within five (5) *Business Days*. If the *Consultant* does not agree with the *Contractor* regarding any aspect of the payment application, then the *Consultant* shall:
 - 1.3.1 advise the *Contractor* of the reasons for the disagreement; and then
 - 1.3.2 issue the *Payment Certificate* in the amounts the *Consultant* determines are correct.
- 1.4 Following the issuance of the *Payment Certificate*, the *Contractor* is to provide an invoice, with the current date, that, where applicable, meets the requirements of the *Payment Legislation*, and is accompanied by the following:
 - 1.4.1 Copy of the *Payment Certificate* issued by the *Consultant*;
 - 1.4.2 A sworn declaration, on CCDC form 9A complete with copyright seal, that all amounts relating to the *Work*, due and owing as of the end of the month covered by the previous *Payment Certificate* to third parties including all *Subcontractors* and suppliers, have been paid; and
 - 1.4.3 Documentation, satisfactory to the *Owner*, showing compliance with *Workers' Compensation Act* and the *Occupational Health and Safety Act* requirements.

2.0 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

- 2.1 After issuance of certificate of *Substantial Performance*, the *Contractor* is to submit an application for payment of the holdback amount in accordance with Article 1.0 of this section.

PAYMENT PROCEDURES

- 2.2 The amount in the *Payment Certificate* for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in the *Lien Legislation*.

3.0 PROGRESSIVE RELEASE OF HOLDBACK

3.1 Release of Holdback for Subcontracts

- 3.1.1 Where *Lien Legislation* permits, the *Contractor* may make a written request to the *Consultant* for a progressive release of holdback associated with the *Work* of a *Subcontractor* or supplier that has been performed prior to *Substantial Performance*. The written request should contain enough information for the *Consultant* to reasonably verify that substantial performance of the subcontract has been achieved and the value of the holdback associated with the subcontract.
- 3.1.2 If the *Consultant* has verified that the *Work* of a *Subcontractor* or supplier has been substantially performed, the *Owner* shall pay the holdback amount retained for such subcontract *Work*, or products supplied by such supplier, on the day following expiration of holdback period for such *Work* stipulated in the *Lien Legislation*.
- 3.1.3 In addition to provisions of preceding paragraphs, ensure that such subcontract *Work* or products are protected pending issuance of the *Certificate of Total Performance* and be responsible for correction of defects or *Work* not performed regardless of whether or not such was apparent when such certificates were issued.

3.2 Annual Holdback Release

- 3.2.1 Where *Lien Legislation* permits, the Lien Holdback retained to December 25th of each year will be released on the *Payment Certificate* along with *Work* completed to February 25th.
- 3.2.2 The procedures described in Article 1.0 of this section apply the to the Annual Holdback Release.

END OF SECTION

PROJECT MEETINGS

1.0 PRE-CONSTRUCTION MEETING

- 1.1 Following *Notice of Award*, the *Consultant* will request a pre-construction meeting of the parties to the *Contract* to discuss and resolve administrative procedures and responsibilities.
- 1.2 Representatives of the *Owner*, *Consultant*, *Contractor*, any major *Subcontractors*, field inspectors, supervisors and surveyors shall be in attendance.
- 1.3 After the time and location of this meeting has been established, the *Contractor* shall notify all concerned parties a minimum four days before the meeting.
- 1.4 The *Consultant* shall chair and record discussions and decisions and circulate the meeting notes to all parties concerned.

2.0 PROGRESS MEETINGS

- 2.1 The *Consultant* shall schedule, chair and administer progress meetings throughout the progress of the *Work*. These meetings will be held bi-weekly.
- 2.2 Representatives of the *Contractor*, and any *Subcontractors* and *Suppliers* attending meetings, must be qualified and authorized to act on behalf of the party each represents. At a minimum, the *Contractor* must ensure that the site superintendent and project manager are available for all meetings.

END OF SECTION

SCHEDULES, PROGRESS REPORTS

1.0 SCHEDULES

- 1.1 Within ten (10) days after receipt of *Notice* of award, prepare and submit a detailed schedule for review by the *Consultant*. The schedule shall be in electronic form and prepared using Microsoft Project or Microsoft Excel software. The *Consultant* may require the use of Critical Path schedule methodology for complex projects.
- 1.2 Schedule shall show dates of commencement and completion of various parts of the *Work*, to the satisfaction of the *Consultant*.
- 1.3 All orders for materials shall be placed in ample time for adherence to the schedule.
- 1.4 Make special note of those times when extra work shifts are required to complete the *Work*.
- 1.5 Prepare definitive schedules for the following specific items:
 - 1.5.1 Schedule of all *Shop Drawings* required
 - 1.5.2 Schedule of material deliveries
 - 1.5.3 Schedule of construction phases
 - 1.5.4 Schedule of street closures and/or lane closures
- 1.6 *Work* may be carried out on Sundays except where prohibited by local bylaws or regulations.
- 1.7 If the *Contractor* desires to work on any day which is a statutory legal holiday the *Contractor* shall notify the *Consultant*, in writing, at least five (5) days in advance of such holiday, stating those places where such *Work* will be conducted. If the *Contractor* fails to give *Notice* in advance of any proposed work on a holiday, such failure shall be considered as a notification that no *Work* requiring the presence of the *Consultant* or their representative will be undertaken.

2.0 PROGRESS REPORTS

- 2.1 Maintain an accurate record of the progress of the *Work*. Submit weekly to the *Consultant*.
- 2.2 The record shall state dates of commencement and percentage of *Work* completed for the different parts of the *Work* and shall include particulars regarding daily weather conditions, number of workers on site, percentage of *Work* completed weekly and shall relate to the schedule.

END OF SECTION

SUBMITTALS PROCEDURES

1.0 SHOP DRAWINGS

- 1.1 *Shop Drawings* are to clearly indicate materials, methods of construction and attachment of anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of the *Work*. Where articles or equipment attach or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. *Shop Drawings* are to indicate their relationship to *Drawings* and *Specifications*. Notify the *Consultant* in writing of any deviations in *Shop Drawings* from the requirements of the *Contract Documents*. Submit digital copy of *Shop Drawings* only. Hard copy submissions of *Shop Drawings* will not be reviewed.
- 1.2 *Shop Drawing* file names must use the following format:

Division Number.Shop Drawing Number_Section Reference_Title_Revision

For example, a vertical turbine pump shop drawing could be named:

43.01_43 21 40_Vertical Turbine Pumps_Rev.0
- 1.3 *Shop Drawings* not stamped, signed and dated by the *Contractor* will be returned without being reviewed and will be stamped "Re-submit".
- 1.4 Failure to submit *Shop Drawings* in a timely manner shall not be considered sufficient reason for an extension to the *Contract Time*.
 - 1.4.1 The *Contractor* must allow for a minimum of 5 business days for the *Consultant* to review and respond to *Shop Drawings*. The *Contractor* is responsible for all schedule implications as a result of incomplete, incorrect, or rejected *Shop Drawings*.
- 1.5 *Shop Drawings* will be returned to the *Contractor* with one of the following notations:
 - 1.5.1 When stamped "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the *Work*.
 - 1.5.2 When stamped "REVIEWED AS MODIFIED - PROCEED", ensure that all copies for use are modified and distributed, same as specified for "NO EXCEPTIONS TAKEN".
 - 1.5.3 When stamped "REVISE & RE-SUBMIT", make the necessary revisions, as indicated, consistent with the *Contract Documents* and submit again for review.
 - 1.5.4 When stamped "NOT REVIEWED", submit other drawings, brochures, etc. for review consistent with the *Contract Documents*.
 - 1.5.5 Only *Shop Drawings* bearing "NO EXCEPTIONS TAKEN" or "REVIEWED AS MODIFIED - PROCEED" shall be used on the *Work* unless otherwise authorized by the *Consultant*.

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- 1.6 After submittals are stamped "NO EXCEPTIONS TAKEN" or "REVIEWED AS MODIFIED - PROCEED", no further revisions are permitted unless re-submitted to the *Consultant* for further review.
- 1.7 Any adjustments made on *Shop Drawings* by the *Consultant* are not an authorization to change the *Contract Price*. If it is considered that such adjustments affect the *Contract Price*, the *Contractor* shall clearly state as such, in writing, and obtain the *Owner's* agreement prior to proceeding with fabrication and installation of *Work*.
- 1.8 The *Contractor* shall make changes in *Shop Drawings* which the *Consultant* may require that are consistent with the *Contract Documents*. When re-submitting, notify the *Consultant* in writing of any revisions other than those requested by the *Consultant*.
- 1.9 The *Consultant's* review is for the sole purpose of ascertaining conformance with the general design concept. This review shall not constitute approval of the detail design inherent in the *Shop Drawings*, responsibility for which shall remain with the *Contractor* submitting the same. Review by the *Consultant* shall not relieve the *Contractor* of its responsibility for errors or omissions in the *Shop Drawings* or of its 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 processes or to techniques of construction, for installation, and for co-ordination of the *Work* of all sub-trades.

2.0 SAMPLES

- 2.1 Submit samples for the *Consultant's* review as specified or as the *Consultant* may reasonably request. Clearly label samples as to origin and intended use in the *Work*. Reference samples to *Contract Documents*.
- 2.2 Submit samples with reasonable promptness and in orderly sequence so as to cause no delay in the *Work*.
- 2.3 Notify the *Consultant* in writing, at the time of submission, of any deviations in samples from requirements of *Contract Documents*.
- 2.4 The *Consultant's* review will be for conformity of design concept and general arrangement only. Such review is not to be considered relief of responsibility for errors or omissions in samples or of responsibility for meeting all requirements of the *Contract Documents*.
- 2.5 Make changes in samples which the *Consultant* may require consistent with *Contract Documents*.

3.0 OPERATING/MAINTENANCE MANUALS

- 3.1 Not less than four (4) weeks prior to the scheduled *Commissioning* date, the *Contractor* must submit to the *Consultant* a digital copy (in indexed pdf format) of operating and maintenance manuals containing information required by the *Specifications*. Revise the digital copy of the manual as directed by the *Consultant* and provide the *Owner* with an

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updated digital copy and four (4) hard copies. At least one hard copy of the operation and maintenance manual must be on site before proceeding with *Commissioning*. All instructions in the manuals shall be in simple language to guide the *Owner* in the proper operation and maintenance of the installation.

- 3.2 Bind contents in a three-ring, hard covered, plastic jacketed binder. Organize contents into applicable sections of work, parallel to *Specifications* break-down. Name of facility to be embossed onto binder cover.
- 3.3 In addition to information called for in the *Specifications*, include the following:
 - 3.3.1 Title sheet, labeled "Operation and Maintenance Instructions", and containing project name and date.
 - 3.3.2 List of contents.
 - 3.3.3 Reviewed *Shop Drawings* of all equipment.
 - 3.3.4 As-built drawings of all mechanical, electrical, control, and alarm installations.
 - 3.3.5 Full description of entire mechanical, electrical, control, and alarm system and operation.
 - 3.3.6 Names, addresses and telephone numbers of all major *Subcontractors* and *Suppliers*.
 - 3.3.7 Operating instructions for all equipment.
 - 3.3.8 Maintenance and troubleshooting instructions for all equipment, including frequency of maintenance tasks. All routine maintenance tasks and frequencies to be summarized in one section within the operating and maintenance manual.
 - 3.3.9 Equipment parts lists.
 - 3.3.10 Emergency operating procedures.
 - 3.3.11 Certified head/capacity curves for pumps.
- 3.4 Each section shall be separated from the preceding section with a plasticized cardboard divider with a tab denoting contents of the section.

4.0 RECORD DRAWINGS AND SURVEY

- 4.1 Following *Notice of Award*, the *Consultant* will provide a complete set of *Contract Drawings* for the purpose of maintaining "as-built" record drawings. Accurately record deviations from *Contract Documents* caused by site conditions and changes approved by the *Consultant*. Update as required and at intervals not exceeding one month.
- 4.2 Identify drawings as "Project Record Copy". Maintain in good condition and make available for inspection on site by *Consultant* at all times.

SUBMITTALS PROCEDURES

- 4.3 Not less than two (2) weeks prior to application for *Ready-for-Takeover* submit record drawings to *Consultant* for review. Provide the *Consultant* with a clearly legible hand marked as-constructed set of *Drawings* and an as-constructed 3D digital topographic survey compatible with the most recent version of AutoCAD in UTM NAD 83 local zone coordinates and a PNEZD comma delimited survey point file, including a complete and accurate record of the details and precise locations of the *Work* as they have been constructed in relation to the legal boundaries of the property or easement. The record shall include:
- 4.3.1 confirmation of all material sizes, types and classifications;
 - 4.3.2 locations and inverts of all installed watermains, sewer mains, reclaimed watermains, culverts, storm sewers and other utilities;
 - 4.3.3 locations and profiles of all relocated watermains, storm sewers and other utilities;
 - 4.3.4 locations, sizes and inverts of all existing services and utilities exposed during the course of the construction; and horizontal alignments of curbs, sidewalks and line painting that are constructed or reinstated.
 - 4.3.5 location of surface features including building corners, building aprons, building overhangs, fencing, access roads, utility poles, transformers, kiosks, utility vaults, valve boxes, manhole lids, trees, shrubs, signs, retaining walls, ditches, top of slope, bottom of slope and open raw land ground shots taken on a 2 m grid.

5.0 PHOTOGRAPHS AND PUBLICITY

- 5.1 No press or publicity releases will be permitted without approval of the *Consultant*.

END OF SECTION

ENVIRONMENTAL PROCEDURES

1.0 GENERAL

1.1 Fires

- 1.1.1 Fires and burning of rubbish on site are not permitted.

1.2 Disposal of Wastes

- 1.2.1 Do not bury rubbish and waste materials on site unless approved by the *Consultant*.
- 1.2.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into watercourses, storm or sanitary sewers.

1.3 Drainage

- 1.3.1 Prepare and submit an Erosion and Sediment Control Plan prepared by a qualified Environmental Professional or another qualified party acceptable to the *Owner* 14 days prior to the commencement of the work.
- 1.3.2 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- 1.3.3 Do not discharge water containing suspended materials into watercourses, sewer or drainage systems.
- 1.3.4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Federal, Provincial and Municipal requirements.

1.4 Site Clearing and Plant Protection

- 1.4.1 Protect existing trees and plants / shrubs on site and on adjacent properties except as indicated otherwise by *Contract Documents*. Carefully wrap all trees with burlap and encase with substantial timbers to a height of minimum 2.5 m where adjacent to construction work, material storage areas, and vehicle lanes. Similarly protect plants.
- 1.4.2 Protect roots during excavation and grading to minimize possible disturbance and damage. Do not allow traffic, vehicles and equipment to compact soil over tree and plant root systems.
- 1.4.3 Minimize stripping of topsoil and vegetation.
- 1.4.4 No tree removal will be permitted, unless otherwise indicated or designated by the *Consultant*.

1.5 Work Adjacent to Watercourses

- 1.5.1 Do not operate *Construction Equipment* in watercourses.
- 1.5.2 Do not use watercourse beds for borrow material without approval from Federal, Provincial and Municipal authorities.

ENVIRONMENTAL PROCEDURES

- 1.5.3 Do not dump excavated fill, waste material or debris in or adjacent to watercourses.
- 1.5.4 Design and construct temporary crossings to minimize erosion to watercourses.
- 1.5.5 Do not skid logs or construction materials across watercourses.
- 1.5.6 Avoid spawning beds when constructing temporary crossings of watercourses.
- 1.5.7 Do not blast under water or within 100 m of spawning beds without approval from Federal, Provincial and Municipal authorities.
- 1.6 Nest/Wildlife Sweep
 - 1.6.1 Where applicable, the Contractor is to employ a Qualified Professional (someone with the education, knowledge, or experience to locate and identify the required wildlife features) to complete a nest/wildlife sweep in accordance with Environment Climate Change Canada's Guidelines to Reduce Risk to Migratory Birds.
 - 1.6.2 The Contractor shall submit a memorandum outlining the findings and recommended mitigations of the nest/wildlife sweep to the Consultant within twenty-four (24) hours of the nest/wildlife sweep.
 - 1.6.3 A Nest/Wildlife sweep shall be conducted prior to vegetation clearing or works which may cause incidental take of migratory birds.
 - 1.6.4 Nest/Wildlife sweeps will be valid for no longer than three (3) to seven (7) days depending on the time within the regional migratory bird's period.
- 1.7 Erosion and Sediment Control
 - 1.7.1 The ESC Plan is to be prepared in accordance with the Consultant's project specific Erosion and Sediment Control Guideline, Alberta Transportations most recent Erosion and Sediment Control Manual and in compliance with all applicable legislation, regulations, and environmental permits.
 - 1.7.2 The Consultant will review the ESC Plan and will advise the Contractor a minimum of (7) days prior to Mobilization on whether the ESC Plan provides sufficient detail with respect to the Project and appears compliant. The Contractor must address any issues or concerns regarding the proposed ESC Plan to the satisfaction of the Consultant a minimum seven (7) days prior to Mobilization.
 - 1.7.3 The Contractor is to inspect, monitor and report on erosion and sediment control weekly and after each rainfall event. The Contractor is to submit erosion and sediment control inspection reports to the Consultant for review.
 - 1.7.4 The Contractor is to provide erosion and sediment control maintenance throughout the duration of the Contract until Total Performance is achieved. This is to include the stockpile and laydown yard, and any borrow pit or stockpile locations.
 - 1.7.5 Inspection and maintenance records are to be documented by the Contractor and kept on site during Construction and provided to the Consultant for review.

ENVIRONMENTAL PROCEDURES

1.7.6 Erosion and Sediment Control Devices are permitted to be removed once revegetation of bare soil is successful, no obvious erosion scour is observed, no bed load of silt and sediment laden runoff is observed, and the inspection and maintenance records indicated satisfactory performance and at the approval of the Consultant. The Contractor is to notify the Consultant prior to the removal of Erosion and Sediment Control Devices.

1.8 Historical Resources

1.8.1 The Contractor is to stop Work and notify the Consultant and a Historical Resources Professional for review and recommendations should Historical Resources be discovered during the Work.

1.9 Pollution Control

1.9.1 Maintain temporary erosion and pollution control features installed under this *Contract*.

1.9.2 Control emissions from equipment and plant to local authorities emission requirements.

1.9.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

1.9.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. *Provide* dust control for temporary roads.

1.10 Inspection and Testing

1.10.1 Owner will arrange for all testing for Work described in this Section unless stated differently.

2.0 DEFINITIONS

2.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.

2.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

3.0 PRODUCTS

3.1 Silt Fence

ENVIRONMENTAL PROCEDURES

- 3.1.1 Silt fence to be manufactured from a woven, slit film geotextile material with a shiny to smooth surface texture designed to reduce velocity of runoff to point that suspended particles settle out due to reduction of hydraulic energy.
- 3.1.2 Minimum Requirements: (All values are "minimum average roll values".)
 - (a) Grab Tensile: 500 N
 - (b) Mullen Burst: 1,900 kPa
 - (c) Elongation at Break: 25% maximum
 - (d) Opening: 600 um maximum
 - (e) UV Rating at 500 hours: 90% retained
 - (f) Efficiency: >75% minimum
 - (g) Construction: woven (tape)
 - (h) Texture: smooth, shiny
 - (i) Posts: 4x4 cm, treated
 - (j) Post Spacing (centres): 2 m maximum
 - (k) Permittivity: 10 L/s/m²

4.0 EXECUTION

4.1 Placement

- 4.1.1 Place silt barrier in a manner that will intercept runoff at or close to right angles to flow. In areas where problem is severe, erect two or more silt barriers parallel to each other, until required degree of control is achieved.
- 4.1.2 Position posts in such a manner that fence, structure remains naturally taut and placed or driven a minimum of 500 mm into ground. Posts to always be positioned downstream.
- 4.1.3 Where a 500 mm depth is impractical or impossible adequately secure or brace posts to prevent overturning of fence due to sediment loading.
- 4.1.4 Bury excess geotextile at bottom of silt fence minimum of 150 mm in trench located upstream such that no flow can pass under fence.
- 4.1.5 Splice subsequent lengths of barrier only at support post locations. Splice by wrapping geotextile fabric completely around each of two abutting support posts such that gap between abutting posts is completely covered by both sections of fabric.

4.2 Quantities

- 4.2.1 Limit silt fence to handle area equivalent to maximum 100 m² per 3 m of fence.

ENVIRONMENTAL PROCEDURES

- 4.2.2 Do not use where site slope is steeper than 3:1 and water flow rates exceed 0.03 m²/s per 3 m of fence.
- 4.2.3 Silt barrier to have efficiency > 75%. Employ successive, parallel fences to achieve required degree of control.
- 4.3 Maintenance
 - 4.3.1 Maintain integrity of silt fences as long as necessary to contain sediment runoff. Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make daily review of location of silt fences in areas where construction activities have changed natural contours and drainage runoff to ensure that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences. Should silt fence become damaged or otherwise ineffective while barrier is still necessary, repair or replace promptly.
 - 4.3.2 Remove sediment deposits when deposit reaches approximately one-third of height of silt fence or install second silt fence upslope.
 - 4.3.3 Do not remove silt fence until *Consultant* directs that it be removed.
- 4.4 Clean Up
 - 4.4.1 At completion of construction phase or as directed by *Consultant*, remove and dispose of any silt accumulations, dress area to give a pleasing appearance, and vegetate all bare areas as specified.

END OF SECTION

REGULATORY REQUIREMENTS

1.0 SAFETY

- 1.1 Observe and enforce all construction safety measures required by applicable codes, regulations and statutes.
- 1.2 In the event of an emergency threatening health, life or property, the *Contractor* shall take such reasonable action as may be necessary to save lives and protect persons from injury. The *Contractor* shall notify the *Owner* of such emergency as promptly as is practical under the circumstances."
- 1.3 Appoint a suitably qualified employee who has sole responsibility on site, on behalf of the *Contractor*, for compliance with the requirements noted in 1.1 above.
- 1.4 In the event of discrepancy between such requirements, the most stringent requirement shall apply.
- 1.5 Employ a qualified specialist for the design of all shoring and false work.
- 1.6 Make available four (4) "Visitor safety helmets" for authorized visitors.
- 1.7 If "NO SMOKING" regulations are in effect in areas of the *Work*, ensure that all workers comply with the regulations.
- 1.8 Ensure that all workers comply with the *Owner's* safety regulations where such regulations are in effect.
- 1.9 Do not load or permit to be loaded any part of the *Work* with a weight, load or force that will exceed the design load and/or endanger its safety.

2.0 CLEANING OF STREETS

- 2.1 Conform to local ordinances and by-laws relating to littering of streets.
- 2.2 Take precautions to prevent depositing mud or debris on public or private roadways adjacent to the *Work*. Clean up immediately, otherwise the *Consultant* will direct necessary cleanup with all costs charged back to the *Contractor*.

3.0 WORKING LIMITS/EASEMENTS

- 3.1 Confine all operations within the *Owner's* property lines unless arrangements have been made by the *Owner* for easement access to private property.
- 3.2 Arrange for encroachment on areas beyond property lines or easement boundaries separately with the property owners.
- 3.3 The *Contractor* shall ensure that all excavated materials, materials to be incorporated in the *Work* and employee access be maintained within the prescribed limits. Cost of repairs to adjacent property shall be borne by the *Contractor*.

REGULATORY REQUIREMENTS

- 3.4 The *Contractor* shall be responsible for negotiating and obtaining permission, in writing, for the use of any other private lands.
- 3.5 Prior to the *Owner* formally accepting any construction in easements, the *Contractor* must have the property owners sign individual easement releases on a form provided by the *Owner* attesting to the satisfactory restoration of their property.
- 3.6 In general, restoration within easements will be to a condition equal to that prior to construction. Only trees which are designed for permanent removal shall be removed and not replaced. Existing turf shall be replaced with new turf. Seeding only of existing turfed areas will not be permitted.
- 3.7 No additional compensation will be made to the *Contractor* for restoration in easements and for securing the specified releases from the property owners.
- 3.8 *Work* in all backyard and side yard easements will be carried out in such a manner as to provide the minimum of disruption to the private owner's property. This may require hand digging or combined machine/hand digging in certain minimum clearance areas.
- 3.9 Timing is of the essence for all *Work* carried out in the easements. The *Contractor* shall ensure the *Work* is carried out in such a manner as to ensure a minimum amount of time is spent within each easement.
- 3.10 The *Contractor* shall give the owner of the property where the *Work* is to be carried out a minimum of 48 hours advance notice of the commencement of *Work* and the owner will indicate to the *Contractor* any limitation regarding access.
- 3.11 The *Contractor* shall be fully responsible and pay for all damages which may be the result of their performance of the *Work*.
- 3.12 Underground sprinkler system piping, wiring, heads and other associated appurtenances shall be repaired and restored to condition equal to or better than that existing prior to construction.
- 3.13 Existing fences shall be taken down, where required, and replaced by the *Contractor* immediately after completion of the *Work*.
- 3.14 Where trees, shrubs, bushes are adjacent to the excavation, care will be taken to avoid damage wherever possible.
- 3.15 The *Contractor* shall be responsible for removing and replacing any walls, existing buildings or structures located within easements. Replacement of building support pads, foundations, retaining wall or other structures requiring removal for construction purposes, will be by the *Contractor* and such removal and replacement shall be considered as lot restoration for which no additional compensation will be paid.
- 3.16 The signed release form from the property owner shall not relieve the *Contractor* from any of its obligations under GC **Error! Reference source not found. – Error! Reference source not found.**

REGULATORY REQUIREMENTS

4.0 EXISTING UTILITIES

- 4.1 Conform to Provincial and municipal regulations during construction in proximity to utility structures.
- 4.2 The *Contractor* shall notify the authority having jurisdiction over each utility one week in advance of their anticipated plan to carry out *Work* in the vicinity of that utility. The *Contractor* shall also arrange if required, for a representative of the utility company to be present at the time the *Work* is being carried out, at no cost to the *Owner*.
- 4.3 Make arrangements with utility companies for protection of pipelines, conduits, drain lines, wiring, and other structures, whether underground, on the surface, or overhead, and satisfy each utility company that the methods or operations are effective.
- 4.4 Indemnify and save harmless the owners of these existing utilities from any loss or damage which may be suffered by reason of the operations of the *Contractor* in the performance of the *Contract*.
- 4.5 At no time operate or adjust in any way an existing utility without first receiving approval from the subject utility.

END OF SECTION

ABBREVIATIONS AND ACRONYMS

1.0 GENERAL

1.1 This section must be referenced to, and interpreted simultaneously with, all other sections pertinent to the *Works* described herein.

1.2 Abbreviations and Acronyms

1.2.1 General

(a)	AASHTO	American Association of State Highway and Transportation Officials
(b)	ACI	American Concrete Institute
(c)	AI	Asphalt Institute
(d)	AISC	American Institute of Steel Construction
(e)	AISI	American Iron and Steel Institute
(f)	ARCA	Alberta Roofing Contractors Association
(g)	ASCE	American Society of Civil Consultants
(h)	ASTM	American Society for Testing and Materials
(i)	AWPA	American Wood Preservers Associations
(j)	AWS	American Welding Society
(k)	BCLMA	B.C. Lumber Manufacturer's Association
(l)	BCLNA	B.C. Landscape and Nursery Association
(m)	BCBC	BC Building Code
(n)	CAN	National Standard of Canada
(o)	CCA	Canadian Construction Association
(p)	CISC	Canadian Institute of Steel Construction
(q)	CITC	Canadian Institute of Timber Construction
(r)	CPCI	Canadian Prestressed Concrete Institute
(s)	CRCA	Canadian Roofing Contractors Association
(t)	CSA	Canadian Standards Association
(u)	C-SHRP	Strategic Highway Research Program – Canadian Component
(v)	CWB	Canadian Welding Bureau
(w)	ISO	International Organization for Standardization

ABBREVIATIONS AND ACRONYMS

	(x)	MSS	Manufacturer's Standardization Society
	(y)	NACE	National Association of Corrosion Engineers
	(z)	NBC	National Building Code
	(aa)	PCI	Prestressed Concrete Institute
	(bb)	PMBC	Plywood Manufacturer's Association
	(cc)	SJI	Steel Joist Institute
	(dd)	SSPC	Steel Structures Painting Council
	(ee)	WCB	Worker's Compensation Board
1.2.2	Utilities		
	(a)	API	American Petroleum Institute
	(b)	AWWA	American Water Works Association
	(c)	CGA	Canadian Gas Association
	(d)	CGSB	Canadian General Standards Board
	(e)	CSPI	Corrugated Steel Pipe Institute
	(f)	IAO	Insurer's Advisory Organization
	(g)	RTAC	Roads and Transportation Association of Canada
	(h)	ULC	Underwriters Laboratories of Canada
	(i)	USA	United States of America Standards (ASA)
1.2.3	Mechanical		
	(a)	AFBMA	Anti Friction Bearing Manufacturer's Association
	(b)	AGMA	American Gear Manufacturer's Association
	(c)	AMCA	Air Moving and Conditioning Association
	(d)	ANSI	American National Standards Institute
	(e)	ACR	Air Conditioning and Refrigeration Institute
	(f)	ASHRAE	American Society of Heating Refrigerating and Air Conditioning Consultants
	(g)	ASME	American Society of Mechanical Engineers
	(h)	EJMA	Expansion Joint Manufacturers Association
	(i)	NFPA	National Fire Protection Association
	(j)	SAE	Society of Automotive Consultants

ABBREVIATIONS AND ACRONYMS

- (k) SMACNASheet Metal and Air Conditioning Contractor's National Association

1.2.4 Electrical

- (a) AIEE American Institute of Electrical Consultants
(b) CEC Canadian Electrical Code
(c) EEMAC Electrical and Electronic Manufacturers Association of Canada
(d) IEC International Electrotechnical Commission
(e) IEEE Institute of Electrical and Electronic Consultants
(f) IES Illuminating Consultants Society
(g) IPCEA Insulated Power Cable Consultant's Association
(h) LEMA Lighting Equipment Manufacturer's Association
(i) NEC National Electrical Code
(j) NEMA National Electrical Manufacturers Association
(k) NESC National Electrical Safety Code

1.3 Use of Abbreviations

- 1.3.1 These abbreviations refer to Specifications, Methods and Standards issued by the respective Association, and the abbreviations are used in the *Specifications*.
1.3.2 Alphanumeric designations following the abbreviations denote the specification, method, or standard.

1.4 Units

- 1.4.1 The *Specifications* are metric and metric usage is based upon SI units in accordance with CSA Standard CAN/CSA-Z234.1 Canadian Metric Practice Guide. In this specification SI units are abbreviated in accordance with the Metric Units and Abbreviations below.

1.4.2 Linear Measure

- (a) Meter m
(b) Millimeter mm
(c) Kilometer km
(d) Micrometer micro-m

1.4.3 Area

- (a) Square meter m²

ABBREVIATIONS AND ACRONYMS

	(b)	Square millimeter	mm ²
	(c)	Hectare	ha
1.4.4	Volume		
	(a)	Cubic meter	m ³
	(b)	Liter	L
1.4.5	Mass and Density		
	(a)	Kilogram	kg
	(b)	Gram	g
	(c)	Tonne	t
	(d)	Kilogram per meter	kg/m
	(e)	Gram per meter	g/m
	(f)	Kilogram per square meter	kg/m ²
	(g)	Gram per square meter	g/m ²
	(h)	Kilogram per cubic meter	kg/m ³
1.4.6	Temperature		
	(a)	Degree Celsius	°C
1.4.7	Force, Pressure, Stress		
	(a)	Newton	N
	(b)	Kilonewton	kN
	(c)	Pascal	Pa
	(d)	Kilopascal	kPa
	(e)	Megapascal	MPa
1.4.8	Velocity, Rate of Flow		
	(a)	Meter per second	m/s
	(b)	Meter per hour	m/h
	(c)	Kilometer per hour	km/h
	(d)	Liter per second	L/s
	(e)	Cubic meter per second	m ³ /s
1.4.9	Power, Energy, Heat, Work		
	(a)	Watt	W

ABBREVIATIONS AND ACRONYMS

	(b)	Kilowatt	kW
	(c)	Kilowatt hour	kWh
	(d)	Joule	J
1.4.10		Electricity	
	(a)	Ampere	A
	(b)	Volt	V

END OF SECTION

QUALITY REQUIREMENTS

1.0 GENERAL

- 1.1 The *Contractor* is fully responsible for the quality of material and *Product* which they Provide and the quality of the *Work*.
- 1.2 The *Contractor* is responsible for *Quality Control* and shall perform such inspections and tests as are necessary to ensure that the *Work* conforms to the requirements of the *Contract Documents*.
- 1.3 During the progress of the *Work*, a sufficient number of tests shall be performed by the *Contractor* to determine that material, *Product* and installation meet the specified requirements.
- 1.4 Minimum requirements regarding *Quality Control* are specified in various sections of the *Specifications* and hereunder, however, the *Contractor* shall perform as many inspections and tests as are necessary to ensure that the *Work* conforms to the requirements of the *Contract Documents*.
- 1.5 Inspection and testing shall be in accordance with the pertinent codes and regulations, and with selected standards of the American Society for Testing and Material (ASTM), Canadian Standards Association (CSA), and other standards as specified in the *Contract Documents*.
- 1.6 *Product* testing, mill tests and laboratory reports to demonstrate that the *Product* and material supplied by the *Contractor* meets the *Specifications* are specified under various sections of the *Contract Documents*.

2.0 QUALITY CONTROL TESTING BY THE CONTRACTOR

- 2.1 The *Contractor* shall retain the services of an independent testing agency under supervision of a registered professional engineer, and pay the cost of testing services for *Quality Control*, including, but not limited to, the following:
 - 2.1.1 Sieve analysis of aggregates to be supplied to the *Work*;
 - 2.1.2 Aggregates and mix design for concrete;
 - 2.1.3 Aggregates and mix designs for soil cement base course;
 - 2.1.4 Aggregates and mix designs for asphaltic concrete;
 - 2.1.5 Standard Proctor Density curves for backfill materials;
 - 2.1.6 Standard Proctor Density curves for approved native backfill;
 - 2.1.7 Compaction test results for backfill and embankment material;
 - 2.1.8 All concrete tests in accordance with CSA A23.1 and Section 03 30 00. This will include:
 - (a) Air and slump tests;

QUALITY REQUIREMENTS

- (b) Cylinder compression tests (minimum 3 per each 60 m³ of concrete placed);

2.1.9 Any other *Product* testing that is required and is specified under various sections of the *Specifications*.

2.2 The *Contractor* is responsible for all other testing as required by the *Contract Documents*.

2.3 The *Contractor* shall promptly process and distribute all required copies of test reports and test information and related instructions to all of his *Subcontractors* and *Suppliers* to ensure that all necessary retesting and replacement of construction can proceed without delay.

2.4 The *Contractor* shall promptly provide the *Consultant* with copies of all test results.

3.0 QUALITY ASSURANCE TESTING BY THE OWNER

3.1 The *Owner* will retain the services of an independent testing agency to approve subgrade. The *Contractor* is to provide a minimum of five *Working Days* notice prior to when a subgrade inspection is required.

3.2 The *Owner* may also retain and pay for the services of an independent testing agency for *Quality Assurance* testing, for the *Owner's* purposes.

3.3 The *Owner's* testing agency and the *Consultant* may inspect and test material, *Product* and the *Work* for conformance with the requirements of the *Contract Documents*; however, they do not undertake to check the quality of the *Work* on behalf of the *Contractor* nor to provide *Quality Control*.

3.4 Inspections and tests by the *Owner's* testing agency and by the *Consultant* do not relieve the *Contractor* of their responsibility to supply material and *Product* and to perform the *Work* in accordance with the requirements of the *Contract Documents*.

3.5 The *Consultant*, at their direction, may order or perform any additional inspections and tests for the purposes of their own or for purposes of the *Owner*.

3.6 The *Contractor* shall coordinate with the *Consultant* the scheduling of the testing and inspection by the *Owner's* testing agencies or by the *Consultant*, to enable testing to be done as necessary, without delay, and the *Contractor* shall notify the *Consultant* sufficiently in advance of operations to allow for such inspection and tests by the *Consultant's* or the *Owner's* testing agency.

3.7 The *Contractor* shall allow the *Consultant* and the *Owner's* testing agencies access to all portions of the *Work* and manufacturing or fabrication plants as necessary. Provide facilities for such access.

4.0 CODE COMPLIANCE TESTING

4.1 Inspections and tests required by the codes or ordinances, or by a plan approval authority, shall be the responsibility of and shall be paid for by the *Contractor*.

QUALITY REQUIREMENTS

- 4.2 Copies of reports resulting from such inspections shall be submitted in a timely manner by the *Contractor* to the *Owner*.

5.0 RETESTING

- 5.1 When tests on *Product*, material or completed portions of the *Work* carried out by the *Contractor* or the *Contractor's* testing agency or by the *Owner's* testing agency yield results not meeting the requirements of the *Contract Documents*, the *Contractor* in addition to carrying out remedial work or replacement of the *Product* or material shall provide for retesting of the remedied *Work* and the replacement *Product* and material. Retesting, including retesting by the *Owner's* testing agency, shall be at the *Contractor's* expense.
- 5.2 In every case where the *Contractor* has submitted test results which fail to meet the requirements of the *Contract Documents*, the *Contractor* shall submit within a practical and reasonable time results of a retest showing that the results are in accordance with the requirements of the *Contract Documents*.
- 5.3 If the *Contractor* fails or refuses to do remedial work or replace unacceptable material or *Product*, the *Consultant* may refuse to certify payment and the *Owner* may refuse to make payment, in addition to any other remedies the *Owner* may have.

END OF SECTION

CONSTRUCTION FACILITIES

1.0 FIELD OFFICES AND SHEDS

1.1 General

1.1.1 The location of temporary structures and storage sites provided by the *Contractor* shall be subject to the approval of the *Consultant*.

1.1.2 The *Contractor* shall maintain temporary structures and storage sites in good order and on completion of the *Work* shall remove all temporary structures from the site.

1.2 *Contractor's* Office

1.2.1 Provide and maintain, in clean condition during entire progress of the *Work*, a suitable office adequately lighted, heated and ventilated, for own use. The location shall be subject to the approval of the *Consultant*.

1.2.2 Completely furnish office to allow for proper filing and examination of *Contract Documents* and regulatory documents.

1.2.3 Provide within office space a table and chairs to accommodate progress meetings.

1.2.4 Provide within office space adequate first aid facilities as required under the Occupational Health and Safety Act.

1.3 Equipment and Tool Storage

1.3.1 Provide and maintain in a clean and orderly condition adequate lockable storage sheds for tools and equipment.

1.4 Materials and Storage

1.4.1 Provide and maintain in a clean and orderly condition suitable weatherproof and lockable sheds for storage and protection of materials which require such protection.

1.4.2 Allocate storage areas on site for materials which do not require weatherproof sheds. Maintain areas in clean and orderly condition. Limit storage of materials and items to storage areas only.

2.0 UTILITIES

2.1 Sanitary Facilities

2.1.1 Provide sanitary facilities for workers in accordance with local health authorities. Maintain facilities in clean and tidy condition.

2.2 Water Supply

2.2.1 Provide a supply of potable water for use during construction.

2.3 Heating and Air Conditioning

CONSTRUCTION FACILITIES

- 2.3.1 Provide all heating and air conditioning required during construction period, including attendants, maintenance and fuel.
- 2.3.2 Pay for all costs in maintaining and providing temporary heat.
- 2.3.3 Be responsible for any damages to the *Work* due to failure in providing adequate heat and protection during construction.
- 2.4 Power and Light
 - 2.4.1 Provide power and light. Install in accordance with regulations of governing authorities.

3.0 BARRIERS

- 3.1 Guard Rail and Barricades
 - 3.1.1 In accordance with local safety regulations, provide guard railings and barricades, detour signs, watch persons, warning lights, flag persons around all excavations and provide railings and barricades around all elevated workspaces

4.0 CONSTRUCTION AIDS

- 4.1 Temporary Retaining Walls
 - 4.1.1 Provide a temporary shoring system to the Prime Consultant for review and approval before any excavation activities.
 - 4.1.2 The shoring system would include sheet piling, or secant piles, etc. as required to protect excavations, and trenches from damage caused by surface runoff, soil slopping, groundwater, or other soil and weather conditions and to beed in a manner which will not encumber the performance of the *Work*.
 - 4.1.3 The shoring system shall be designed and sealed by a professional engineer registered with APEGA

END OF SECTION

TRAFFIC CONTROL, VEHICLE ACCESS AND PARKING

1.0 GENERAL

- 1.1 This specification covers all aspects of traffic accommodation including the supply, installation, maintenance and removal of temporary construction signing and traffic control devices which are specifically related to construction, repair or emergency situations and which are generally removed when the *Work* is completed, or the *Work* no longer impacts traffic.
- 1.2 Submit a Traffic Management Plan to the *Consultant* prior to the commencement of construction. Plan to indicate alternate routes and accesses for all private property and will be reviewed with affected property owners prior to construction taking place.
- 1.3 During progress of the *Work*, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the *Work* so as to cause minimum of inconvenience to general public.
- 1.4 Give minimum 7 days' notice to emergency services and municipal works authorities prior to beginning construction and comply in all respects with their requirements.
- 1.5 Comply with stated requirements regarding closure of streets or highways and post proper notices and/or signals, and provide necessary barriers, guards, lights, flagmen or watchmen as may be necessary in best interests of public. All costs involved in respect of above requirements will be deemed to be included in the *Contract Price*.
- 1.6 Inform all owners, occupants or properties where access is affected in advance of proposed road and/or sidewalk closures.
- 1.7 For *Work* in public rights-of-way, road closures, detours and start of construction shall be advertised in local newspapers at least 48 hours in advance and on radio the morning of the commencement of each week that the subject road is affected. The cost of such advertising shall be included within the *Contract Price*.
- 1.8 Traffic accommodation and temporary construction signing is the sole responsibility of the *Contractor*.
- 1.9 Parking will be permitted on the site provided it does not disrupt the performance of the *Work*.
- 1.10 Maintain existing access roads to the site(s) at all times including supply and placement of gravel to repair damage resulting from *Contractor's* use of roads, grading, providing dust control and snow removal. If access will be temporarily interrupted, a minimum of 7 days' notice must be provided to the *Consultant*. Schedule work to minimize interruptions to access.

2.0 REFERENCE STANDARD

- 2.1 Regulate traffic in general accordance with local requirements.

TRAFFIC CONTROL, VEHICLE ACCESS AND PARKING

3.0 PROTECTION OF PUBLIC TRAFFIC

- 3.1 Comply with requirements of Acts, Regulations, and By-Laws in force for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.
- 3.2 When working on travelled way:
 - 3.2.1 Place equipment in position to present minimum of interference and hazard to travelling public.
 - 3.2.2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
 - 3.2.3 Do not leave equipment on travelled way overnight.
- 3.3 Do not close any lanes of road or highway without approval of the *Consultant*. Before rerouting traffic erect suitable signs and devices, provide sufficient crushed gravel to ensure a smooth riding surface.
- 3.4 At no time shall any intersection be closed over any weekend without the written permission of the *Consultant*.
- 3.5 Keep travelled way well graded, free of potholes and of sufficient width that required number of lanes of traffic may pass.
- 3.6 When directed by the *Consultant*, provide well graded, graveled detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights and maintain roadway, including gravel surfacing, dust palliative or paving of detour or temporary road as described and/or appropriate to such work.
- 3.7 Provide and maintain reasonable road access and egress to property fronting along or in vicinity of *Work* unless approved otherwise by the *Consultant*.
- 3.8 Excavation shall be conducted in a manner to cause the least interruption to traffic. When traffic must cross open trenches, the *Contractor* shall provide suitable "bridges" at street intersections, lanes, and driveways.
- 3.9 Maintain access for emergency vehicles through or around the *Place of the Work*.

4.0 INFORMATIONAL AND WARNING DEVICES

- 4.1 Meet with the *Consultant* prior to commencement of the *Work* to prepare list of signs and other devices required for *Project*.
- 4.2 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from the *Work*.
- 4.3 Supply and erect signs, delineators, barricades, and miscellaneous warning device as specified by Provincial highways ministry publications.

TRAFFIC CONTROL, VEHICLE ACCESS AND PARKING

- 4.4 Place signs and other devices in additional locations as appropriate or as directed by the *Consultant*.
- 4.5 Continually maintain traffic control devices in use by:
 - 4.5.1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - 4.5.2 Removing or covering signs which do not apply to conditions existing from day to day.

5.0 CONTROL OF PUBLIC TRAFFIC

- 5.1 Provide flag persons, trained and properly equipped in following situations:
 - 5.1.1 When public traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
 - 5.1.2 When it is necessary to institute one-way traffic system through the construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - 5.1.3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - 5.1.4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - 5.1.5 For emergency protection when other traffic control devices are not ready available.
 - 5.1.6 In situations where complete protection for workmen, working equipment and public traffic is not provided by other traffic control devices.
 - 5.1.7 At each end of restricted sections where pilot cars are required.
- 5.2 Provide pilot cars where public traffic must use particularly hazardous routes or where traffic is required to remain in one lane or change periodically from one lane to another or negotiate sections of construction at restricted speed. Equip pilot cars with orange flashing lights and signs clearly designating vehicles as pilot cars.
- 5.3 Provide and maintain suitable detours or temporary access routes for pedestrian traffic, complete with suitable warning and advisory signs.

END OF SECTION

PRODUCTS/WORKMANSHIP

1.0 PRODUCTS

1.1 Quality of *Products*

- 1.1.1 If requested, furnish evidence as to type, source and quality of *Products* provided.
- 1.1.2 Should any dispute arise as to the quality or fitness of materials, equipment or articles, the decision rests strictly with the *Consultant* based upon the requirements of the *Contract Documents*.
- 1.1.3 Unless otherwise indicated in the *Specifications*, maintain uniformity of manufacturer for any particular or like *Products*.
- 1.1.4 Permanent labels, trademarks, and nameplates on materials, equipment and articles are not acceptable in prominent locations except where required for operating instructions and when located in mechanical or electrical rooms.

1.2 Availability of *Products*

- 1.2.1 Following *Notice of Award*, review *Product* requirements and anticipate foreseeable delivery delays in any items. If delays in deliveries of materials, equipment or articles are foreseeable, propose substitutions or other remedial action in ample time to prevent delay in performance of the *Work*.
- 1.2.2 If such proposal is not provided to the *Consultant*, the *Consultant* reserves the right to substitute more readily available *Products* later in order to prevent delays, at no additional cost to the *Owner*.
- 1.2.3 No substitution of any *Product* will be permitted unless the *Product* cannot be incorporated into the *Work* within the *Contract Time*.
- 1.2.4 To receive approval, proposed substitutes must equal or exceed the quality, finish and performance of those specified and/or shown, and must not exceed the space requirements allotted on the *Drawings*.
- 1.2.5 *Provide* documentary proof of equality, difference in price (if any) and delivery dates in the form of certified quotations from *Suppliers* of both specified *Products* and proposed substitutions.
- 1.2.6 Include all costs in the difference in price (if any) for any required revisions to other structures and *Products* to accommodate such substitutions.

1.3 Storage, Handling, and Protection of *Products*

- 1.3.1 Handle and store *Products* in a manner to prevent damage, contamination, deterioration and soiling and in accordance with manufacturer's recommendations when applicable.

PRODUCTS/WORKMANSHIP

- 1.3.2 Store packaged or bundled *Products* in original and undamaged condition with manufacturers' seals and labels intact. Do not remove from packaging or bundling until incorporated into the *Work*.
- 1.3.3 *Products* subject to damage from weather are to be stored in weatherproof enclosures.
- 1.3.4 Store cementitious materials clear of earth on concrete floors and away from walls.
- 1.3.5 When used for grout or mortar materials, keep sand clean and dry. Store sand on polyethylene and cover with waterproof tarpaulins during inclement weather.
- 1.3.6 Store sheet material and lumber on flat, solid supports and keep clear of ground.
- 1.3.7 Store and mix paints in a room assigned for this purpose. Keep room under lock and key at all times. Remove oily rags and any other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- 1.3.8 Remove and replace damaged *Products* at own expense.
- 1.4 Manufacturer's Directions
 - 1.4.1 Unless otherwise specified, install or erect all *Products* in accordance with manufacturers' recommendations. Do not rely on labels or enclosures provided with *Products*. Obtain instructions directly from manufacturers.
 - 1.4.2 Notify the *Consultant*, in writing, of any conflicts between the *Contract Documents* and manufacturers' instructions.
- 1.5 Transportation Costs of *Products*
 - 1.5.1 Pay all costs for transportation of *Products* required for the *Work*.
 - 1.5.2 Transportation costs for *Products* supplied by the *Owner* will be paid by the *Owner*. Be responsible for unloading, handling and storage of such *Products* unless specified otherwise.

2.0 WORKMANSHIP

- 2.1 Co-ordination
 - 2.1.1 Co-ordinate the work of all *Subcontractors*, if such are engaged by the *Contractor*.
 - 2.1.2 Ensure that all *Subcontractors* examine the *Contract Documents* for other parts of the *Work* which may affect the performance of their work.
 - 2.1.3 Ensure that sleeves, openings and miscellaneous foundations are provided as required for the *Work*.
 - 2.1.4 Ensure that items to be built in are supplied, when required, with all necessary templates, measurements and *Shop Drawings*.
- 2.2 Cutting and Remedial *Work*

PRODUCTS/WORKMANSHIP

- 2.2.1 Perform all cutting and remedial work that may be required to make the several parts of the *Work* come together properly. Co-ordinate and schedule the *Work* to ensure that cutting and remedial work are kept to a minimum.
- 2.2.2 Should the *Owner* or anyone employed by him be responsible for ill-timed work necessitating cutting and/or remedial work to be performed, the cost of such work will be valued as provided in the General Conditions.
- 2.2.3 Employ specialists familiar with the materials affected in performing cutting and remedial work. Perform in a manner to neither damage nor endanger any portion of the *Work*.

3.0 MEASUREMENTS

3.1 Metric *Project*

- 3.1.1 Unless otherwise noted, this *Project* has been designed and is to be constructed in the S.I. metric system of measurements.
- 3.1.2 During construction, when specified metric elements are unattainable at the time they are required to meet the *Contract Time*, the *Contractor* shall notify the *Consultant* in writing and suggest alternative substitutions. Costs due to these substitutions shall be borne by the *Contractor*.

END OF SECTION

OWNER SUPPLIED EQUIPMENT

1.0 GENERAL

1.1 General

1.1.1 This section provides supplemental requirements and clarifications specific to the Owner-supplied equipment.

1.1.2 This section contains supplemental installation requirements to ensure Manufacturer criteria are achieved. The *Contractor* shall ensure the standby power generator (Geset) and the Motor Control Center (MCC) follow the requirements outlined in respective sections and divisions.

1.1.3 See Division 26 for additional information specific to motor installation and testing.

1.2 Definitions

1.2.1 Vendor / Manufacturer:

Vendor/Manufacturer: The party under a separate contract with the Owner to furnish the products and special services specified herein. Owner-Furnished Products

1.3 Owner Supplied Equipment:

1.3.1 Standby Power Generator (Genset) and Motor Control Center (MCC)

(a) The Owner is in the process of pre-purchasing a Genset and MCC. The *Contractor* to refer to the Reference Information for the technical details and work shall be performed by the supplier and the Contractor.

(i) Emergency power system for supply of power in the event of failure of normal supply as indicated and in accordance with Canadian Electrical Code Section 46 and local inspection authority. System to be automatic, unattended, emergency power supply consisting of:

(A) Diesel fuel powered, electric generating unit with control panel

(B) Accessories and equipment as specified.

(ii) Motor Control Center, accessories, and equipment as specified.

(b) Quantity: one (1) Genset and one (1) MCC

(c) Delivery Location: The *Vendor* will coordinate delivery of the equipment directly to the *Midline Pumo Station* site. Upon delivery, the *Contractor*, *Vendor* and *Consultant* will inspect the equipment. If the site is not ready, the Contractor shall coordinate the expected delivery date with the Vendor.

(d) Estimated Delivery Date: The *Contractor* may assume the Genset and MCC will be available by October/November 2025.

OWNER SUPPLIED EQUIPMENT

- (e) Handling and Storage: See *Manufacturer's* recommendations.
- (f) Certification of proper installation. *Contractor* and *Vendor* to sign Form 101.
- (g) Functional testing. The *Vendor* shall coordinate performance functional testing in coordination with the *Owner*, *Contractor*, and *Consultant*. The *Vendor* and *Contractor* shall sign Form 102.

1.4 Transfer of Products

- 1.4.1 The *Contractor* shall take temporary ownership of the Genset and MCC upon delivery to the site and visual inspection pending the satisfaction of the equipment conditions. Equipment ownership will be returned to the Owner after successful commissioning. While under temporary ownership, the Contractor shall assume full responsibility for each piece of equipment.
- 1.4.2 The *Contractor shall* ensure that all equipment-related activities are consistent with the *Manufacturer's* recommendations.

1.5 SCHEDULING

- 1.5.1 The *Owner* will keep the *Contractor* informed of planned delivery dates.

2.0 PRODUCTS (NOT USED)

3.0 EXECUTION

- 3.1 See Division 26.

END OF SECTION

FIELD ENGINEERING

1.0 REQUIREMENTS INCLUDED

- 1.1 The *Contractor* shall be responsible for:
 - 1.1.1 Field engineering survey services to measure and stake the site.
 - 1.1.2 Survey services to establish and confirm alignment and grade measurements for the *Work*.
 - 1.1.3 Providing an as-constructed survey per Section 01 33 00 – Submittal Procedures.
- 1.2 The *Owner* shall be responsible for:
 - 1.2.1 Providing a maximum of three control monuments and one benchmark for use by the *Contractor*.

2.0 RELATED REQUIREMENTS

- 2.1 Section 01 33 00 – Submittals Procedures.

3.0 SURVEY REFERENCE POINTS

- 3.1 Existing base horizontal and vertical control points are designated on the *Drawings*.
- 3.2 Locate, confirm, and protect control points. Preserve permanent reference points during construction.
- 3.3 Make no changes or relocations without prior written notice to the *Consultant*.
- 3.4 Report to *Consultant* when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- 3.5 *Contractor* to replace control points in accordance with the original survey control.

4.0 DRAWINGS AND DIGITAL INFORMATION

- 4.1 Issued for Construction Drawings
 - 4.1.1 The *Consultant* will provide the *Contractor* with three (3) full size colour copies of the Issued for Construction drawings and all revisions thereto for the *Contractor's* use.
 - 4.1.2 The *Consultant* will provide a PDF copy of the Issued for Construction drawings and all revisions thereto for the *Contractor's* use.
 - 4.1.3 This PDF file may be used by the *Contractor* to produce any paper copies, at the *Contractor's* cost, required in addition to those provided in Section 4.1.1.
- 4.2 AutoCAD Files
 - 4.2.1 The *Consultant* will provide an AutoCAD 2023 copy of the Issued for Construction line work and all revisions thereto for the sole purpose of survey layout.

FIELD ENGINEERING

- 4.2.2 No reproductions are permitted from the AutoCAD file.
- 4.2.3 All information obtained from the AutoCAD files, must be verified against the Issued for Construction drawings. Any discrepancies between the AutoCAD file and the Issued for Construction drawings must be immediately reported to the *Consultant*.

5.0 SURVEY REQUIREMENTS

- 5.1 Establish at least two additional permanent benchmarks on site, referenced to established benchmarks by survey control points. Record locations with horizontal and vertical data in Project Record Documents.
- 5.2 Establish all lines and levels; locate and lay out by instrumentation.
- 5.3 Stake for excavation, pipe laying and other related installations.
- 5.4 Establish pipe invert elevations.
- 5.5 All pipe grades shall be established by survey instruments and laser, unless otherwise approved by the *Consultant*.
- 5.6 The *Contractor* shall provide the *Consultant* with assistance as required, to aid in checking the layout surveys and the grades of the installed *Work*. There shall be no additional cost to the *Owner* for the provision of such assistance to the *Consultant*. The surveyors and the assistants provided by the *Contractor* shall be the same person or persons at all times for the duration of the *Contract*, or as otherwise approved by the *Consultant*.
- 5.7 The *Contractor* shall be charged with the cost of verifying or replacing any legal survey pins, monuments, or reference stakes damaged during construction by the *Contractor's* operations. In the event that the *Contractor* requires the removal of any legal survey markers for the purpose of the *Work*, the cost of replacement will be borne by the *Owner*, provided the written consent of the *Consultant* is first received and the pin has been adequately referenced by a Professional Land Surveyor.
- 5.8 The *Consultant* will make "random checks" of the *Contractor's Work* and will review the layout to ascertain general conformity with the intent of the *Contract Documents*. The *Consultant's* review shall in no way relieve the *Contractor* of his responsibilities for errors or omissions in the field surveys or of responsibility for meeting all requirements of the *Contract*.

END OF SECTION

CLOSEOUT PROCEDURES

1.0 FINAL CLEANING

- 1.1 Prior to *Ready-for-Takeover*, remove surplus *Products*, tools, construction machinery and equipment not required for the performance of the remaining *Work*.
- 1.2 Remove waste *Products* and debris and leave the *Work* clean and suitable for occupancy by *Owner*.
- 1.3 Prior to *Total Performance of the Work*, remove surplus *Products*, tools, construction machinery, equipment, waste products and debris.
- 1.4 Leave the *Work* clean before the final inspection process commences.
- 1.5 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- 1.6 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors, and ceilings.
- 1.7 Vacuum clean and dust building interiors, behind grilles, louvers and screens.
- 1.8 Wax, seal, shampoo or prepare building floor finishes, as recommended by the manufacturer.
- 1.9 Inspect finishes, fitments, and equipment and ensure specified workmanship and operation.
- 1.10 Broom clean and wash exterior walks, steps and surfaces.
- 1.11 Remove dirt and other disfigurements from exterior building surfaces.
- 1.12 Clean and sweep roofs, gutters, downspouts, areaways, and sunken walls.
- 1.13 Sweep and wash clean site paved areas.
- 1.14 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

2.0 SYSTEMS DEMONSTRATIONS

3.0 REFER TO SECTION 01 91 00. DOCUMENTS

- 3.1 Collect reviewed submittals and assemble documents completed by *Subcontractors*, *Suppliers*, and *Manufacturers*.
- 3.2 Submit material prior to application for *Ready-for-Takeover*. For equipment put into use with *Owner's* permission during construction, submit within ten (10) *Working Days* after start-up.
- 3.3 Provide warranties fully executed and notarized.

CLOSEOUT PROCEDURES

- 3.4 Execute transition of Performance and *Labour and Materials Payment Bond* to warranty period requirements.

4.0 REMOVAL OF TEMPORARY FACILITIES

- 4.1 Prior to application for *Ready-for-Takeover* remove all temporary offices and furniture, hoardings, fencing, tree and plant protection and all other items used to aid the performance of the *Work*. Make good surfaces.

5.0 PROJECT COMMISSIONING

- 5.1 Complete commissioning as outlined in Section 01 91 00.

6.0 INSPECTION/TAKEOVER PROCEDURES

- 6.1 During the final inspection of the *Work*, a list of deficiencies and defects will be tabulated.
- 6.2 Refer to Section 01 91 00.

END OF SECTION

GENERAL COMMISSIONING REQUIREMENTS

1.0 GENERAL

1.1 Summary

- 1.1.1 This section specifies requirements for *Commissioning* the *Works* into operation. This section must be referenced to, and interpreted simultaneously with, all other sections pertinent to the *Work* described herein.
- 1.1.2 Provide, commission, and turn over to the *Owner* the complete *Work*. During the *Commissioning* period demonstrate that the operation of the System as a whole, as well as all components, is correct and in accordance with the *Contract* requirements.
- 1.1.3 Testing and *Commissioning* shall be performed by the *Contractor* and witnessed by Manufacturer's representative(s) where specified, in the presence of the *Consultant* and the *Owner's* representative.
- 1.1.4 The *Consultant* will act as the *Commissioning* agent for the *Owner*.
- 1.1.5 Related Requirements
 - (a) Start up and test all pieces of equipment in accordance with individual *Specification* Sections.
 - (b) All Divisions to ensure that their specification results in all systems being fully tested and operational prior to *Commissioning*.
 - (c) Where not specifically detailed in individual *Specification* Sections, each piece of equipment shall be installed, started up and tested in accordance with the manufacturer's written instructions and procedures and in accordance with procedures and standards of applicable certification sponsoring associations before the system is commissioned as a whole.

1.2 Submittals for review

- 1.2.1 Prepare a written Testing and *Commissioning* Plan prior to commencement of testing and submit to the *Consultant* no later than 1 month before the start of testing and *Commissioning* for review and comment.
 - (a) A *Commissioning* Plan will be required for:
 - (i) Pumping Systems – including pumps, motors, controls and alarms.
 - (ii) Chemical System – including pumps, skids, tanks, controls and alarms.
 - (iii) Back Up Power – including the generator and Automatic Transfer Switch (ATS), controls, and associated ventilation and alarms. A power failure simulation shall be conducted as part of back-up power commissioning.

GENERAL COMMISSIONING REQUIREMENTS

- (iv) The Pump Station Control System – including all control signals, automatic valves, operational alarms, interlocks, and shutdowns.
 - (v) SCADA Integration as needed.
 - (vi) Electrical Control, Instrumentation, and Programming.
 - (vii) Heating and Ventilation System – including controls.
- (b) The Testing and *Commissioning* Plan will include but not be limited to;
 - (i) Submittal of Draft Operations and Maintenance Manual
 - (ii) Schedule of training sessions for each system and piece of equipment
 - (iii) Duration of *Commissioning* period
 - (iv) Name of organization and/or *Contractor* personnel proposed to perform *Commissioning* services.
 - (v) Designate who has managerial responsibility for coordination of entire *Commissioning* process and procedures.
 - (vi) Timing of site visits by Manufacturer's Representatives
 - (vii) Sequencing of equipment testing
 - (viii) Sequencing of connection to existing facilities
 - (ix) Sequencing of connection to source of process fluid
 - (x) Bypass procedures of the *Work* during *Commissioning* if required.
 - (xi) *Contractor*, *Subcontractor* and *Supplier* personnel to be present.
 - (xii) List of data to be recorded and analyses to be performed during the testing and *Commissioning* period.
 - (xiii) Form of final *Commissioning* report.
- 1.2.2 Provide summary of qualifications, certifications, training and experience of testing personnel if requested.
- 1.2.3 Provide final testing reports from equipment manufacturers or their representatives. Organization having managerial responsibility shall make reports. Final reports will include but not be limited to:
 - (a) Signature of recorder and supervisor of reporting organization on each testing record.
 - (b) Make and model of each instrument used, and latest date of calibration of each.

GENERAL COMMISSIONING REQUIREMENTS

- (c) Records of all operational data identified in the *Commissioning* Plan for each piece of equipment.
- 1.2.4 Provide Form 101 to 103 for the equipment listed below and other equipment identified throughout the *Contract Documents* per part 3 of this Section:
 - (a) Pumps
 - (b) Wet Well Level Control
 - (c) Chemical Pump Systems
 - (d) Flow Meters
 - (e) Flow Control Valves
 - (f) Pressure Transmitters
 - (g) Level Transmitters
 - (h) Level Switches
 - (i) Generator/Automatic Transfer Switch (ATS)
 - (j) Heating and Ventilation System
 - (k) Motor Control Center (MCC)
 - (l) Programmable Logic Control (PLC)
 - (m) Variable Frequency Drives (VFDs)
 - (n) Safety Devices
 - (o) Emergency Shower
- 1.3 Testing requirements
 - 1.3.1 Testing personnel shall have the training, experience and qualifications necessary to undertake the specified testing services specified in other sections and to undertake trouble-shooting and operation of the equipment.
 - 1.3.2 Comply with procedural standards of certifying association under whose standard *Commissioning* will be performed. Perform *Commissioning* under direction of supervisor qualified under certification requirements of applicable certifying association.
 - 1.3.3 Comply with applicable procedures and standards of the equipment manufacturer. Perform *Commissioning* under direction of supervisor qualified by the manufacturer.
 - 1.3.4 Laboratory services that are required to demonstrate compliance will be paid for by the *Contractor*.

GENERAL COMMISSIONING REQUIREMENTS

2.0 PRODUCTS

- 2.1.1 Consumables
- 2.1.2 The cost of power to commission the facilities will be paid for by the *Owner*.
- 2.1.3 Provide all lubricants required to commission the facilities.
- 2.1.4 The *Owner* will Provide any process chemicals required to commission the facilities.
- 2.1.5 Replace any spare parts used during the *Commissioning* period.
- 2.2 Testing Personnel
 - 2.2.1 Provide and pay for all testing personnel, regardless of the length of time required for *Commissioning* of the *Work*.

3.0 EXECUTION

- 3.1 General
 - 3.1.1 Prepare each system for *Commissioning*.
 - 3.1.2 Cooperate with testing organization(s) and provide access to equipment and systems.
 - 3.1.3 Provide personnel and operate systems at designated times in *Commissioning* Plan.
 - 3.1.4 Operate equipment in accordance with manufacturers' instructions and the *Commissioning* Plan.
 - 3.1.5 Submit proposed changes or deviations from the Testing and *Commissioning* Plan in writing to the *Consultant* for review and comment, and acceptance of proposed deviations must be received from *Consultant* prior to making change(s) or deviation(s).
 - 3.1.6 Report to *Consultant* any deficiencies or defects noted during testing and *Commissioning*.
 - 3.1.7 Operation of any existing system not part of the *Work* must be by *Owner's* personnel only.
- 3.2 Preparation
 - 3.2.1 Testing and *Commissioning* Plan.
 - (a) Revise Testing and *Commissioning* Plan based on *Consultant's* Review comments.
 - (b) Testing and *Commissioning* cannot proceed until the *Contractor's* plan has been approved by the *Consultant*.

GENERAL COMMISSIONING REQUIREMENTS

- 3.2.2 Failure to provide O&M manuals as specified prior to *Commissioning* may result in delay to *Commissioning* at the *Contractor's* expense.
- 3.2.3 Instruments
- (a) Provide instruments required for monitoring and adjusting operations.
 - (b) Make instruments available to *Consultant* as requested and as appropriate to facilitate spot checks during *Commissioning*.
 - (c) Retain possession of instruments and remove at satisfactory completion of *Commissioning*.
- 3.2.4 Notify *Consultant* 10 *Working Days* prior to beginning of testing and *Commissioning* operations.
- 3.2.5 Other sections of the *Specifications* may contain specific testing, cleaning, balancing and operation requirements, which are to be followed in conjunction with this Section. Complete all testing required by individual Sections and the items listed below prior to *Commissioning*;
- (a) Perform all specified static testing for pipe or ducting connected to the equipment.
 - (b) Inspect and clean all pipe, vessels and equipment and all electrical connections.
 - (c) Verify all equipment provided as part of the *Work* including but not limited to computers and electronic equipment are ready for full operation. Inspection must include but not be limited to:
 - (i) Soundness without damaged parts;
 - (ii) Completeness in all details as specified;
 - (iii) Correctness of setting, alignment and arrangements of parts;
 - (iv) Proper rotation of motors and drives;
 - (v) Adequacy and correctness of packing, sealing and lubrication.
 - (d) Submit Form 101 – Certificate of Satisfactory Installation for specified equipment.
 - (e) Run each piece of equipment for a minimum of 24 hours in accordance with the testing requirements in individual sections and in accordance with equipment manufacturer's recommended start-up testing procedures in the presence of the *Consultant* and *Owner's* Representatives.
 - (i) Test with water for equipment conveying liquid
 - (ii) Test with air for equipment conveying air

GENERAL COMMISSIONING REQUIREMENTS

- (f) Run each system for a minimum of 24 hours to demonstrate;
 - (i) The function of all components over the entire range of specified operation including variations in flow, pressures, speeds and controls.
 - (ii) Proper operation in hand and automatic control
 - (iii) All alarms, safety devices, interlocks, and annunciation by simulation of malfunctions
 - (g) Submit a brief testing report to the *Consultant* for each individual item and for each system.
 - (h) Submit Form 102 – Certificate of Satisfactory Testing for specified equipment.
- 3.2.6 Testing must indicate that individual items and systems are in good operating condition, comply with specified requirements and are ready for operation. Only alarms deliberately initiated for testing and verification will be acceptable.
- 3.2.7 Complete any adjustments recommended by the Manufacturer's Representative or rectification of deficiencies observed by the *Owner* or the *Consultant*.
- 3.2.8 Co-ordinate with *Owner* to ensure that all required *Owner* supplied consumables are on site and available for *Commissioning*.
- 3.2.9 Following the *Consultant's* acceptance of successful start-up and testing of all individual pieces of equipment the *Contractor* should begin *Commissioning* the facility.
- 3.3 *Commissioning*
 - 3.3.1 The *Contractor* must connect the *Work* to the source of design process fluid and run the System for 4 weeks. During this time the *Contractor* is responsible for operating the System and must coordinate integration into the overall System with the *Owner*.
 - 3.3.2 During Week 1 and 2:
 - (a) *Subcontractors*, *Suppliers*/manufacturers must be available for questions, troubleshooting, problem-solving and operation optimization.
 - (b) Complete training sessions as called for in the separate specification sections of Divisions. Training sessions may be scheduled earlier through collaboration with the *Consultant* and *Owner*. All training must be completed before the end of Week #1.
 - (c) The *Owner* will observe the operation by the *Contractor*, with the intention that the *Contractor*, *Subcontractors*, *Suppliers* and manufacturers will be

GENERAL COMMISSIONING REQUIREMENTS

- available to provide instruction and training to the *Owner* and available to answer questions from the *Owner* and *Consultant*.
- (d) Complete equipment and systems testing that require the equipment to be handling the design process fluid.
 - (e) Accurately record data as described in the *Commissioning* Plan. Submit for review.
- 3.3.3 After completion of Week 1 and after receiving the recorded data from Week 1 the *Consultant* will undertake final inspection of the *Work* for *Ready-For-Takeover*.
- 3.3.4 During Week #3 and 4:
- (a) The *Owner* will operate the *Work*, and the *Contractor* must observe.
 - (b) *Subcontractors*, *Suppliers*/manufacturers must be available to answer questions from the *Owner* and *Consultant* to assist with troubleshooting, problem solving and operation optimization.
 - (c) Additional deficiencies that are identified during Week #2 will be added to the *Ready-For-Takeover* list of deficiencies, and the *Contractor* will resolve issues and deficiencies arising out of Week #1 and Week #2 *Commissioning*.
- 3.3.5 Only alarms deliberately initiated for testing and verification will be acceptable.
- 3.3.6 Once *Commissioning* and *Owner* Training are complete to the satisfaction of the Manufacturer's Representative and the *Contractor*, a Certificate of Satisfactory *Commissioning* Form 103 must be completed for each system's component and presented to the *Consultant*.
- 3.3.7 The *Consultant* must sign the Certificate of Satisfactory *Commissioning* Form 103(s) when *Commissioning* and training has been completed to the satisfaction of the *Consultant*.
- 3.3.8 Following satisfactory completion of Week # 2 of *Commissioning*, the *Consultant* will issue a Certificate of *Commissioning* Completion.
- 3.3.9 During the Warranty Period, the *Contractor*, *Subcontractors*, *Suppliers*, and manufacturers must be available to address questions by the *Owner* and the *Consultant* as part of the *Work*.

Comments: _____

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

CERTIFICATE OF SATISFACTORY TESTING – FORM 102

Comments: _____

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Consultant
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

CERTIFICATE OF SATISFACTORY COMMISSIONING – FORM 103

Installing Contractor: _____

[illegible]

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

Date:

Consultant
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

END OF SECTION

DIVISION 03 - CONCRETE

CONCRETE FORMING AND ACCESSORIES

1. GENERAL

1.1 General Requirements

- .1 The General Conditions of the Contract and all Sections of Division 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other sections.

1.2 Related Requirements

- .1 Section 03 20 00 - Concrete Reinforcing
- .2 Section 03 30 00 - Cast-in-Place Concrete
- .3 Section 07 92 00 - Joint Sealants

1.3 Reference Standards

- .1 CSA Group (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 O86:19, Engineering Design in Wood
 - .3 CSA O121-17, Douglas Fir Plywood
 - .4 CSA O151-17, Canadian Softwood Plywood
 - .5 CSA O153-13, Poplar Plywood
 - .6 CSA O325-16, Construction Sheathing
 - .7 CSA O437.0-93, OSB and Waferboard
 - .8 CSA S269.1-16, Falsework and Formwork
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S701.1-17, Standard for Thermal Insulation, Polystyrene Boards

CONCRETE FORMING AND ACCESSORIES

1.4 Administrative Requirements

- .1 Pre-Installation Meetings: Hold pre-installation meeting one week before beginning concrete works in accordance with Section 01 31 19 - Project Meetings.
 - .1 Ensure attendance by Contractor, affected Subcontractors, consultant.
 - .1 Verify Project requirements.

1.5 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature, and data sheets for proprietary materials used in [formwork liners] and [coatings]. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS).
- .3 Submit shop drawings for formwork and falsework.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the province of the project.
 - .2 Prepare Shop Drawings in accordance with CSA S269.1 for formwork and falsework.
 - .3 Indicate formwork design data, permissible rate of concrete placement, and temperature of concrete in formwork.
 - .4 Indicate sequence of erection and removal of formwork and falsework.
 - .5 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.
 - .6 Indicate sequence of erection and removal of formwork and falsework.
 - .7 Include the following information on falsework Shop Drawings:
 - .1 Longitudinal, lateral, vertical, dead, live and impact loads used in design.
 - .2 Safe bearing capacity of soil underneath mud sills.
 - .3 Maximum column, post and support loads.

CONCRETE FORMING AND ACCESSORIES

- .4 Deflection diagrams for beams with deflection of 10 mm or more.
- .5 Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.
- .6 Grade of structural steel.
- .7 Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.
- .8 Fully detailed steel frame shoring.
- .9 Species, grades and sizes of wood.
- .10 Type and weight of equipment (moving or stationary) supported by falsework.
- .11 Sequence, methods and rate of concrete placement.
- .12 Proprietary equipment, adequately identified for checking purposes.
- .13 Full details and locations of splices.

1.6 Quality Assurance

- .1 Perform in accordance with Section 01 43 00 - Quality Assurance.
- .2 Retain a professional engineer registered or licensed in the province of the project, with experience in formwork and falsework design of comparable complexity and scope, to perform the following services as part of work of this Section:
 - .1 Design of formwork and falsework.
 - .2 Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments.
 - .3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of work is in accordance with Contract Documents and reviewed Shop Drawings.

1.7 Delivery, Storage, and Handling

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Storage and Handling Requirements: Maintain formwork without defects or damages that could affect concrete appearance or cause staining.

CONCRETE FORMING AND ACCESSORIES

2. PRODUCTS

2.1 Materials

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA O86, CSA O437.0, and CSA O153.
- .2 Pan forms: removable steel free of bends, dents, and residual concrete; having a high potential for reuse as indicated.
- .3 Form ties:
 - .1 For concrete not designated 'Architectural': Removable or snap-off metal ties, fixed or adjustable length, and free of devices leaving holes larger than 25 mm in diameter in concrete surface.
- .4 Form liner:
 - .1 Plywood: Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151, or Poplar to CSA O153, T and G or square edge, minimum 19 mm thick.
- .5 Form release agent: Proprietary, non-volatile material that will not stain concrete or hinder the application of subsequent coatings, treatments, or flooring materials to the concrete surface with low VOC.
- .6 Falsework materials: To CSA S269.1.
- .7 Sealant: To Section 07 92 00 - Joint Sealants.

3. EXECUTION

3.1 Formwork Preparation

- .1 Before placing concrete clean formwork in accordance with CSA A23.1/A23.2.
- .2 Apply form release agent in accordance with manufacturer's recommendations, prior to placing reinforcing steel, anchoring devices and embedded plates.
- .3 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing concrete.
- .4 Do not apply form release agent where wood graining characteristics are required on the finished concrete surfaces.

CONCRETE FORMING AND ACCESSORIES

3.2 Tolerances

- .1 Camber slabs and beams 6 mm per 3 m of span unless otherwise shown on drawings. Review method of providing camber with Consultants prior to proceeding. Maintain beam depth and slab thickness from cambered surface.
- .2 Construct formwork to produce concrete with dimensions, lines and levels within the following tolerances. Tolerances are not cumulative.
 - .1 Deviation from Vertical Line: 6 mm in 3 m, 9 mm in 6 m, and 20 mm in 12 m or more.
 - .2 Deviation from Horizontal Line: 6 mm in 3 m.
 - .3 Deviation from Linear Building Lines from Drawings and Positions of Columns, Walls and Partitions: 6 mm.
 - .4 Deviation in Cross Sectional Dimensions of Columns and Beams, and in Thickness of Slabs and Walls: plus or minus 6 mm.

3.3 Fabrication and Erection

- .1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with Drawings.
- .2 Fabricate and erect falsework in accordance with CSA S269.1.
- .3 Do not place shores and mud sills on frozen ground.
- .4 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .5 Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.
- .6 Align form joints and make watertight.
 - .1 Minimize the number of form joints used.
- .7 Use 20-mm chamfer strips on external corners and 20-mm fillets at interior corners and joints, unless otherwise indicated on Drawings.
- .8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .9 Build in anchors, sleeves, and other inserts required to accommodate work specified in other Sections.

CONCRETE FORMING AND ACCESSORIES

- .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

3.4 Removal and Reshoring

- .1 Leave formwork in place for the following minimum periods of time after placing concrete.
 - .1 7 days for walls and sides of beams.
 - .2 7 days for columns.
 - .3 14 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.
 - .4 2 days for footings and abutments.
- .2 Do not remove forms and falsework until concrete has gained sufficient strength to carry its own weight, plus construction loads and other design loads that are liable to be imposed. Verify strength of concrete by compression tests to the satisfaction of the consultant.
- .3 Remove formwork when concrete has reached 75 % of its 28 day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .4 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .5 Space reshoring in each principal direction at not more than 3000 mm apart.
- .6 Reuse formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.5 Site Quality Control

- .1 Site Inspections:
 - .1 Professional engineer responsible for signing and stamping shop drawings to conduct on-site inspections and prepare and submit inspection reports verifying this part of the work is in accordance with Contract Documents and reviewed Shop Drawings.
 - .2 Perform inspections a minimum of once per month.

3.6 Cleaning

CONCRETE FORMING AND ACCESSORIES

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

CONCRETE REINFORCING

1. GENERAL

1.1 General Requirements

- .1 The General Conditions of the Contract and all Sections of Division 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other sections.

1.2 Related Requirements

- .1 Section 03 05 05 – Concrete Testing and Inspection
- .2 Section 03 11 00 - Concrete Forms and Accessories
- .3 Section 03 30 00 – Cast-in-Place Concrete

1.3 Reference Standards

- .1 ASTM International (ASTM):
 - .1 ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- .2 CSA Group (CSA):
 - .1 CSA A23.1:19/CSA A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
 - .2 CSA A283:19, Qualification Code for Concrete Testing Laboratories
 - .3 CSA A23.3:19, Design of Concrete Structures
 - .4 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement
 - .5 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .6 CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction
- .3 Reinforcing Steel Institute of Canada (RSIC):

CONCRETE REINFORCING

- .1 RSIC-[2020], Manual of Standard Practice

1.4 Administrative Requirements

- .1 Pre-Installation Meetings: In accordance with Section 01 31 19 - Project Meetings, hold pre-concrete pouring meeting one week before pouring concrete.
 - .1 Ensure key personnel, site supervisor, Consultant, specialty contractor - finishing, and forming attend.
 - .1 Verify project requirements.
 - .2 Review reinforcing testing report.

1.5 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions if available, product literature and data sheets for proprietary materials used in concrete reinforcement. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS).
- .3 Shop Drawings:
 - .1 Submit shop drawings stamped and signed by professional engineer registered or licensed in province of project location.
 - .1 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, location and length of reinforcement splices, location of mechanical and welded splices if approved by the Consultant, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings, and locations of chairs, bolsters, spacers, and hangers. Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
 - .2 Indicate placing of reinforcement and:
 - .3 Detail lap lengths and bar development lengths to CSA A23.3 Provide Class B tension lap splices unless otherwise indicated on Drawings.

CONCRETE REINFORCING

- .4 Indicate position and size of openings in slabs and walls. Coordinate with the different trades requiring openings.
 - .5 Indicate the concrete cover dimension to the reinforcement.
- .4 Test and Evaluation Reports:
 - .1 When requested, submit certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks before beginning reinforcing work.
 - .2 Where mill tests reports originate from a mill outside Canada or the United States of America, the Contractor shall have mill test reports verified by a certified laboratory in Canada by testing the material to the specified material standard, including boron content. The testing laboratory shall be certified to ISO/IEC 17025 by an organization accredited by the Standards Council of Canada for the tests required. Samples for testing shall be collected by personnel employed by the certified laboratory. A verification letter shall be provided by the certified laboratory that includes at a minimum, the applicable mill test reports, testing standards, date of verification testing, and declaration of material compliance with Contract requirements. The verification letter shall be signed by an authorized officer of the certified laboratory.
- .5 Source Quality Control Submittals:
 - .1 When requested, submit, in writing, proposed source of reinforcement material.

1.6 Quality Assurance

- .1 Qualifications:
 - .1 Testing Laboratory: Certified to CSA A283.
 - .2 Welders shall be qualified by Canadian Welding Bureau for classification of work being performed.
 - .3 The fabricator shall be certified to CSA W47.1, Division 1 or 2.1.
 - .4 Perform welding inspection to CSA W178.
 - .5 Fusion welding: Certified to CSA W59.

1.7 Delivery, Storage, and Handling

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.

CONCRETE REINFORCING

- .2 Package bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

2. PRODUCTS

2.1 Reinforcement Materials

- .1 Substitute different sized bars only if permitted in writing by Consultant.
- .2 Reinforcing Steel: Billet steel, grade 400, deformed bars to CSA G30.18, unless otherwise indicated; Plain Finish.
- .3 Reinforcing steel: Weldable low alloy steel deformed bars to CSA G30.18.
- .4 Cold-drawn annealed steel wire ties: To ASTM A1064/A1064M.
- .5 Welded steel wire fabric:
 - .1 Plain in accordance with ASTM A1064/A1064M, fabricated from steel wire into flat sheets; sizes as indicated on Drawings.
 - .2 Provide in flat sheets only.
- .6 Chairs, bolsters, bar supports, spacers: To CSA A23.1/A23.2.
- .7 Tie wire: 1.5 mm diameter annealed wire.
- .8 Mechanical splices: Subject to approval from Consultant.
- .9 Plain round bars: To CSA G40.20/G40.21.

2.2 Fabrication

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Consultant's written approval for locations of reinforcement splices other than those shown on Contract Drawings and shop drawings.
- .3 Upon approval from Consultant, weld reinforcement in accordance with CSA W186.

CONCRETE REINFORCING

- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
- .5 Fabricate within following tolerances:
 - .1 Sheared Length: +/- 10 mm
 - .2 Stirrups, Ties and Spirals: +/- 10 mm
 - .3 Other Bends: +/- 25 mm
- .6 Locate Reinforcing splices not shown on drawings at points of minimum stress.

3. EXECUTION

3.1 Site Bending

- .1 Do not bend or weld reinforcement on site except where indicated or when authorized by Consultant.
 - .1 If site bending is authorized, bend reinforcement procedure shall conform to the standard without heat, applying slow and steady pressure.
 - .2 Replace reinforcement bars that develop cracks or splits.

3.2 Placing Reinforcement

- .1 Cutting or puncturing vapour retarder is not permitted. Repair damage and reseal vapour retarder before placing concrete.
- .2 Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2. Chair slab reinforcing not further apart than 1200 mm in either direction.
- .3 Place, support and secure reinforcement against displacement. Do not deviate from required position.
- .4 Position of reinforcing shall take precedence over position of conduit or piping.
- .5 Place reinforcing steel in walls, slabs, and columns to provide concrete cover for fire endurance, as required by the National Building Code of Canada – 2023 Alberta Edition.
- .6 Use plain round bars as slip dowels in concrete.
 - .1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

CONCRETE REINFORCING

- .7 Prior to placing concrete, notify Consultant with sufficient time to review reinforcing material and placement and provide written comments.
- .8 Maintain minimum concrete cover to reinforcement during concrete placement.

3.3 Site Quality Control

- .1 Site tests: Conduct tests on the following in accordance with Section 01 45 00 - Quality Control and submit report as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section:
 - .1 Reinforcing steel and welded wire fabric.
- .2 Inspection and testing of reinforcing and reinforcing materials carried out by testing laboratory designated by Consultant for review to CSA A23.1/A23.2.
- .3 Distribute test results for discussion at pre-pouring concrete meeting between testing laboratory and Consultant.
- .4 Owner will pay for costs of requested tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .5 Inspection or testing by Owner does not augment or replace Contractor's quality control nor relieve Contractor of any contractual responsibility.

3.4 Cleaning

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 General Requirements

- .1 The General Conditions of the Contract and all Sections of Division 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other sections.

1.2 Related Requirements

- .1 Section 03 10 00 - Concrete Forming and Accessories
- .2 Section 03 20 00 - Concrete Reinforcing
- .3 Section 04 05 00 - Common Work Results for Masonry
- .4 Section 07 11 13 - Bituminous Dampproofing
- .5 Section 07 26 00 - Vapour Retarders

1.3 Price and Payment Procedures

- .1 Measurement and Payment:
 - .1 Measurement Procedures: In accordance with Section 01 29 00 - Payment Procedures.
 - .2 Measure cast-in-place concrete in structure in cubic metres calculated from neat dimensions authorized in writing by Consultant.
 - .1 Concrete placed beyond dimensions indicated are not measured.
 - .3 No deductions made for volume of concrete displaced by reinforcing steel, structural steel, or piles.
 - .4 No deductions made for volume of concrete less than 0.1 m³ in volume displaced by individual drainage openings.
 - .5 Cast-in-place concrete in superstructure not measured but paid for as a fixed price item.

CAST-IN-PLACE CONCRETE

- .6 Supply and installation of anchor bolts, nuts and washers and bolt grouting not measured but considered incidental to work.
- .7 Measure supply and installation of water stops in lineal metres installed.

1.4 Abbreviations and Acronyms

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement types:
 - .1 GU, GUb, GUL and GULb - General use cement
 - .2 MS, MSb and MSLB - Moderate sulphate-resistant cement
 - .3 MH, MHb, MHL and MSLB - Moderate heat of hydration cement
 - .4 HE, HEb, HEL and HELb - High early-strength cement
 - .5 LH, LHb, LHL LHLb - Low heat of hydration cement
 - .6 HS, HSb and HSLb - High sulphate-resistant cement
- .2 Fly ash types:
 - .1 F - with a maximum CaO content of 8%
 - .2 CI - with CaO content of 15% and 20%
 - .3 CH - with a minimum CaO content of 20%
- .3 Other Supplementary Cementitious Materials (SCM) types:
 - .1 S-GGBFS - Ground, granulated blast-furnace slag
 - .2 N – Natural pozzolan
 - .3 SF – Silica fume with minimum silicon dioxide (SiO₂) content of 85%
 - .4 SFI – Silica fume with silicon dioxide (SiO₂) content between 75% and 85%
 - .5 GL – Ground glass with maximum total alkali (NaEq) content of 4%
 - .6 GH – Ground glass with total alkali (NaEq) content between 4% and 13%

1.5 Definitions

CAST-IN-PLACE CONCRETE

- .1 Supplementary Cementitious Materials (SCM)s: Materials added to concrete which contribute to the properties of hardened concrete through hydraulic or pozzolanic activity.
- .2 Workability: This term broadly describes the total properties and expectations for concrete delivered to site as follows:
 - .1 Individual tested properties of concrete that account for confined or free flow slump, penetration, compaction, or relative plasticity of various concrete mix designs used for the project.
 - .2 Overall properties involved with mixing, handling, transportation, and placement using vibratory compaction methods without loss of homogeneity of in-place concrete.

1.6 Reference Standards

- .1 ASTM International (ASTM):
 - .1 ASTM C171-20, Standard Specification for Sheet Materials for Curing Concrete
 - .2 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete
 - .3 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - .4 ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete
 - .5 ASTM C881/C881M-20a, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - .6 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
 - .7 ASTM C1059/C1059M-24, Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
 - .8 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
 - .9 ASTM D624- 20, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

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- .10 ASTM D1751- 23, Standard Specification for Performed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- .11 ASTM D1752- 18, Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-M 86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .3 CSA Group (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 A283: 19, Qualification Code for Concrete Testing Laboratories
 - .3 CSA A3000- 18, Cementitious Materials Compendium

1.7 Administrative Requirements

- .1 Pre-Installation Meetings: In accordance with Section 01 31 19 - Project Meetings, convene pre-installation meeting one week before beginning concrete works.
 - .1 Ensure key personnel, site supervisor, Consultant speciality Subcontractor - finishing, forming, concrete producer, and testing laboratories attend.
 - .1 Verify project requirements.
 - .2 Discuss appropriate Subcontractor footwear that will not damage the underslab membrane, and other related precautions required to ensure the membrane's continuous integrity.
- .2 Coordination:
 - .1 Coordinate sequencing and installation of underslab waterproofing, underslab plastic sheet vapour retarder, and/or underslab gas barrier membrane with Section 07 26 00 - Vapour Retarders.

1.8 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

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- .1 Submit manufacturer's instructions, product literature and data sheets for proprietary materials used in cast-in-place concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS Safety Data Sheet (SDS).
- .3 Samples:
 - .1 When requested, submit two samples a minimum 1 weeks before beginning work for review and acceptance of materials proposed for use as follows:
 - .1 1 L of curing compound.
 - .2 1 m length of each type of joint filler.
 - .3 1 m length of each type of waterstop.
 - .2 Samples will not be returned for inclusion into work.
- .4 Site Quality Control Submittals:
 - .1 Concrete pours: Submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in SITE QUALITY CONTROL in Part 3 of this Section.
 - .2 Concrete hauling time: Submit deviations exceeding the maximum allowable time of 90 minutes for concrete delivered to site of Work and discharged after batching for review by Consultant.

1.9 Quality Assurance

- .1 Quality Assurance: In accordance with Section 01 43 00 - Quality Assurance.
- .2 Submit a valid and recognized certificate from the plant delivering the concrete a minimum of two weeks before starting concrete work for approval by Consultant.
 - .1 Submit test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture meet specified requirements.
- .3 Inform Consultant of fly ash source at least four weeks before beginning concrete work.
 - .1 Changing source of fly ash without written approval from Consultant is prohibited.
- .4 Submit proposed quality control procedures a minimum four weeks before starting concrete work, for review by Consultant on the following items:

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- .1 Falsework erection
- .2 Hot weather concrete
- .3 Cold weather concrete
- .4 Curing
- .5 Finishes
- .6 Formwork removal
- .7 Joints
- .5 Quality Control Plan: Submit written report to Consultant verifying compliance that cast-in-place concrete meets performance requirements of concrete as established in PRODUCTS in Part 2 of this Section.

1.10 Delivery, Storage, and Handling

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: Deliver to site of Work and discharge within a maximum of 90 minutes after batching.
 - .2 Modifying maximum time limit before receiving written agreement from Consultant and concrete producer as described in CSA A23.1/CSA A23.2 is prohibited.
 - .3 Submit deviations for review by Consultant.
 - .4 Concrete delivery: Ensure continuous concrete delivery from plant meets CSA A23.1/CSA A23.2.

1.11 Site Conditions

- .1 Placing concrete during rain or weather events that could damage concrete is prohibited.
- .2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/CSA A23.2
- .3 Cold weather protection:
 - .1 Maintain protection equipment in readiness on Site.
 - .2 Use protection equipment when ambient temperature is below 5°C, or when temperature may fall below 5°C before concrete has cured.

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- .3 Placing concrete upon or against surface at temperature below 5°C is prohibited.
- .4 Hot weather protection:
 - .1 Protect concrete from direct sunlight when ambient temperature is above 27°C.
 - .2 Prevent forms from getting too hot before concrete is placed. Apply accepted methods of cooling that will not negatively affect concrete.
- .5 Protect concrete from drying.

2. PRODUCTS

2.1 Design Criteria

- .1 Performance: To CSA A23.1/CSA A23.2, and as described in MIXES in PART 2 - PRODUCTS of this Section.

2.2 Performance Criteria

- .1 Quality Control Plan: Ensure concrete supplier meets performance criteria of concrete as established by Consultant and provide verification of compliance as described in QUALITY ASSURANCE in Part 1 of this Section.

2.3 Materials

- .1 Portland Cement: GU, MS, and/or HS
- .2 Blended hydraulic cement: Type GUB, and/or HSB to CSA A3000 (specifically CSA A3001).
- .3 Portland-limestone cement: Type GUL to CSA A3000 (specifically CSA A3001).
- .4 Supplementary cementitious materials: Minimum 20 % Type F fly ash replacement, by mass of total cementitious materials to CSA A3000 (specifically CSA A3001).
- .5 Water: To CSA A23.1/CSA A23.2.
- .6 Aggregates: To CSA A23.1/CSA A23.2 Non-reactive permitted.
- .7 Admixtures:
 - .1 Air entraining admixture: To ASTM C260/C260M.
 - .2 Chemical admixture: To ASTM C494/C494M . Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .3 Corrosion-inhibiting admixture: To ASTM C1582/C1582M.

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- .4 Shrinkage-reducing admixture (SRA): To ASTM C494/C494M.
- .5 Viscosity-modifying agent (VMA): To ASTM C494/C494M.
- .8 Shrinkage Compensating Grout: Premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/CSA A23.2.
 - .1 Compressive strength: 16 MPa at 24 hours and 50 MPa at 28 days.
 - .2 Net shrinkage at 28 days: Maximum 0%.
- .9 Non-premixed Dry Pack Grout: Composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 35 MPa at 28 days.
- .10 Curing Compound: To CSA A23.1/CSA A23.2 and ASTM C309, Type 1 Clear or translucent without dye.
- .11 Construction joints to have two strips of ConSeal No.202. All joints to be wrapped with ConSeal CS-212 polyolefin joint wrap. Concrete structure sides and top to be wrapped with waterproof self-adhered sheet applied membrane; Blueskin WP 200 or approved equal.

2.4 Mixes

- .1 Performance Method for specifying concrete: To meet Consultant performance criteria to CSA A23.1/CSA A23.2.
 - .1 Concrete supplier to meet performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following plastic state requirements:
 - .1 Uniformity: To CSA A23.1/CSA A23.2.
 - .2 Workability: Free of surface blemishes, loss of mortar, colour variations, and/or segregation.
 - .3 Provide concrete mix to meet the following hard state requirements:
 - .1 Durability and class of exposure: Refer to drawings for exposure class requirements.
 - .2 Compressive strength at 28 and/or 56 days age: Refer to drawings for compressive strength requirements.

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- .3 Intended application: Shall be determined from drawings and where not obvious, contact the Consultant directly.
- .4 Coarse aggregate size maximum 20 mm.

3. EXECUTION

3.1 Preparation

- .1 Obtain Consultant's site inspection and written recommendations before placing concrete.
 - .1 Provide a minimum of 48 hours notice before planned time of placing concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints is not allowed.
 - .2 Ensure concrete delivery and handling facilitate placing with minimum amount of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete permitted only after approval of equipment and mix.
- .5 Disturbing reinforcement and inserts during concrete placement is prohibited.
- .6 Before placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing.
- .7 Protect previous work from staining.
- .8 Clean and remove stains before application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.
- .10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
 - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .11 Do not place load upon new concrete until authorized by Consultant.

3.2 Installation/Application

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- .1 Do cast-in-place concrete work in accordance with CSA A23.1/CSA A23.2.
- .2 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Consultant.
 - .2 Where approved by Consultant, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .3 Sleeves and openings greater than 100 x 100 mm that are not indicated in the reviewed shop drawings must be approved by Consultant.
 - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Consultant before placing concrete.
 - .5 Confirm locations and sizes of sleeves and openings shown on drawings.
- .3 Installation - Anchor bolts:
 - .1 Set anchor bolts to templates in coordination with appropriate Subcontractor before placing concrete.
 - .2 Grout anchor bolts in holes drilled after concrete has set only after receipt of written approval from Consultant and in accordance with grout manufacturer's recommendation, whichever is more stringent.
 - .3 Protect anchor bolt holes from water accumulation, and snow and ice build-ups.
 - .4 Set bolts with epoxy grout.
 - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers taking into consideration ambient temperature at time of erection.
- .4 Installation - Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .5 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/CSA A23.2.
 - .2 Use procedures as reviewed by Consultant or those noted in CSA A23.1/CSA A23.2 to remove excess bleed water. Ensure surface is not damaged.

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- .3 Cure concrete in accordance with CSA A23.1/CSA A23.2. If required, use curing compounds compatible with applied finish on concrete surfaces.
 - .1 Applied finish on concrete: Provide written declaration of compatibility of compounds used.
- .4 Provide steel trowel finish unless otherwise indicated].
- .5 Rub exposed sharp edges of concrete with carborundum to produce a minimum 3-mm radius edges unless otherwise indicated.
- .6 Installation - Waterstops:
 - .1 Install waterstops to provide continuous water seal.
 - .2 Do not distort or pierce waterstop in way as to hamper performance.
 - .3 Do not displace reinforcement when installing waterstops.
 - .4 Use equipment to manufacturer's requirements to site splice waterstops.
 - .5 Tie waterstops rigidly in place.
 - .6 Use only straight heat-sealed butt joints on site.
 - .7 Use factory welded corners and intersections unless otherwise approved by Consultant.
- .7 Installation - Joint fillers:
 - .1 Provide filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Consultant.
 - .2 When more than one piece required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form construction joints as indicated.
 - .4 Install joint filler.
 - .5 Use 12-mm-thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless otherwise indicated.
- .8 Installation - Damp-proof membrane:
 - .1 Install damp-proof membrane under concrete slabs-on-grade inside building.

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- .2 Lap damp-proof membrane a minimum 150 mm at joints and seal.
- .3 Seal punctures in damp-proof membrane before placing concrete.
- .4 Use patching material a minimum 150 mm larger than puncture and seal.

3.3 Tolerances

- .1 Concrete surface tolerance to CSA A23.1/CSA A23.2 Straightedge Method 6 mm = 3 meter.

3.4 Site Quality Control

- .1 Site tests: Conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section.
 - .1 Concrete pours
 - .2 Slump
 - .3 Air content
 - .4 Compressive strength at 7 and 28 and/or 56 days
 - .5 Air and concrete temperature
- .2 Inspection and testing of concrete and concrete materials carried out by testing laboratory designated by Consultant to CSA A23.1/CSA A23.2.
 - .1 Ensure testing laboratory certified to CSA A283.
- .3 Distribute test results for discussion at pre-pouring concrete meeting between testing laboratory and Consultant.
- .4 Owner will pay for costs of tests or as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .5 Testing agency will take additional test cylinders during cold weather concreting. Cure cylinders on Project site under same conditions as concrete which they represent.
- .6 Non-Destructive Methods for Testing Concrete: To CSA A23.1/CSA A23.2.
- .7 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 Cleaning

CAST-IN-PLACE CONCRETE

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .1 Provide appropriate area on Project site where concrete trucks can be safely washed.

END OF SECTION

CONCRETE FLOOR FINISHES

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 CAN/CSA-A23.1 00 - Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CGSB-25.20-95 - Surface Sealer for Floors.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate the work of this section with the work of Section 03 30 00 – Cast in Place Concrete as required for hardeners to ensure proper application.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit product data for each product.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in containers sealed and labeled by manufacturers.
- .2 Storage and Handling Requirements:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding storage, handling and disposal of hazardous materials.

1.5 SITE CONDITIONS

- .1 Provide temporary lighting, as required, to provide a minimum of 1200 watt light source, placed 2.5 meters above floor surface, for each 40 m2 of floor being finished.
- .2 Maintain ambient temperature of 10°C minimum from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .3 Ensure substrate is within moisture limits prescribed by product manufacturers.
- .4 Ventilate enclosed spaces as required during product application and for 48 hours after application.

Part 2 Products

2.1 MATERIALS

- .1 Sikafloor 261 Morritex Broadcast RAL 7012 Bassalt Grey (minor containments for chemical resistance) - two-component, fast-cure, solvent-free, low-VOC, wide-range

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chemical resistant epoxy resin binder and coating available in unlimited colours for horizontal surfaces.

- .2 Sika Duroplast -100N with sikagard primers Duroplast EE for CMU and Concrete and Cor-Pro -470 for steel for vertical surfaces.

Part 3 Execution

3.1 VERIFICATION OF CONDITIONS

- .1 Verify that site conditions and surfaces are ready to receive work.

3.2 APPLICATION

- .1 Install fully in accordance with manufactures instructions.
- .2 Test concrete in accordance with manufactures instructions.

END OF SECTION

DIVISION 05 – METALS

STRUCTURAL STEEL FOR BUILDINGS

1. GENERAL

1.1 General Requirements

- .1 The General Conditions of the Contract and all Sections of Division 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other sections.

1.2 Related Requirements

- .1 Section 05 21 00 – Steel Joist Framing
- .2 Section 05 31 00 – Steel Decking
- .3 Section 09 91 23 - Interior Painting

1.3 Reference Standards

- .1 ASTM International (ASTM):
 - .1 ASTM A193/A193M-20, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications
 - .2 ASTM F3125-18, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):
 - .1 Handbook of the Canadian Institute of Steel Construction
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel

STRUCTURAL STEEL FOR BUILDINGS

- .4 CSA Group (CSA):
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 CAN/CSA-S16-19, Limit States Design of Steel Structures
 - .4 CAN/CSA-S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members
 - .5 CSA W47.1:09(R2014), Certification of Companies for Fusion Welding of Steel
 - .6 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding
 - .7 CSA W59-18, Welded Steel Construction (Metal Arc Welding)
- .5 The Master Painters Institute (MPI):
 - .1 MPI-INT 5.1, Structural Steel and Metal Fabrications
 - .2 MPI-EXT 5.1, Structural Steel and Metal Fabrications
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
 - .1 NACE No. 3/SSPC SP-6-07, Commercial Blast Cleaning

1.4 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the province of the Work.
- .3 Erection drawings:
 - .1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
 - .1 Description of methods.
 - .2 Sequence of erection.
 - .3 Type of equipment used in erection.

STRUCTURAL STEEL FOR BUILDINGS

- .4 Temporary bracings.
- .4 Fabrication drawings:
 - .1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of the Work.
- .5 Source Quality Control Submittals:
 - .1 If requested by the Consultant, submit copies of mill test reports 4 weeks before fabrication of structural steel.
 - .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
 - .2 Provide mill test reports certified by metallurgists qualified to practise in the province of the Work.
- .6 Fabricator Reports:
 - .1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.
- 1.5 Qualifications**
 - .1 Erectors shall have a minimum of 5 years of experience on industrial steel construction projects.
- 1.6 Delivery, Storage and Handling**
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.
- 2. PRODUCTS**
 - 2.1 Design Requirements**
 - .1 Design details and connections in accordance with requirements of CAN/CSA-S16 and to resist forces, moments, shears and allow for movements indicated.
 - .2 Shear connections:

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- .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required. Design shear connections for a minimum of 70% of section capacity.
- .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in the province of the Work, for non standard connections.

2.2 Materials

- .1 Structural Steel: To CSA-G40.20/G40.21 Grade 300W and/or 350W
- .2 Anchor Bolts: To CSA-G40.20/G40.21, Grade 300W
- .3 Bolts, nuts and washers: to ASTM A325.
- .4 Welding Materials: To CSA W48 Series CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop Paint Primer: To CISC/CPMA2-75 solvent reducible alkyd, grey.
- .6 Hot Dip Galvanizing: Galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 Fabrication

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds. Grind smooth.
- .3 Provide holes in top & bottom for weeping.

2.4 Shop Painting

- .1 Clean, prepare surfaces, and shop prime structural steel in accordance with CAN/CSA-S16 and MPI INT 5.1 and EXT 5.1 except where members to be encased in concrete.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to NACE No.3/SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 3 to 6 mils, except:

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- .1 Surfaces to be encased in concrete.
- .2 Surfaces to receive site installed stud shear connections.
- .3 Surfaces and edges to be site welded.
- .4 Faying surfaces of slip-critical connections.
- .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

3. EXECUTION

3.1 General

- .1 Structural Steel Work: In accordance with CAN/CSA-S16.
- .2 Welding: in accordance with CSA W59
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and components

3.2 Connection to Existing Work

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Consultant for direction before commencing fabrication.

3.3 Marking

- .1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection
- .2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.4 Erection

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and CAN/CSA-S136 and in accordance with reviewed erection drawings.

STRUCTURAL STEEL FOR BUILDINGS

- .2 Site cutting or altering structural members: to approval of Consultant.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 Site Quality Control

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Consultant.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Consultant.
- .3 Submit test reports to Consultant within 2 weeks of completion of inspection.
- .4 Owner will pay costs of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .5 Test shear studs in accordance with CSA W59

3.6 Site Painting

- .1 Paint in accordance with Section 09 91 23 - Interior Painting.
 - .1 Touch-up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual

3.7 Cleaning

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

**DIVISION 06 – WOODS, PLASTICS, AND
COMPOSITES**

MISCELLANEOUS ROUGH CARPENTRY

1. GENERAL

1.1 General Requirements

- .1 The General Conditions of the Contract and all Sections of Division 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other sections.

1.2 Related Requirements

- .1 Section 06 05 73- Wood Treatment

1.3 Reference Standards

- .1 The American Society of Mechanical Engineers (ASME):
 - .1 ASME B18.6.1-1981(R2016), Wood Screws (Inch Series)
- .2 ASTM International (ASTM):
 - .1 ASTM A307-21 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - .2 ASTM C954-22, Standard 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
 - .3 ASTM F1667-18 Standard Specification for Driven Fasteners: Nails, Spikes and Staples
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems
- .4 CSA Group (CSA):
 - .1 CSA O86-19 Engineered Design in Wood

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- .2 CSA O112.9-21, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure)
- .3 CSA O121-17(R2022), Douglas Fir Plywood
- .4 CSA O141-23, Softwood Lumber
- .5 CSA O151-17(R2022), Canadian Softwood Plywood
- .6 CSA O153-19, Poplar Plywood
- .7 CSA O325-21, Construction Sheathing
- .5 Canadian Wood Council:
 - .1 Wood Design Manual 2020 edition
 - .2 Engineering Guide for Wood Frame Construction 2014
- .6 National Lumber Grades Authority (NLGA):
 - .1 Standard Grading Rules for Canadian Lumber 2017
 - .2 NLGA SPS-1-2013, Fingerjoined Structural Lumber
 - .3 NLGA SPS-2-2013, Machine Graded Lumber
 - .4 NLGA SPS-4-2020, Fingerjoined Machine Graded Lumber
- .7 ULC Standards/UL Canada (ULC):
 - .1 CAN/ULC-S101- 14, Standard Methods for Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S102- 10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.4 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals (to be submitted before starting any work of this Section):
 - .1 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

MISCELLANEOUS ROUGH CARPENTRY

- .2 Include manufacturer's pre-engineered installation details and pre-engineered roof joist span charts.
- .3 Submit certified test reports for prefabricated structural members from an approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Submit Canadian Construction Materials Centre (CCMC) Product Evaluation Report number for engineered wood products.
- .5 Submit manufacturer's installation instructions.
- .2 Shop Drawings:
 - .1 For structural applications submit drawings stamped and signed by professional engineer registered or licensed in the province of the project.
 - .2 Provide a comprehensive set of engineering calculations or computer analysis and design outputs demonstrating the adequacy of the proposed system when requested by the Consultant.
- .3 Informational Submittals (to be submitted during the course of Work):
 - .1 Material Certificates: Submit certificates for machine-graded dimensional lumber indicating species and grade selected for each use and design values approved by the NLGA.

1.5 Delivery, Storage, and Handling

- .1 Delivery and Acceptance Requirements: Protect materials from weather conditions while in transit and while on the jobsite
- .2 Storage and Handling Requirements:
 - .1 Store materials using pallets or blocking a minimum of 150 mm from the ground and covered with protective waterproof sheets allowing for air circulation and ventilation under the covering.
 - .2 Protect edges and corners of sheet materials from damage during handling and storage.
 - .3 Protect kiln-dried and seasoned wood materials from conditions that will cause an increase to moisture content.
 - .4 Store engineered lumber on its edge.

MISCELLANEOUS ROUGH CARPENTRY

- .5 Stack, lift, brace, cut and notch engineered lumber products in accordance with manufacturer's instructions and recommendations.

2. PRODUCTS

2.1 Description

.1 Regulatory Requirements:

- .1 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade-marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and that conform to National Grading Rules published by the NLGA.
 - .1 Grading: Machine Grading, Visual Grading, or Both
 - .2 Moisture Content: Kiln Dry, 19% or less
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86
 - .4 Sizes: Nominal dressed dimensions described in CSA O141 for surfaced dry conditions and wood species.
- .2 Panel Grades: Provide panel products that are grade-marked by agencies recognized by CSA O325 and National Institute of Standards and Technology, Voluntary Product Standard PS 2 04 Performance Standard for Wood-Based Structural-Use Panels as modified by other listed CSA panel standards.

2.2 Performance Criteria

- .1 Plywood Grades: Provide plywood products in nominal dimensions required for the project; grade-marked by accredited agencies of the APA and that conform to the Canadian Plywood Grading Guide, and tolerances described for specific plywood Products below, and identified as follows:
 - .1 Name of Standard CSA O121 and/or CSA O151;
 - .2 Manufacturer's Mill Identification;
 - .3 Bond Quality (Exterior or Interior);
 - .4 Commercial Species Grouping (DFP, CSP, ASP or HEM-FIR);
 - .5 Product Grade (SEL);

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- .6 Nominal Thickness; and
- .7 Additional Grade or Product Designations (as approved).
- .2 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to National Grading Rules published by the National Lumber Grades Authority, and as follows:
 - .1 Grading: Machine Grading, Visual Grading, or Both.
 - .2 Moisture Content: Kiln Dry, 19% or less.
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86 and NLGA SPS 2.
 - .4 Sizes: Nominal dressed dimensions described in CSA O141 for surfaced dry conditions and wood species.
 - .5 Acceptable Alternative Products: Lumber products meeting requirements of the American Lumber Standards Committee designated ALS Program Lumber and that are accepted by the Canadian Lumber Standards Accreditation Board, may be acceptable for the Project when proof of compliance with strength and related properties meeting CSA O86 are submitted before purchasing any lumber products.

2.3 Materials

- .1 Lumber Materials:
 - .1 Structural Light Framing: Provide No. 2 Grade and better materials, and as follows:
 - .1 Sizes: 38-mm to 89-mm width by 38-mm to 235-mm depth as indicated on drawings.
 - .2 Fingerjoined Materials: Not Allowed.
 - .3 Species Group: Spruce-Pine-Fir (SPF).
 - .4 Selection for Appearance: Not Required.
 - .2 Light Framing: Provide Standard Grade with the following minimum properties:
 - .1 Sizes: Maximum 38-mm width by maximum 89-mm depth.
 - .2 Fingerjoined Materials: Not Allowed .

MISCELLANEOUS ROUGH CARPENTRY

- .3 Species Group: Spruce-Pine-Fir (SPF).
- .3 Strapping: Provide 19-mm deep x 38-mm wide materials as described above.
- .4 Miscellaneous Framing: Provide furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers, and other materials matching lumber used within framed construction; or use Light Framing, No. 2 Grade or better materials where lumber grade is not indicated.
- .2 Panel Materials:
 - .1 Structural Shear Walls and Floor Diaphragm Panels: Provide design rated plywood panels; at choice of Consultant, meeting requirements of CSA O86, thickness as indicated on drawings and as follows:
 - .1 Design Rated Plywood: Exterior rated, sheathing grade square edged Douglas Fir or Canadian Softwood Plywood meeting requirements of CSA O121 or CSA O151.
 - .2 Wall Sheathing: Provide plywood wall sheathing having End Use Mark W (Walls); at choice of Consultant, meeting requirements of CSA O325 and as follows:
 - .1 Plywood: Exterior rated, sheathing grade square edged Douglas Fir or Canadian Softwood Plywood meeting requirements of CSA O121 or CSA O151.
 - .3 Roof Sheathing: Provide plywood roof sheathing at choice of Consultant, thickness as required by span rating and meeting requirements of CSA O325 and as follows:
 - .1 Span Rated Plywood: Exterior rated, sheathing grade square edged with H Clips Douglas Fir or Canadian Softwood Plywood meeting requirements of CSA O121 or CSA O151.
 - .2 H-Clips: Galvanized steel or extruded aluminum; 38-mm x 38-mm blocking securely nailed between framing members will be considered as an acceptable alternative to tongue and groove material and H-Clip materials.
 - .3 Plywood Underlayment: Exterior rated, sheathing grade square edged Poplar plywood meeting requirements of CSA O153.
 - .4 Plywood Blocking and Backing Panels: Douglas Fir and Canadian Softwood Plywood using exterior grade adhesives meeting requirements of CSA O121 or CSA O151; kiln dry plywood to moisture content of 15% or less, and as follows:

MISCELLANEOUS ROUGH CARPENTRY

- .1 Concealed Blocking: Select Grade (SEL) Canadian Softwood Plywood).
- .2 Exposed Panels and Panel Boards: Good One Side (G1S) Douglas Fir Plywood.

2.4 Accessories

- .1 Driven Fasteners: Steel nails, spikes, brads and staples meeting requirements of ASTM F1667. Ensure length is sufficient to penetrate connecting solid wood materials.
 - .1 Exterior Work: Hot-dipped galvanized and ACQ compatible.
 - .2 Interior High Humidity Work: Hot-dipped galvanized.
 - .3 Pressure Treated Materials: Refer to Section 06 05 73 – Wood Treatment.
- .2 Rough Hardware (Bolts, Nuts and Washers): Provide manufacturer recommended fastening devices and anchors meeting requirements of ASTM A307 and as follows:
 - .1 Ground Contact Materials: Hot-dipped galvanized and ACQ compatible.
 - .2 Exterior Work: Hot-dipped galvanized and ACQ compatible.
 - .3 Interior High Humidity Work: Hot-dipped galvanized.
 - .4 Pressure Treated Materials: Refer to Section 06 05 73 – Wood Treatment.
- .3 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:
 - .1 Exterior Work: Galvanized, ceramic coated or stainless steel.
 - .2 Interior Work: Galvanized.
- .4 Screws for Fastening to Cold-Formed Metal Framing: Steel screws meeting requirements of ASTM C954, except for wafer heads and reamer wings whose length should be as recommended by screw manufacturer for material being fastened.
- .5 Prefabricated Metal Anchoring Systems, Framing Connectors and Hangers: Prefabricated hot-dipped zinc coated steel or stainless steel products tested or designed in accordance with CSA O86; types and configurations as indicated on drawings.
- .6 Sill Gaskets: Flexible, self-adhering closed-cell foam membrane that bridges gaps and irregularities between top of concrete foundation and sill components; nominal 10-mm thickness x 140-mm width x manufacturer's maximum length.
- .7 Subflooring Adhesive: CAN/CGSB-71.26, cartridge loaded.

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- .8 General Purpose Adhesive: CSA O112.9.
- .9 Joist Hangers, Connectors and Fasteners: In accordance with accepted shop drawings, minimum 1 -mm thick steel sheet, galvanized to a minimum ZF001 coating designation.
- .10 Nailing Discs: Flat caps, minimum 25 -mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.
- .11 Roof Sheathing H-Clips: Formed "H" shape, thickness to suit panel material, [extruded 6063-T6 aluminum alloy] type approved by Consultant.
- .12 Wood Preservative: As specified in Section 06 05 73- Wood Treatment.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for product installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant 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 Consultant.

3.2 Installation

- .1 Requirements:
 - .1 Accurately frame and properly assemble rough carpentry work.
 - .2 Securely attach rough carpentry work to substrate by anchoring and fastening.
 - .3 Include required nails, fastenings and other connectors.
 - .4 Set rough carpentry to required levels and lines with members plumb, true to line, cut, and fitted.
 - .5 Fit rough carpentry to other construction.
 - .6 Locate furring, nailers, blocking, grounds, and similar supports as required when attaching to other construction.

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- .7 Do not use materials with defects that impair the quality of the rough carpentry or use pieces that are too small to use with a minimum number of joints or optimum joint arrangement.
- .2 Sill Plate Construction: Install sill gasket material between pressure treated sill plate and concrete foundation wall in accordance with manufacturer's instructions.
- .3 Wood Frame Construction: Space framing members at maximum 406 mm on centre or as noted on the drawings, using continuous pieces of the longest possible length and as follows:
 - .1 Fabricate wood frame construction to the requirements of Part 9 of the NBC, except where more stringent requirements are indicated on the drawings.
 - .2 Make allowance for erection stresses.
 - .3 Securely brace members in place to maintain plumb and true until permanently fixed and held to structure.
 - .4 Minimize cutting of framing members for pipes and other penetrations by coordinating with other parts of the Work before starting work of this Section; limit cutting and hole drilling to limitations listed in Part 9 of the NBC.
- .4 Sheathing Installation: Install sheathing in accordance with Part 9 of the NBC and as follows:
 - .1 Wall Sheathing: Install wall sheathing horizontally to wood framing using minimum 50-mm long coated nails at 150 mm along edges and 305 mm along vertical members in the middle of the sheets; leave 2 mm to 3 mm between sheets to allow for shrinkage of wood framing.
 - .2 Shear Wall Sheathing: Refer to drawings for nailing patterns and installation details; install blocking behind all shear wall sheathing joints; adhere and nail sheathing to wall framing.
 - .3 Roof Sheathing: Install roof sheathing with length perpendicular to roof framing using 50-mm coated nails at 150 mm along edges and 305 mm along roof framing in the middle of the sheets and as follows:
 - .1 Nail size and pattern noted above is a minimum requirement; increase number and decrease spacing, or increase size as required to meet site conditions.
 - .2 Butt joints tightly together, support all edges of non tongue and grooved sheathing with 38-mm x 89-mm framing, H Clips or other acceptable method for square edge sheathing.

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- .5 Roof Framing, Parapets, Cant Strips and Plates:
 - .1 Construct wooden roof curbs around openings in the roof for vents, ducts, and other penetrations.
 - .2 For parapets and edge blocking using pressure preservative treated wood, refer to Section 06 05 73 - Wood Treatment for additional installation requirements.
 - .3 Make curbs a minimum height of 200 mm above roof membrane; make base of curbs same thickness as insulation.
 - .4 Form sloped tops to wood parapet plates and wood up stands more than 38 mm wide to roofs that receive metal flashings; sloped not less than 2:12.
 - .5 Provide continuous wood backing for flashings.
 - .6 Provide solid wood or plywood sheathing and backing to receive membrane and metal flashings, conforming to ARCA Manual; fasten plywood sheathing securely to walls of parapets using mechanical fasteners; nails are not acceptable.
 - .7 Construct framing and blocking for membrane control joints conforming to ARCA Manual.
 - .8 Do not use pressure preservative treated wood when in direct contact with PVC adhered roof membranes.
- .6 Pressure Preservative Treated Wood: Install pressure preservative treated wood in accordance with Section 06 05 73 - Wood Treatment.
- .7 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 -mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 305 mm intermediate.

3.3 Cleaning

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.4 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

SHOP FABRICATED WOOD TRUSSES

1. GENERAL

1.1 General Requirements

- .1 The General Conditions of the Contract and all Sections of Division 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other sections.

1.2 Summary

- .1 This Section includes requirements for supply and installation of shop-fabricated wood trusses using light-gauge metal connection plates and truss accessories required for a complete structural system with the following components:
- .2 This Section requires delegated design, engineering analysis and preparation of sealed and signed shop drawings performed by a qualified, supporting professional engineer registered or licensed in the province of the Work, who is retained by the truss fabricator responsible for fabrication of wood trusses described in this Section in accordance with Section 01 35 73 – Delegated Design Procedures.

1.3 Related Requirements

- .1 Section 01 35 73 – Delegated Design Procedures
- .2 Section 04 05 19 – Masonry Anchorage and Reinforcing
- .3 Section 06 10 53 – Miscellaneous Rough Carpentry

1.4 Definitions

- .1 Delegated Design Professional Engineer: The supporting professional engineer hired by, engaged by or contracted to truss fabricator for the design of light metal plate connected wood trusses described in this Section. They produce signed and sealed shop drawings, are registered in the province of the Work, they are not the Consultant, and they are responsible for the following:
 - .1 Schedule B - Assurance of Professional Design Involvement and Commitment for Field Reviews by the Registered Professional of Record: Documents prepared by the supporting professional engineer indicating extent of their involvement with

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design solution as recommended by provincial engineering associations in accordance with Section 01 35 73 – Delegated Design Procedures.

- .2 Schedule C-2 - Assurance of Field Reviews and Compliance by the Registered Professional of Record: Document prepared by the supporting professional engineer indicating their general review of the installed system on site during construction in accordance with Section 01 35 73 – Delegated Design Procedures.

- .2 Equal Dimensions: Structural wood products and assemblies indicating equal dimensions on the Drawings shall be calculated to align with in-place structural elements followed by an even division of the space between structural elements. Space glued laminated construction products evenly between adjacent structural members, but not necessarily evenly spaced across the entire assembly.

1.5 Reference Standards

- .1 ASTM International (ASTM):
 - .1 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
 - .3 ASTM D7612-21, Standard Practice for Categorizing Wood and Wood-Based Products According to their Fiber Sources
 - .4 ASTM F1667-13 Standard Specification for Driven Fasteners: Nails, Spikes and Staples
- .2 CSA Group (CSA)
 - .1 CSA O86 Consolidation-19, Engineering Design in Wood.
 - .2 CSA S347-14(R2023), Method of Test for Evaluation of Truss Plates Used in Lumber Joints.
- .3 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2017
 - .2 NLGA SPS-1-2013, Fingerjoined Structural Lumber
 - .3 NLGA SPS-2-2013, Machine Graded Lumber
 - .4 NLGA SPS-4-2020, Fingerjoined Machine Graded Lumber

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- .4 National Research Council Canada (NRC)
 - .1 National Building Code of Canada (NBC) 2020
 - .2 Canadian Construction Materials Centre (CCMC)-, Registry of Product Evaluations
- .5 Truss Plate Institute of Canada (TPIC)
 - .1 BCSI Canada 2014, Building Component Safety Information Book, Guide to Good Practice for Handling, Installing, Restraining and Bracing of Metal Plate Connected Wood Trusses
 - .2 TPIC - 2019, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses (Limit States Design).
 - .3 [TPIC TB4-[2020], Design for Corrosive Environments]

1.6 Administrative Requirements

- .1 Coordination: Coordinate temporary protective measures required by this Section to prevent exposure to weather and other deleterious environmental conditions in accordance with Section 01 35 43 – Environmental Procedures.
- .2 Pre-Construction Meeting: Conduct a pre construction meeting a minimum of two weeks before starting work of this Section in accordance with Section 01 31 19 – Project Meetings, attended by Constructor, Subcontractor Trade Contractor, truss fabricator, other affected subcontractors, and Consultant to discuss the following:
 - .1 Verify project requirements
 - .2 Review installation conditions
 - .3 Coordinate with building subcontractors affected by work of this Section
 - .4 Review truss fabricator's written product handling and installation instruction requirements

1.7 Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals (to be provided before starting any work of this Section):
 - .1 Product Data:

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- .1 submit truss fabricator's installation instructions, special handling criteria, installation sequence, and printed product literature and data sheets describing product characteristics, performance criteria, physical size, finish and limitations of hardware components required for installation.
- .2 Shop Drawings: Prepare and submit shop drawings in accordance with the Truss Plate Institute of Canada (TPIC) Truss Design Drawing requirements indicating connection details, erection sequence, framing details and the following:
 - .1 Special Requirements: Identify special structural modifiers (if any) that may be required by local Authority Having Jurisdiction.
 - .2 Wood Truss Drawings: Indicate applicable TPIC Truss Design Procedures and CSA O86 engineering requirements, including the following:
 - .3 Indicate stress diagram or print out of computer design indicating design load for truss members - include allowable load and stress increase.
 - .4 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
 - .5 Indicate adjustments to lumber and connector plate design values based on conditions of use (if any).
 - .6 Indicate connector plate types, thickness, size and location at each joint, except where symmetrical configurations allow for centreline illustration of joints.
 - .7 Indicate connection requirements for truss to bearing, truss or girder ply to ply and site-assembled splices.
 - .8 Indicate end connections of trusses to resist uplift and lateral reactions.
 - .9 Supporting professional engineer registered or licensed in the province of the work, is required to seal and sign design solutions presented in submitted shop drawings prepared under their supervision.
 - .3 Placement Drawings: Submit placement and layout drawings for review by Consultant including the following:
 - .1 Indicate sequence of installation and erection, and temporary bracing requirements.

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- .2 Label truss and girder layouts using the same identification numbers indicated on shop drawings described in Subparagraph 1.6.2.2 above.
 - .3 Indicate partitions being used as bearing walls.
 - .4 Indicate hanger type used for connecting trusses to girder trusses and beams.
 - .5 Indicate connection requirements for truss to bearing, truss or girder ply to ply and site-assembled splices when not indicated on shop drawings described in Subparagraph 1.6.2.2 above.
- .3 Informational Submittals: Provide the following submittals concurrently with Action Submittals described above:
- .1 Qualification Data: Submit concurrently with shop drawings proof of qualifications for truss fabricator and materials proposed for use as described in Article 1.7, Quality Assurance below.
 - .2 Certificates: Submit certificates signed by truss fabricator indicating that Products supplied to the Project meet requirements of TPIC Truss Design Procedures.
 - .3 Delegated Design Submittals: Submit delegated design of shear connections in accordance with Section 01 35 73 – Delegated Design Procedures for design criteria described in Article 2.2 below. Include the following:
 - .1 Design Notes and Data: Submit supporting professional engineer's design notes and calculations only when requested by Consultant concurrently with shop drawings verifying capacity of members, connectors for related components of the work, and that assemblies meet design requirements described in this Section.
 - .2 Schedule B: Assurance of Professional Design Involvement and Commitment for Field Reviews by the Registered Professional of Record: Submit concurrently with preliminary shop drawings indicating supporting professional engineer's limitation of design responsibilities.
 - .3 Schedule C-2: Assurance of Field Reviews and Compliance by the Registered Professional of Record: Submit concurrently with site report indicating supporting professional engineer's assessment that installation is substantially compliant with system design indicated on shop drawings.
 - .4 Source Quality Control Submittals: Submit test reports for shop-fabricated wood trusses signed by supporting professional engineer registered or licensed in the

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province of the work, or other independent testing agency acceptable to Consultant indicating compliance with specifications for specified performance characteristics and physical properties.

- .5 Site Quality Control Submissions: Submit truss fabricator's site services reports within three (3) days of review to Consultant.

1.8 Quality Assurance

- .1 Qualifications: When requested by Consultant, provide proof of qualifications as described in Article 1.6, Submittals.
 - .1 Truss Fabricators: Obtain shop-fabricated structural wood trusses and accessories from a single fabrication source qualified in accordance with CWTA National Quality Standard that can provide evidence of In-Plant Qualification Program recognized by regional wood truss associations or other proof of manufacturing and design capability acceptable to the Consultant.
 - .2 Truss Plate Manufacturer: Provide evidence that plates used for truss manufacturing are manufactured to meet testing requirements of CSA S347, and are listed in the Registry of Product Evaluations published by Canadian Construction Materials Centre (CCMC), or other proof of manufacturing capability acceptable to the Consultant.
 - .3 Welded Connection Fabricator: Provide welded connections fabricated in a shop certified by CWB to CSA W47.1, Division 1 or 2.1.

1.9 Delivery, Storage and Handling

- .1 Delivery and Acceptance Requirements: Deliver, handle, store and protect materials in accordance with truss fabricator's written instructions, and in accordance with BCSI Canada.
- .2 Storage and Handling Requirements:
 - .1 Provide bearing supports and bracings to prevent bending, warping and overturning of trusses, in accordance with truss fabricator's written instructions and in accordance with BCSI Canada
 - .2 Store and protect materials from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the truss fabricator
 - .3 Keep materials dry
 - .4 Store trusses on hard, dry and level surface

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- .5 Do not store truss lumber in direct contact with ground
- .6 Do not expose trusses to prolonged weather exposure

1.10 Site Conditions

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where shop-fabricated wood trusses are indicated to fit between or around other construction. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating shop-fabricated wood trusses without site measurements where site measurements cannot be made without delaying the Work. Coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

2. PRODUCTS

2.1 Description

- .1 Regulatory Requirements: Fabricate trusses, bracing and bridging in accordance with CSA O86 using truss joint components tested in accordance with CSA S347, and using products bearing accredited stamp with the manufacturer's name and certificate number, grade, CCMC report number (if applicable) and quality control agency.
 - .1 Qualification Markings: Apply CWTA Plant Qualification marking or tag or other plant certification agency accredited by the Standards Council of Canada to each truss assembly in a readily visible location.
 - .2 Loading: Design trusses to account for minimum uniform and minimum concentrated loadings stipulated in [NBC] commentary applicable to metal plate connected wood trusses.
 - .3 Loading Markings: Apply additional special markings at point load locations other than truss heels on each truss, and on bottom chord of bottom bearing, parallel chord trusses.
- .2 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and that conform to National Grading Rules published by NLGA.
 - .1 Grading: Machine Grading, Visual Grading, or Both
 - .2 Moisture Content: Kiln Dry, 19% or less

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- .3 Structural Design Properties: Strength and related properties in accordance with CSA O86 and NLGA SPS 2
- .4 Acceptable Alternate Products: Lumber products meeting requirements of the American Lumber Standards Committee designated ALS Program Lumber and that are accepted by the Canadian Lumber Standards Accreditation Board, may be acceptable for the Project when proof of compliance with strength and related properties meeting CSA O86 are submitted before purchasing any structural wood products
- .5 Durable Construction: Provide products and installation practices that are rot and insect resistant, and improve performance of the building through use of appropriately sourced and durable products for fire-resistant assemblies , mass timber construction .

2.2 Design Criteria

- .1 Design Responsibility: Truss fabricator is required to retain a supporting professional engineer registered or licensed in the province of the Work, experienced in the design and detailing of light metal plate connected wood trusses in accordance with TPIC Truss Design Procedures using engineering properties listed in CSA O86 for components described in this Section, and as follows:
 - .1 Loads and forces shown on Drawings are not factored, unless specifically indicated otherwise.
 - .2 Request any loads and forces not shown on Drawings from Consultant, and that are required by the supporting professional engineer registered or licensed in the province of the Work, to complete design and detailing of connections.
 - .3 The supporting professional engineer will provide the following in accordance with governing standards described in this Section:
 - .1 design of wood truss members for Serviceability Limit States described in TPIC Truss Design Procedures, and as indicated on Drawings
 - .2 design and detailing of wood truss members, bracing and bridging based on design loading and spacing indicated on Drawings
 - .3 design and detailing of connections not specifically detailed on the Drawings
 - .4 details of dimensions to accommodate mechanical services passing through truss members indicated on Drawings

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- .5 written confirmation that components are fabricated in accordance to shop drawings submitted for the Consultant's review
- .2 Structural Performance Requirements: Design shop-fabricated structural wood component connections to allow for building movements without damage or over stressing, connection failures, and imparting undue strain on fasteners and anchors. Also take into account the following structural performance requirements:
 - .1 Wet Service Conditions Modifier: Required, in accordance with TPIC TB4
 - .2 Dead Loads: Dead loads as indicated on Drawings and others that should be included.
 - .3 Live Loads: Live loads as indicated on Drawings.
 - .4 Roof Loads: Roof loads as indicated on Drawings and others that should be included.
 - .5 Snow Loads: Snow loads as indicated on Drawings and others that should be included
 - .6 Exterior Wind Loads: Wind loads q_{50} for deflection and for strength, modified by importance factors, building exposure, gust effect factors, and pressure coefficients in accordance with structural commentaries and also accounting for the following:
 - .1 Wind Design Data: Location specific data from the NBC
 - .7 Live Load Deflection Limit: $L/360$
- .3 Design Tolerances: Design trusses with positive camber to allow for calculated deflection under dead and live loads to planar profile along slope or level top chord appropriate to truss type; limit horizontal deflection at reaction points to a maximum of 19 mm.
- .4 Modifications to Design: Supporting professional engineer registered or licensed in the province of the Work, is required to account for changes to dimension and bearing capacities inherent with their Products where they are used to establish the Bid Price, while keeping in mind the following:
 - .1 Changes to placement of girder trusses and other loadbearing elements indicated on Drawings will not be permitted without before the acceptance from the Consultant
 - .2 Changes that modify design criteria described by the Consultant will not be permitted without before the acceptance from the Consultant

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- .3 No adjustment to contract price will be considered where manufactured or fabricated component sizes must change to account for design loads indicated on Drawings

2.3 Materials

- .1 Truss Framing: Provide wood materials meeting truss fabricator's design requirements and meeting Structural Performance Requirements listed above, and as follows:
 - .1 Fire Retardant Treated Wood (FRTW): Fire retardant treatment of dimensional lumber, refer to Section 06 05 73 – Wood Treatment
 - .2 Sizes: Lumber sizes as described in TPIC Truss Design Procedures.
 - .3 Grade: Provide No. 2 Grade and better materials
 - .4 Species Group: Spruce Pine Fir (SPF), Douglas Fir Larch (D.FIR L) or Hemlock Douglas Fir (HEM FIR).
 - .5 Selection for Appearance: Not Required
 - .6 Acceptable Alternate Products: Consultant will permit use of truss grade structural composite lumber that meets requirements of TPIC Truss Design Procedures
- .2 Truss Plates: Provide truss plates meeting requirements of CSA S347, manufactured from galvanized steel sheet meeting requirements of ASTM A653/A653M, having zinc coating designation Z275, and as follows:
 - .1 Grade: Structural steel sheet or high strength, low alloy steel sheet as determined by truss fabricator's supporting professional engineer registered or licensed in the province of the Work, based on loads and use conditions identified by Consultant.
 - .2 Duplex Coating: Apply epoxy polyamide corrosive protective coating to galvanized truss plates before fabrication of truss assemblies in accordance with TPIC TB4.
 - .3 Truss Anchors and Hangers: Provide truss anchors and hangers meeting requirements of CSA O86, manufactured from galvanized steel sheet meeting requirements of ASTM A653/A653M, having zinc coating designation Z275; types and configurations as indicated on drawings and as follows:
 - .1 Roof Truss Tie-Downs: Brackets rated for wind uplift loads indicated above.

2.4 Accessories

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- .1 Wood Framing and Blocking: Provide sawn lumber materials as specified in Section 06 10 53 – Miscellaneous Rough Carpentry.
- .2 Driven Fasteners: Steel nails, spikes, brads, and staples meeting requirements of ASTM F1667 or CSA B111. Ensure length is sufficient to penetrate connecting solid wood materials.
 - .1 Exterior Work: Hot-dipped galvanized and ACQ compatible.
 - .2 Interior High Humidity Work: Hot-dipped galvanized.
 - .3 Interior Work: Electroplated zinc plated, or cadmium plated.
 - .4 Pressure Treated Materials: Refer to Section 06 05 73 – Wood Treatment.

2.5 Fabrication

- .1 Fabricate wood trusses based on the reviewed shop drawings that were created in accordance with TPIC Truss Design Procedures at an accredited truss plant participating in CWTA In-Plant Qualification Program and with the following:
 - .1 Assemble truss members in design configuration required for Project
 - .2 Assemble truss members using jigs or other means to maintain uniformity and accuracy of assembly with joints closely fitted to meet tolerances listed by TPIC Truss Design Procedures
 - .3 Account for design camber and roof slopes when positioning truss members

2.6 Source Quality Control

- .1 In-Plant Testing and Inspections:
 - .1 Test a minimum of three trusses of each type as described in CWTA In-Plant Qualification Program and submit a report indicating that tested trusses represent trusses used for the Project
 - .2 Indicate any manufacturing and material variances described in Appendix G of TPIC Truss Design Procedures
 - .3 Conduct in plant testing and inspections in accordance with CSA S347
 - .4 Document any follow-up repairs, rework or replacement of trusses for nonconforming materials or variances in workmanship.

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- .5 Supporting professional engineer registered or licensed in the province of the Work, will direct all follow up repairs and rework and validate that trusses delivered to the Project meet specified requirements.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant
 - .2 Inform Consultant 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 Consultant

3.2 Preparation

- .1 Concentrated Load Prevention: Prevent concentrated loads on trusses until required bracing and sheathing is installed; do not permit stacking of sheathing bundles, lumber and other materials on unsheathed trusses.

3.3 Erection

- .1 Installation Requirements:
 - .1 Erect wood trusses in accordance with reviewed shop drawings, fabricator's written instructions, and in accordance with BCSI Canada
 - .2 Make adequate provisions for handling and erection stresses
 - .3 Exercise care to prevent out-of-plane bending of trusses
 - .4 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed
 - .5 Install permanent bracing, bridging and sheathing in accordance with reviewed shop drawings, before the application of loads to trusses
 - .6 Do not cut or remove any truss component without written confirmation by Consultant, and supporting professional engineer registered or licensed in the province of the Work.

SHOP FABRICATED WOOD TRUSSES

- .2 Bracing Requirements:
 - .1 Install permanent lateral bracing as indicated on shop drawings, in size and grade described, and fastened at locations shown using number and size of nails described on truss shop drawings
 - .2 Restrain lateral movement of bracing using permanently installed cross bracing at ends of each truss run and evenly spaced at intervals of six metres or less
 - .3 Restrain top chord of trusses to prevent lateral movement using sheathing or permanent bracing as indicated on shop drawings
 - .4 Install lateral ties evenly spaced at intervals of three metres or less; with additional permanent lateral bracing as indicated on shop drawings
- .3 Site Modifications: Cutting, notching or drilling of shop-fabricated wood trusses arising from site conditions that do not meet fabricator's standard details will not be permitted without fabricator's written recommendations, as directed by the Consultant.
- .4 Damaged Components:
 - .1 Do not use shop-fabricated wood truss components that exhibit visible damage; damaged components will require replacement with material of same quality and performance as specified Products
 - .2 Notify Consultant and supporting professional engineer immediately of any damage to wood truss components
 - .3 Supporting professional engineer registered or licensed in the province of the Work, will recommend repair or replacement procedures as directed by the Consultant
 - .4 No work for repair or replacement of damaged components will be permitted without Consultant's written instructions
- .5 Protective Coatings: Clean and prepare exposed surfaces of metal connector plates; brush apply primer and one coat of protective coating.

3.4 Site Quality Control

- .1 Truss Fabricator's Site Services: Truss fabricator's supporting professional engineer registered or licensed in the province of the Work, will review completed construction to verify that installation of wood truss system is in accordance with shop drawings and placement drawings.

SHOP FABRICATED WOOD TRUSSES

- .1 Review products supplied under this Section and confirm that wood truss system handling, installation and erection, protection and cleaning of its products is in accordance with fabricator's written instructions
- .2 Truss fabricator's site services and recommendations include product use recommendations and periodic site visits for inspection of product installation in accordance with truss fabricator's instructions
- .3 Schedule site visits to review work at the following stages:
 - .1 after delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 after completion of Work of this Section.
- .4 Submit written reports in format acceptable to Consultant, to verify compliance of Work with Contract.

3.5 Cleaning

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at the end of each day
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning

3.6 Closeout Activities

- .1 Non-Conforming Work: Consultant will confirm correction and verification procedures with manufacturer, and instruct Subcontractor responsible for work of this Section on repair procedures or replacement of non-conforming work.
- .2 Adjusting: Repair damage to adjacent materials caused by installation of materials specified in this Section.
- .3 Repairs:
 - .1 Replace wood trusses that are damaged or do not meet requirements
 - .2 Apply touch-up coating materials to provide minimum dry film thickness recommended by coating system manufacturer
 - .3 Repair damaged galvanized coatings on exposed surfaces with galvanized repair coating in accordance with ASTM A780/A780M and truss plate manufacturer's written instructions

SHOP FABRICATED WOOD TRUSSES

END OF SECTION

**DIVISION 07 – THERMAL AND MOISTURE
PROTECTION**

RIGID BOARD INSULATION

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM D1248 Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
 - .2 ASTM D4101 Standard Specification for Polypropylene Injection and Extrusion Materials
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S701 Thermal Insulation, Polystyrene, Boards and Pipe Coverings
 - .2 CAN/ULC-S702 Thermal Insulation Mineral Fibre for Buildings

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing:
 - .1 Schedule application of insulation to follow immediately after installation of sheet membrane air and vapour seal and to proceed concurrently with it.

1.4 QUALITY ASSURANCE

- .1 Certifications:
 - .1 Polystyrene insulation shall be tested, certified and labelled for conformance with CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering, in accordance with, ULC, or other certification program accredited by Standards Council of Canada.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver and store materials, undamaged in original wrappings, in a suitable environment.
- .2 Storage and Handling Requirements:
 - .1 Store to protect materials from wind, moisture, sunlight and accidental ignition.

1.6 SITE CONDITIONS

- .1 Install insulation during dry weather conditions.

Part 2 Products

2.1 INSULATION

- .1 Vertical below grade: Polystyrene, Type 4: to CAN/ULC-S701. Thickness indicated on drawings.
- .2 Walls and soffits above grade: Polystyrene, Type 2: to CAN/ULC-S701. Thickness indicated on drawings.

2.2 BOARD DIMENSIONS AND SHAPE

- .1 Minimum Width: 400 mm.
- .2 Minimum Length: 1200 mm.

RIGID BOARD INSULATION

- .3 Thickness: as indicated on drawings

2.3 FASTENERS

- .1 Only use fasteners in the top 300mm of insulation in the area that EIFS is to be applied. To a maximum depth of 150mm below grade. Below this level use adhesive to install insulation. Provide a horizontal butt joint between the two forms on installation of the rigid board.
- .2 Fasteners shall be specifically designed to anchor insulation by frictional resistance within structurally adequate substrates. They shall be inserted into and compressed against surrounding substrates, either by being driven or screwed, and shall be one of the following types:
- .1 Plastic: with integral shank and head of minimum 45 mm diameter to distribute stresses, of high density polyethylene to ASTM D1248 or high density polypropylene to ASTM D4101.
 - .2 Carbon Steel or Stainless Steel: of nail, screw or expansion type, with separate hot-dip galvanized sheet steel or high density polyethylene or polypropylene stress distribution plates of minimum 50 mm diameter or width.
 - .3 One of the following combination masonry connectors/insulation fasteners:
 - .1 Masonry Connectors: as specified in Section 04 20 00, designed, with or without optional insulation retainer plates, to function as insulation fasteners.
- .3 Performance requirements for installed insulation fasteners:
- .1 Pullout Resistance: minimum 200 N, perpendicular to applicable substrates and within temperature range of -30°C to +40°C.
 - .2 Corrosion Resistance: carbon steel components shall show not more than 15% of the surface rusted, and coatings shall not blister, peel or crack, when tested to Corrosion Test Procedure of Factory Mutual Research Approval Standard, Class I Roof Covers (4470).

Part 3 Execution

3.1 INSTALLATION OF INSULATION

- .1 Install insulation boards horizontally. Offset vertical joints minimum 300 mm.
- .2 Cut and trim insulation neatly to fit around corners and penetrations. Take care to prevent cutting sheet membrane air and vapour seal.
- .3 Butt joints tightly. Deform board edges as required to maintain tight butt joints at insulation fasteners and other penetrations located at board joints.

3.2 INSTALLATION OF FASTENERS

- .1 Secure all above grade and partially below grade insulation boards with fasteners, anchored to substrates capable of providing specified fastener pull-out performance. Do not anchor to gypsum sheathing.
- .2 Install fasteners following fastener manufacturer's recommendations for type of substrate, drill bits, edge distance, installation methods, and ambient and substrate temperature conditions.
- .3 Space fasteners horizontally at:
- .1 maximum 800 mm o.c.,
 - .2 minimum 100 mm and maximum 200 mm from vertical board joints. If stud spacing exceeds 400mm, maximum spacing of fasteners horizontally shall be a maximum of 200mm from vertical board joints.
- .4 Space fasteners vertically:

RIGID BOARD INSULATION

- .1 At all horizontal board joints and on centre line of board widths, or
- .2 At $\frac{1}{4}$ of board width from all horizontal joints.
- .5 Do not use plastic fasteners in horizontal, suspended installations.

END OF SECTION

NON-RIGID FIBROUS INSULATION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

- .1 Polyethylene Sheet Vapour Retarder: Section 09 29 00.

1.2 REFERENCE DOCUMENTS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C553-08 Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 ASTM C665-06 Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .3 ASTM C1320-05 (2009) Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S702-09 Thermal Insulation Mineral Fibre for Buildings.
 - .2 CAN/ULC S703-01 Standard for Cellulose Fibre Insulation (CFI) for Buildings, Includes Amendment 1.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver insulation and accessories in original unopened packaging or cartons bearing manufacturer's seals and labels.
- .2 Storage and Handling Requirements:
 - .1 Store materials under cover on raised platforms, away from moisture. Keep dry at all times.

2. Products

2.1 BATT INSULATION

- .1 Fibrous Glass Batts: GREENGUARD Certified preformed insulation without a membrane, sized for friction fit between framing, thermal resistance (R-Value) as indicated on the drawings.
- .2 Fibrous Mineral Wool Batts: preformed mineral slag insulation without membrane, sized for friction fit between framing, thermal resistance (R-Value) as indicated on the drawings.

2.2 LOOSE FILL INSULATION

- .1 Loose Mineral Wool and Loose Glass Fibre: GREENGUARD Certified blowing installation, thermal resistance (R-Value) as indicated in insulation schedule.
- .2 Loose Cellulose Fibre: to CAN/ULC S703, suitable for blowing installation, thermal resistance (R-Value) as indicated in insulation schedule.

NON-RIGID FIBROUS INSULATION

3. Execution

3.1 PREPARATION

- .1 Ensure all in-wall construction is complete before beginning installation.
- .2 Install insulation after building substrate materials are dry.
- .3 Ensure substrate materials are properly installed and complete before beginning installation.

3.2 INSTALLATION - GENERAL

- .1 Install insulation materials in accordance with manufacturer's recommendations.
- .2 Install insulation to maintain continuity of thermal protection of building elements and spaces.
- .3 Fit insulation tightly around openings and protrusions in plane of insulation.
- .4 Install adequate blocking at eaves to ensure proper ventilation of attic space.

3.3 INSTALLATION OF BATT INSULATION

- .1 Install batts between framing members, structural components and other items snug and tight.
- .2 Cut and trim batts neatly to fit spaces. Use batts free from ripped or damaged back and edges.
- .3 Do not compress insulation to fit into spaces.

3.4 INSTALLATION OF LOOSE FILL INSULATION

- .1 Pneumatically place loose fill insulation above ceilings between joists.
- .2 Fill above ceiling spaces to uniform thickness to provide specified minimum thermal resistance. Ensure no air pockets occur.

END OF SECTION

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

Part 1 General

1.1 SECTION INCLUDES

- .1 This Section includes requirements for:
 - .1 A spray applied rigid cellular polyurethane thermal insulation foam product applied where indicated, so as to provide a continuous air seal.
 - .2 A spray applied thermal barrier over the polyurethane. Thermal barrier may or may not be required. Refer to Article 1.3.

1.3 REFERENCE DOCUMENTS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM D1621-04a Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .2 ASTM D1622-08 Standard Test Method for Apparent Density of Rigid Cellular Plastics
 - .3 ASTM D1623-09 Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
 - .4 ASTM D2126-09 Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
 - .5 ASTM D2842-06 Standard Test Method for Water Absorption of Rigid Cellular Plastics
 - .6 ASTM E84-09c Standard Test Method for Surface Burning Characteristics of Building Materials
 - .7 ASTM E96/E96M-05 Standard Test Methods for Water Vapor Transmission of Materials
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.5 QUALITY ASSURANCE

- .1 Regulatory Agency Approvals
 - .1 Whichever of the following products is used, Contractor shall be responsible for obtaining approval for use in intended applications from authority having jurisdiction:
 - .1 Spray applied polyurethane foam containing integral fire inhibitors.
 - .2 Thermal barrier required for protection of spray applied polyurethane foam without integral fire inhibitors.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

- .1 Deliver and store materials, undamaged in original wrappings, in a suitable environment.
- .2 Storage and Handling Requirements:
 - .1 Store to protect materials from wind, moisture, sunlight and accidental ignition.

1.7 SITE CONDITIONS

- .1 Maintain minimum ambient temperature of 5°C for minimum 24 hours before, during and 72 hours after completion of application.

Part 2 Products

2.1 PRODUCT OPTIONS

- .1 Contractor shall select one of the following options:
 - .1 Provide spray applied polyurethane foam containing integral fire inhibitors. An additional, separate thermal barrier is not required.
 - .2 Provide spray applied polyurethane without integral fire inhibitors. An additional, separate thermal barrier is required.
- .2 Spray Applied Polyurethane Foam: rigid, cellular thermal insulation with following properties when applied:

Property	Test Method	Requirement
Density	ASTM D1622	42 kg/m ³ max. 10 kg/m ³ min.
Compressive strength	ASTM D1621	104 kPa with max. 10% deformation
Tensile Strength	ASTM D1623	138 kPa min.
Response to thermal and humid aging	ASTM D2126	12% max. volume change
Water absorption	ASTM D2842	5% max. by volume
Water vapour permeability	ASTM E96E96M	Core: max. 180 ng/(Pa.s.m ²) Skins: max. 60 ng/(Pa.s.m ²)

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

- .3 Spray Applied Polyurethane Foam Containing Integral Fire Inhibitors: same properties as specified in 2.1.1, with following additional fire hazard classification properties when tested to CAN/ULC-S102 or ASTM E96E96M:
 - .1 Flame spread: max. 10.
 - .2 Smoke developed: max. 500.
 - .3 Fuel contributed: 0.

2.3 THERMAL BARRIER

- .1 Thermal Barrier: spray applied fire retardant overcoat meeting applicable requirements of the Alberta Building Code for a thermal barrier over foamed plastic.

Part 3 Execution

3.1 VERIFICATION OF CONDITIONS

- .1 Inspect areas to receive work of this Section and ensure conditions are suitable to begin application.
- .2 Ensure that all work penetrating through air seal is complete.
- .3 Ensure that appropriate back-up material has been installed in all large voids.

3.2 PROTECTION OF EXISTING WORK

- .1 Protect from overspray all finish surfaces which will be exposed to view.

3.3 SUBSTRATE PREPARATION

- .1 Clean substrates of dirt, dust, grease, oil, loose material and other matter which may affect bond of spray applied materials.
- .2 If recommended by manufacturer, prime substrates in accordance with manufacturer's instructions.
- .3 Remove oil from galvanized sheet steel substrates and apply prime coating in accordance with manufacturer's instructions.

3.4 SPRAY APPLIED POLYURETHANE FOAM APPLICATION

- .1 Spray apply polyurethane foam in accordance with manufacturer's instructions. Use equipment recommended by manufacturer.
- .2 Apply material as indicated and in sufficient thickness to achieve a complete air seal.
- .3 Wall/decking Junctures: provide continuous gusset profiled seal, extending 150 mm vertically and horizontally from juncture. Ensure application leaves no voids.
- .4 Windows & Doors: apply only enough product to form an effective air seal toward warm side of frames, do not fill entire cavity with foam. If application deforms frames, remove foam, restore frame alignment and re-apply foam.

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

3.5 THERMAL BARRIER APPLICATION

- .1 Spray apply fire retardant overcoat to spray applied polyurethane foam surfaces, in sufficient thickness to provide a thermal barrier meeting the Alberta Building Code and requirements of authority having jurisdiction.

3.6 AIR SEAL APPLICATION SCHEDULE

- .1 Provide air seal at the following:
 - .1 Juncture of external walls and roofs.
 - .2 Perimeter of windows & doors.
 - .3 Other locations indicated on drawings.

END OF SECTION

STAND SEAM ROOF

1. General

1.1 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
- .2 Shop Drawings:
 - .1 Submit shop drawings or catalogue illustrations.

1.2 GENERAL

- .1 Do not apply roofing material when the weather or the condition of the substrate is such that the required installation procedures cannot be followed or which would jeopardize the performance of the roofing system. It is recommended that prefinished sheets be formed near 20°C (68°F).
- .2 Protect the metal roofing materials and components from moisture during storage. Protect pre-finished metal panels and accessories from damage to their paint coating during fabrication, delivery and storage at the job site.
- .3 Co-ordinate roof application with other trades and minimize traffic on the completed roof panel surface.

1.3 WARRANTY

- .1 If roofing system has been constructed by a non-member of ARCA, Contractor shall obtain a maintenance bond for the performance of Contractor's obligations to provide a 5-year warranty. In the amount of 100% of the cost of materials and labour associated with the roofing and roofing related work performed under this Contract. If the system is not eligible for an ARCA warranty, the One-Year Contractor Warranty shall be acceptable.

2. Products

2.1 PANELS

- .1 Standing seam roof panels, trim, flashings and accessories shall be manufactured from ASTM Standard A446, Grade A steel, with a minimum yield strength of 33,000 PSI, with a protective galvanizing coating to ASTM Standards, A653/A653M, minimum zinc coating designation Z275.
 - .1 Standing seam roof cladding, underlayment, sloping rigid insulation, rigid insulation, roof vapour barrier atop roof substrate or similar approved.
 - .2 Profile & Colour: To be selected from Manufacturer's standard profile & colour scheme.
 - .2 Pre-coated roof panel (Polar White or standard colour selection, as reviewed and approved by Building Owner and Architect.
 - .3 Painted liner panel (Painted liner panel shall be G90 galvanized steel conforming to ASTM specification A653 (G90) and 8000 series silicone polyester paint on the exposed side and non-colour controlled wash coat primer on unexposed side).
 - .4 Alternative roof assembly systems are acceptable such as Butler, Robertson Building Systems, provided tested systems can be provided. Owner and Consultants review & approval required on any substitutions.

2.2 SEALANTS

STAND SEAM ROOF

- .1 Butyl tape and Foam Closures
- .2 Sealant and caulking shall be selected for their ability to resist weathering, for their compatibility with and their ability to adhere to the metal panel/flashing finish.
- .3 Sealant/caulking shall be non-hardening, exterior type, applied in tape or gun form. Where permitted, provide a minimum of two (2) rows of a continuous bead of sealant at panel lap joints.

2.3 UNDERLAYMENTS

- .1 Hi-temp self-adhering S.B.S. modified bituminous membrane (Membranes with a high temperature resistant formulation). Temperature limitations for S.B.S. underlayment membranes shall be compatible with the metal panel type. In general, higher temperatures from the increased conductivity of dark coloured metal panels may cause some SBS membranes to break down.
- .2 High Temperature SBS membrane – see section 07 26 00. To be compatible with metal roof.

2.4 SUBSTRATES

- .1 The substrate of which the underlayment, eave protection and metal panels are attached shall be exterior grade wood sheathing under C.S.A Standards with a minimum thickness of 19 mm (3/4") plywood.
- .2 For proper attachment of the underlayment membrane, the substrate for metal panel support shall be clean, dry and clear of all loose debris and fasteners.

2.5 PANEL CLIPS

- .1 Panel clips shall be made from minimum 24 gauge corrosion resistant metal.
- .2 Fixed panel clips shall be used for the attachment of metal panels up to 10 meters (32.8 ft.) long.
- .3 Two (2) piece expansion panel clips shall be used for the attachment of metal panels over 10 meters (32.8 ft.) in length.
- .4 It is the responsibility of the design professional or Engineer of record to determine the spacing of clips required to meet the design wind-uplift requirements of the project. The metal roof system manufacturer shall confirm compliance with the designed wind uplift resistance for the buildings location.

2.6 FASTENERS

- .1 Nails are not permitted for the fastening of metal roofing systems.
- .2 Metal flashing fasteners shall not penetrate the supporting substrate to allow for proper expansion and contraction of the metal panel.
- .3 Fasteners for metal roofing shall conform to ASME B18.6.3. Provide pullout resistance to the approval of the Engineer of record.
- .4 Tapping and drive screws shall be corrosion resistant.
- .5 Concealed fasteners shall be minimum #10 by 25 mm (1 in.) long pan-head or modified truss-head screws. The screw head shall be compatible with the clip design and provide suitable clearance from the underside of the panel.
- .6 Exposed fasteners shall be sealed rivets, or minimum #10 corrosion resistant sheet metal screws supplied with metal-backed EPDM or neoprene washers.
- .7 Nails and other fastening devices used in the application of the underlayment or eave protection membranes shall be hot-dipped galvanized.

STAND SEAM ROOF

- .8 Fasteners shall penetrate a minimum distance of 25 mm (1") into dimensional lumber decks and shall extend a minimum distance of 12.5 mm (0.5") beyond the underside of wood sheathing substrates

2.7 FLASHINGS

- .1 Dektite type flashings or flashed curbs shall seal plumbing vent stacks. Flashing fasteners shall not penetrate the supporting substrate to allow for proper expansion and contraction of the metal panel.
- .2 Penetrations shall be curbed if the flange width of a penetration flashing exceeds 60% of the panel width. Sloped crickets are required on the upslope side of the curb.
- .3 Metal flashings shall be fabricated in maximum 3000 mm (10 ft.) lengths from similar materials and standards.
- .4 Fasten ridge flashings to underlying J-channels to allow the roof panels to move independently of the cap flashings. Join capping end laps with S-locks installed to shed water (See Detail No.2). Cap flashings shall overlap the roof panels a minimum distance of 50 mm (2").
- .5 Ends of panels in the J-channel shall incorporate a watertight end pan fold (bread pan).
- .6 When the panels are secured at the eave, proper allowance must be provided for panel movement at the ridge.
- .7 When the panels are secured at the ridge, proper allowance must be provided at the drip edge overlap to allow for expansion and contraction of the metal panel.
- .8 When long panels are used; fixation at the center of the panel may be specified. Both the ridge and eave must provide the required space to accommodate the expansion and contraction of the metal panel.
- .9 Roof/Wall intersections shall be flashed with not less than one layer of sheet metal flashing. The metal flashing shall extend a minimum distance of 150 mm (6") up the wall and shall overlap a minimum distance of 100 mm (4") onto the underlying metal roof panels.
- .10 The gable and rake edge flashings shall be formed to fully cover the machine-formed or hand-formed standing seam legs located along the gable/rake edge.
- .11 The flashing shall not be fastened directly to the metal roof panels. Flashing securement shall be made at the fascia and to the J-channel, which runs continuously under the flashing along the gable/rake edge.

2.8 VENT PIPE PENETRATIONS

- .1 Plumbing vents and round vent pipe penetrations, 300 mm (12") and smaller in diameter, with an outside temperature of less than 415° F, may be waterproofed with a Dektite type flexible flashing (See Detail No. 9). This type of flexible flashing shall be made from EPDM rubber and shall be resistant to ozone and ultraviolet light deterioration.
- .2 Curb circular vent penetrations when their locations coincide with the metal panel's standing seams.
- .3 Ensure fastening of flashing flanges to the metal panel do not penetrate the supporting substrate.

3 Execution

3.1 INSTALLATION, GENERAL

- .1 Install in accordance with manufacturer's instructions and recommendations.
- .2 Form metal roof panels to field dimensions in continuous lengths, spanning from eave to ridge, free from dents and distortion. Optionally, two or three stiffening ribs may be incorporated into the panel profile while forming.

STAND SEAM ROOF

- .3 Curved metal roofing panels shall be machine curved to minimize seam buckling and panel deformation.
- .4 Panels shall be formed in 300 mm (12") to 510mm (20") widths.
- .5 The male and female standing seams shall be formed and mechanically seamed with a minimum 38 mm (1.5") high vertical leg and a minimum 9.5 mm (0.375") wide horizontal leg. To accommodate the single fold panel crimp, male seams shall be formed with an additional minimum 9.5 mm (0.375") long vertical return leg.
- .6 When joined together, the finished male and female standing seam profiles shall properly nest with the panel clips. Add in-seam sealant for roof slopes less than 3:12.
- .7 Where metal panels terminate at walls, curbs, ridge/hip junctions, the panel ends shall be finished with a watertight pan fold. The end pan fold height shall be equal to the standing seam height.
- .8 Panel end laps are not permitted in the field of the metal panel roofing system, except at curbs and roof penetrations.
- .9 Roof panels shall be prepared with lock folds for panel attachment at the eaves or at valleys without exposed fasteners.
- .10 Align panels parallel to the roof slope and square to the eaves.
- .11 The metal panels shall be uniformly supported by the substrate before their attachment.
- .12 Attach roof panels in accordance with engineered drawings and specifications to their supporting substrate with sheet metal panel clips using a minimum of two (2) fasteners per clip placed adjacent to the vertical leg of the panel clip. To provide for thermal panel movement, expansion panel clips may be substituted for fixed panel clip. Install expansion clips carefully to avoid binding.

3.2 SEAMING / FOLDING

- .1 For slopes 3:12 and greater, a 38 mm (1.5 in.) high single-fold crimp, that fully incorporates the panel clips, is required along the entire panel length at the standing seam.
- .2 For slopes less than 3:12, a 50 mm (2 in.) high double-lock seam, that fully incorporates the panel clips, is required along the entire panel length at the standing seam.

3.3 DRIP EDGE

- .1 A 38mm (1½") wide fold lock shall be used at the drip edge flashings to permit thermal movement of the roof panels at the eave edge.

END OF SECTION

FIBER CEMENT SIDING

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

- .1 Fiber cement lap siding, panels, shingle, trim, fascia, moulding and accessories; James Hardie HZ5 Engineered for Climate Siding.
- .2 Factory-finished fiber cement lap siding, panels, shingle, trim, fascia, moulding and accessories; James Hardie HZ5 Engineered for Climate Siding.

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

- .1 Joint Sealants Section 07 92 00

1.2 REFERENCE DOCUMENTS

- .1 ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets
- .2 ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool and Tape.
- .3 ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.3 SUBMITTALS

- .1 Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- .2 Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches (100 by 150 mm), representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

- .1 Installer Qualifications: Minimum of 2 years experience with installation of similar products.
- .2 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - .1 Finish areas designated by Architect.
 - .2 Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - .3 Refinish mock-up area as required to produce acceptable work.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
- .3 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

FIBER CEMENT SIDING

1.7 WARRENTY

- .1 Product Warranty: Limited, non-pro-rated product warranty. Store products in manufacturer's unopened packaging until ready for installation.
 - .1 HardiePlank HZ5 lap siding for 30 years.
- .2 Product Warranty: Limited, product warranty.
 - .1 HardieTrim HZ and HZ5 boards for 15 years.
- .3 Finish Warranty: Limited product warranty against manufacturing finish defects.
 - .1 When used for its intended purpose, properly installed and maintained according to James Hardie's published installation instructions, James Hardie's ColorPlus finish with ColorPlus Technology, for a period of 15 years from the date of purchase: will not peel; will not crack; and will not chip. Finish warranty includes the coverage for labor and material.
- .4 Workmanship Warranty: Application limited warranty for 2 years.

2. Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Fax: 949-367-4981; Email: [request info \(info@jameshardie.com\)](mailto:request_info@jameshardie.com); Web: www.jameshardiecommercial.com

2.2 SIDING

- .1 HardiePlank HZ5 lap siding, HardiPanel HZ5 vertical siding, HardieSoffit HZ5 panels and HardieShingle HZ5 siding requirement for Materials:
 - .1 Fiber-cement Siding - complies with ASTM C 1186 Type A Grade II.
 - .2 Fiber-cement Siding - complies with ASTM E 136 as a noncombustible material.
 - .3 Fiber-cement Siding - complies with ASTM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.
- .8 Trim:
 - .1 HardieTrim HZ5 boards and HardieTrim HZ boards as manufactured by James Hardie Building Products, Inc.

2.3 FASTENERS

- .1 Wood framing fasteners: to suit exposure and site conditions
 - .1 Wood Framing: 4d common corrosion resistant nails.
 - .2 Wood Framing: 6d common corrosion resistant nails.
 - .3 Wood Framing: 8d box ring common corrosion resistant nails.
 - .4 Wood Framing: 0.089 inch (2.2 mm) shank by 0.221 inch (5.6 mm) head by 2 inches (51 mm) corrosion resistant siding nails.
 - .5 Wood Framing: 0.093 inch (2.4 mm) shank by 0.222 inch (5.6 mm) head by 2 inches (51 mm) corrosion resistant siding nails.
 - .6 Wood Framing: 0.093 inch (2.4 mm) shank by 0.222 inch (5.6 mm) head by 2-1/2 inches (64 mm) corrosion resistant siding nails.
 - .7 Wood Framing: 0.091 inch (2.3 mm) shank by 0.221 inch (5.6 mm) head by 1-1/2 inches (38 mm) corrosion resistant siding nails.
 - .8 Wood Framing: 0.091 inch (2.3 mm) shank by 0.225 inch (5.7 mm) head by 1-1/2 inches (38 mm) corrosion resistant siding nails.
 - .9 Wood Framing: 0.121 inch (3 mm) shank by 0.371 inch (9.4 mm) head by 1-1/4

FIBER CEMENT SIDING

inches (32 mm) corrosion resistant roofing nails.

.10 Wood Framing: No. 11 gauge 1-1/4 inches (32 mm) corrosion resistant roofing nails.

.11 Wood Framing: No. 11 gauge 1-1/2 inches (38 mm) corrosion resistant roofing nails.

.12 Wood Framing: No. 11 gauge 1-3/4 inches (44 mm) corrosion resistant roofing nails.

2.3 FINISHES

.1 Factory Primer: Provide factory applied universal primer.

.1 Primer: Factory primed by James Hardie.

.2 Topcoat: Refer to Section 09900 and Exterior Finish Schedule.

.2 Factory Finish: Refer to Exterior Finish Schedule.

.1 Product: ColorPlus Technology by James Hardie.

.2 Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.

.3 Process:

.1 Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer's own facility utilizing a multi-coat, heat cured finish within one manufacturing process.

.2 Each finish color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or production runs as measured by photospectrometer and verified by third party.

.4 Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed

.5 Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.

.6 Factory Finish Color for Trim, Soffit and Siding Colors:

.1 TBC

3. Execution

3.1 EXAMINATION

.1 Do not begin installation until substrates have been properly prepared.

.2 If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

.3 Nominal 2 inch by 4 inch (51 mm by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistive barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

.1 Install water-resistive barriers and claddings to dry surfaces.

.2 Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.

.3 Protect siding from other trades.

.4 Minimum 20 gauge 3-5/8 inch (92 mm) C-Stud 16 inches maximum on center or 16 gauge 3-5/8 inches (92 mm) C-Stud 24 inches (610 mm) maximum on center metal framing complying with local building codes, including the use of water-resistive barriers and/or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

.1 Install water-resistive barriers and claddings to dry surfaces.

.2 Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.

FIBER CEMENT SIDING

- .3 Protect siding from other trades.

3.2 PREPARATION

- .1 Clean surfaces thoroughly prior to installation.
.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
.3 Install a water-resistive barrier is required in accordance with local building code requirements.
.4 The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

3.3 INSTALLATION – HARDIEPLANK HZ5 LAP SIDING AND ARTISAN HZ5 LAP SIDING

- .1 Install materials in strict accordance with manufacturer's installation instructions. Starting: Install a minimum 1/4 inch (6 mm) thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-1/4 inches (32 mm) wide laps at the top. The bottom edge of the first plank overlaps the starter strip.
.2 Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
.3 Align vertical joints of the planks over framing members.
.4 Maintain clearance between siding and adjacent finished grade.
.5 Locate splices at least one stud cavity away from window and door openings.
.6 Wind Resistance: Where a specified level of wind resistance is required Hardieplank lap siding is installed to framing members and secured with fasteners described in Table No. 2 in National Evaluation Service Report No. NER-405.
.7 Locate splices at least 12 inches (305 mm) away from window and door openings.

3.4 INSTALLATION TRIM BOARDS

- .1 Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.
.2 Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
.3 Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.
.4 Maintain clearance between trim and adjacent finished grade.
.5 Trim inside corner with a single board trim both side of corner.
.6 Outside Corner Board Attach Trim on both sides of corner with 16 gage corrosion resistant finish nail 1/2 inch (13 mm) from edge spaced 16 inches (406 mm) apart, weather cut each end spaced minimum 12 inches (305 mm) apart.
.7 Allow 1/8 inch gap between trim and siding.
.8 Seal gap with high quality, paint-able caulk.
.9 Shim frieze board as required to align with corner trim..
.10 Fasten through overlapping boards. Do not nail between lap joints.
.11 Overlay siding with single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten HardieTrim boards to HardieTrim boards.
.12 Shim frieze board as required to align with corner trim.
.13 Install HardieTrim Fascia boards to rafter tails or to sub fascia.

FIBER CEMENT SIDING

3.6 FINISHING

- .1 Finish unprimed siding with a minimum one coat high quality, alkali resistant primer and one coat of either, 100 percent acrylic or latex or oil based, exterior grade topcoats or two coats high quality alkali resistant 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.
- .2 Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

3.7 PROTECTION

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

FLASHING AND RAINWATER GOODS

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 Alberta Roofing Contractor's Association (ARCA).
 - .1 Roofing Applications Standard Manual
- .2 Aluminum Association (AA):
 - .1 AA-C22-A41 Anodized Clear Coatings
 - .2 AA-C22-A42 Integral Colour Coatings
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/ A653M-09 - Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
 - .2 ASTM D2822-11 - Asphalt Roof Cement.
 - .3 ASTM D3019-17 - Lap Cement Used with Asphalt Roll Roofing, Non-Fibered, Asbestos-Fibered, and Non-Asbestos-Fibered.
- .4 SCAQMD South Coast Air Quality Management District, California State (SCAQMD):
 - .1 SCAQMD Rule #1168, June 2006

1.2 MOCK-UP

- .1 All metal flashings shall be part of a building envelope mock-up to confirm profiles, dimensions, colour and installation requirements PRIOR the complete batch of flashings.
- .2 Each flashing profile for mock-up shall be at least 600mm long.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Handling Requirements:
 - .1 Store products off ground and under cover in a dry, well ventilated enclosure.
 - .2 Stack pre formed material in manner to prevent twisting, bending and rubbing.
 - .3 Provide protection for galvanized and pre coated surfaces.
 - .4 Prevent contact of dissimilar metals during storage. Protect from acids, flux, and other corrosive materials and elements.

Part 2 Products

2.1 MATERIALS

- .1 Sheet Steel: Commercial or Forming Steel to ASTM A653M with Z275 hot dip galvanized zinc coating, in thickness and finish specified in this Section.
- .2 Schedule 40 circular downspouts.

FLASHING AND RAINWATER GOODS

- .3 Sheet Steel Finish: factory painted, baked-on enamel of proven durability for exterior exposure, to CSSBI Technical Bulletin No. 7, 5000 series. Finish colours will be selected from paint manufacturer's standard range.
- .4 Eavestrough Brackets: 3 mm x 38 mm hot dip galvanized steel strap.
- .5 Eavestrough Spacers: 2 mm x 38 mm hot dip galvanized steel strap, rectangular section.
- .6 Recessed Reglet: preformed 0.70 mm hot dip galvanized steel channel with face and ends covered with plastic tape.

2.2 ACCESSORIES

- .1 Flashing Nails: #12 hot dipped zinc coated, annular ringed.
- .2 Sheet Metal Screws: cadmium plated, self tapping, pan head.
- .3 Bituminous Paint: emulsion type.
- .4 Plastic Cement: to ASTM D2822.
- .5 Lap Cement: to ASTM D3019.
- .6 Eavestrough Fasteners: 10 mm dia. x 150 mm long, hot dip galvanized lag screws and ferrules.
- .7 Downspout Straps: 0.55 thick sheet steel.

2.3 FABRICATION

- .1 Form flashings and rainwater goods from sheet steel as specified, true and accurate to size, free from distortion and other defects detrimental to appearance and performance.
- .2 Provide sheet steel for flashing in thickness as per the following:

Flashing Type	Sheet Steel Thickness (mm)
Metal rake & eave edge flashing	0.55
Curb flashing	0.55
Valley flashing	0.70
Penetration flashings	0.70

- .3 Fabricate flashing in maximum lengths of 2.4 metres.
- .4 Overbrake rake and eave flashings slightly so that when installed, fascia flashings are sprung tightly to fascia boards or wall fascia panels.
- .5 Form eavestrough of 125 mm widths using continuous rolling process. Downspouts shall be corrugated. Form eavestroughs from thickness in accordance with the following table:

FLASHING AND RAINWATER GOODS

Profile	Nominal Width	Girth	Sheet Thickness
Ogee	125 mm	255 mm	0.48 mm
	150 mm	380 mm	0.55 mm
Rectangular		510 mm	0.55 mm
		530 mm to 635 mm	0.70 mm

Part 3 Execution

3.1 EXAMINATION

- .1 Examine surfaces to receive work of this Section.
- .2 Notify Construction Manager of surfaces which are considered unacceptable to receive work of this Section.

3.2 INSTALLATION, ROOF FLASHINGS

- .1 Lap flashing joints 50 mm, and seal both sections along lap with sealant. Nail joints securely.
- .2 Backpaint sheet steel with bituminous paint on surfaces in contact with concrete, masonry, other cementitious materials, and dissimilar metal.
- .3 Where reglet detail is required, insert metal flashing into reglet to form tight fit. Seal flashing into reglet with sealant.
- .4 Set edge flashing on deck along rake and eave edges.
- .5 Nail deck flange to deck with two rows of annular ringed nails. Set one row 25 mm from fascia board, with nails at 400 mm centres. Set second row 25 mm from cut edge of metal, with nails at 400 mm centres, staggered with first row.

3.3 INSTALLATION, RAINWATER GOODS

- .1 Join sheet steel components with silicon sealant and cadmium plated screws.
- .2 Secure 125 mm wide eavestroughs to building with lag screws through ferrules.
- .3 Secure eavestroughs over 125 mm wide with staggered brackets and spacer bars.
- .4 Install eavestroughs in maximum 15 m lengths, sloped to downspouts. Close ends of each length and allow 15 mm between lengths. Provide at least one downspout per eavestrough length.
- .5 Install elbows and tees as required, and secure downspouts with straps at 1.8 m centres, minimum 2 straps per downspout.

END OF SECTION

FIRESTOPPING

Part 1 General

1.1 INTENT

- .1 Provide firestopping to meet the requirements of the Alberta Building Code (Latest Edition).

1.2 REFERENCE DOCUMENT

- .1 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S115-05 - Standard Method of Fire Tests of Firestop Systems
- .2 Warnock Hersey (WH) Certification Listings, current edition
- .3 SCAQMD South Coast Air Quality Management District, California State (SCAQMD):
 - .1 SCAQMD Rule #1168, June 2017.

1.3 PERFORMANCE REQUIREMENTS

- .1 Firestopping shall provide a rating to match the fire rating of the fire separation it is penetrating, when tested to ULC S115, for a rating period applicable to the fire separation.
- .2 Firestopping of electrical and communications cables shall be easily re-enterable and re-sealable with negligible risk of damage to cables, and shall not require de-rating of electrical cables.
- .3 Firestopping used to fill voids in floors having openings 100 mm diameter or larger, and which are accessible to the public, shall support floor design loading.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate construction of fire separations and penetrations through fire separations with work of this Section.
 - .2 Ensure penetrations have been completed prior to installing firestopping.
 - .3 Install firestopping prior to insulation of piping, unless insulation is part of a tested firestop system meeting requirements.

1.5 SUBMITTALS

- .1 Comply with requirements of Division 01.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets for each firestopping system to be used.
 - .2 Submit two copies of WHMIS MSDS, Material Safety Data Sheets.
 - .3 Data shall indicate conformance with requirements of this Section, including ULC or Warnock Hersey system number.

FIRESTOPPING

1.6 QUALITY ASSURANCE

- .1 Mock-Up:
 - .1 Provide site mock-up of each proposed type of firestop system at locations designated by and for approval by the consultant.
 - .2 Approved mock-up shall establish minimum standard, and may be incorporated into work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials in original, unopened packaging bearing manufacturer's seals and labels intact.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, under cover and away from moisture.

Part 2 Products

2.1 SYSTEMS AND MATERIALS

- .1 Firestopping systems: as listed under ULC or as listed in WH Listings under "Through-Penetration Firestopping Systems".
- .2 Firestopping materials, whether used in a tested system or not, shall be:
 - .1 Listed under ULC or under WH Listings,
 - .2 Labelled with applicable ULC or WH label, and
 - .3 Compatible with applicable substrates and openings.
 - .4 With VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.
- .3 Provided that all other specified requirements can be met, and unless specific systems or materials are specified in the Firestopping Schedule, use any of the following products, either singly or in combination:
 - .1 Elastomeric sealant.
 - .2 Elastomeric coating.
 - .3 Mineral fibre.
 - .4 Mortar.
 - .5 Intumescent putty.
 - .6 Poured-in-place silicone foam.
 - .7 Preformed silicone foam.
 - .8 Multi-cable transit system.
 - .9 Any other product which meets all other specified requirements.
- .4 Primer: as recommended by firestopping manufacturer for applicable substrate.

FIRESTOPPING

Part 3 Execution

3.1 VERIFICATION OF CONDITIONS

- .1 Examine condition of voids to be filled to ensure suitability for firestop systems.
- .2 Verify installation of service penetrations and adjacent construction has been completed.

3.2 PREPARATION

- .1 Prepare substrates and surfaces to a clean, dry, and frost-free condition, ready to receive firestopping.
- .2 Prime substrates and surfaces to manufacturer's recommendations.

3.3 INSTALLATION

- .1 Provide tested firestopping systems meeting specified performance requirements wherever the continuity of a fire separation is interrupted by mechanical, electrical or other service penetrations, or by any other openings, gaps or discontinuities.
- .2 Install tested firestopping systems in accordance with manufacturer's recommendations and in strict conformance with tested systems.
- .3 In locations for which there are no applicable tested firestopping systems, provide firestopping materials where indicated and as detailed on drawings. Install materials in accordance with manufacturer's recommendations.
- .4 Where applicable, neatly tool or trowel firestopping surfaces remaining exposed and make flush with surrounding exposed surfaces.

END OF SECTION

JOINT SEALANTS

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 Canadian General Standards Board (CGSB):
 - .1 CGSB 19 GP 5M-84 - Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1)
 - .2 CAN/CGSB 19.13-M87 - Sealing Compound, One-Component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M - Sealing Compound, One Component, Butyl Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB 19.17 -M90
 - .5 CAN/CGSB 19.24 -M90
- .2 SCAQMD South Coast Air Quality Management District, California State (SCAQMD):
 - .1 SCAQMD Rule #1168, June 2006

Part 2 Products

2.1 MATERIALS

- .1 Joint Cleaner: Non corrosive solvent recommended by sealant manufacturer for applicable substrate material.
- .2 Primer: Non staining type recommended by sealant manufacturer.
- .3 Joint Back Up: Extruded tubing, polyvinylchloride / neoprene / butyl to suit application and sealant type, 6 mm minimum thick wall, oversized 30 50%.
- .4 Joint Back Up: Round closed cell foam, extruded polyethylene /urethane / neoprene, Shore A hardness of 20, tensile strength 140 to 200 kPa, oversized 30 50%, compatible with sealant and primer, non adhering to sealant.
- .5 Joint Back Up: Round solid rod, neoprene / EPDM / butyl rubber, Shore A hardness 40.
- .6 Bond breaker: Pressure sensitive polyethylene tape, not bondable to sealant.
- .7 Sealant: Polysulphide base, one (1) component, to CAN/CGSB 19.13 M87, colour to be selected, Shore A hardness 15 25.
- .8 Sealant: Polysulphide base, two (2) component, to CAN/CGSB 19.24 M90 Type 2, colour to be selected, Shore A hardness 15 25.
- .9 Sealant: Acrylic Base, one (1) component to CGSB CAN/CGSB-19.17-M90 emulsion base, colour to be selected, Shore A hardness [].
- .10 Sealant: Silicone base, one (1) component to CAN/CGSB 19.13 M87, colour to be selected, Shore A hardness 15 25.

JOINT SEALANTS

- .11 Sealant: Silicone base, two (2) component, to CAN/CGSB 19.24 M90, colour to be selected, Shore A hardness 15 25.
- .12 Sealant: Polyurethane base, one (1) component, to CAN/CGSB 19.13 M87 type 2, colour to be selected, Shore A hardness 20 35.
- .13 Sealant: Polyurethane base, multi component, to CAN/CGSB 19.24 M90 type 2, colour, Shore A hardness 20 35.
- .14 Sealant: Butyl polyisobutylene base, one (1) component, to CGSB 19 GP 14M, colour to be selected, Shore A hardness 10 20.
- .15 Sealant: Urethane, one (1) component, to CAN/CGSB 19.13-M87, low-modulus, moisture cure, colour to be selected, +/- 35%.

Part 3 Execution

3.1 EXECUTION

- .1 Remove dust, paint, loose mortar and all foreign matter; dry joint surfaces.
- .2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
- .3 Remove oil, grease and other coatings from non ferrous metals with appropriate solvent.
- .4 Prepare concrete, masonry, glazed and vitreous surfaces as recommended by sealant manufacturer.
- .5 Examine joint dimensions and size materials to achieve joint depth which is half the width of the joint with minimum width and depth of 5 mm, maximum width 25 mm.
- .6 Install joint back up to achieve correct joint depth.
- .7 To prevent staining, mask adjacent surfaces with tape prior to priming.
- .8 Apply bond breaker tape in accordance with manufacturer's directions.
- .9 Prime sides of joints to manufacturer's directions immediately prior to caulking.

3.2 APPLICATION

- .1 Apply sealant in accordance with manufacturer's directions, using a gun with proper size nozzle, to leave a weathertight, air tight installation. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
- .2 Use Urethane, one (1) component, sealant and closed-cell polyethylene backer rod joint back up and bond breaker for joints in metal door frame, precast wall panels and metal flashings. Colours to be selected.
- .3 Form surface of sealant smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

JOINT SEALANTS

- .4 In masonry cavity construction, vent caulked joints from cavity to 3 mm beyond external face of wall by inserting 3 mm diameter plastic tubing at bottom of each joint and maximum of 1500 mm O.C. vertically.
- .5 In precast concrete panel facing, vent space behind panels by inserting 3 mm diameter plastic tubing at bottom of each vertical caulked joint and at every second intersection of horizontal and vertical joints.
- .6 Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings, using recommended cleaners as work progresses. Remove masking tape after tooling of joints.

END OF SECTION

DIVISION 08 – OPENINGS

HOLLOW METAL FRAMES

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 13 13 - Hollow Metal Doors

1.2 REFERENCE DOCUMENTS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M -09 - Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
 - .2 ASTM B29 03 (R2009) - Refined Lead
 - .3 ASTM B749 03 (R2009) - Lead and Lead Alloy Strip, Sheet and Plate Products
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.181 99 - Ready Mixed Organic Zinc Rich Coating
 - .2 CGSB 41 GP 19Ma 84 - Rigid Vinyl Extrusions for Windows and Doors
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA G40.20/G40.21 04- - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 CAN/CSA G164 M92 (R2003) - Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 CSA W59 03(R2008) - Welded Steel Construction (Metal Arc Welding)
- .4 Canadian Steel Door Manufacturers' Association (CSDMA):
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990
- .5 Green Seal: Standards:
 - .1 GC-03 - Green Seal Environmental Criteria for Anti-Corrosive Paints, Second Edition, January 7, 1997
 - .2 GS-11 - Green Seal Environmental Criteria for Paint, First Edition, May 1993
- .6 Master Painters Institute:
 - .1 Master Painters Institute Green Performance Standard GPS-1-08
- .7 National Fire Protection Association (NFPA):
 - .1 NFPA 80 - Fire Doors and Fire Windows
 - .2 NFPA 252 - Fire Tests of Door Assemblies
- .8 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule - June 2006, Adhesives and Sealants
 - .2 1168 – Applications
- .9 Underwriters' Laboratories of Canada (ULC):

HOLLOW METAL FRAMES

- .1 CAN/ULC S701 05 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
- .2 CAN/ULC S702 09 - Thermal Insulation, Mineral Fibre, for Buildings
- .3 CAN/ULC S704 03 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced
- .4 CAN4 S104 M80 (R1985) - Fire Tests of Door Assemblies
- .5 CAN4 S105 09 - Fire Door Frames Meeting the Performance Required by CAN4 S104

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
- .2 Shop Drawings:
 - .1 Submit shop drawings.
 - .2 Clearly indicate each type of frame, material, material thicknesses, mortises, reinforcements, anchors, finish, and special features.
 - .3 Reference frames to door schedule. Indicate door numbers and construction where applicable.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Receive and store materials as recommended by materials manufacturer.
- .2 Storage and Handling Requirements:
 - .1 Adequately protect surfaces from damage during moving, handling and storage.

1.5 QUALITY ASSURANCE

- .1 Manufacture fire door and frame components and assemblies to ULC/ULI/Warnock Hersey/Factory Mutual requirements
- .2 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:
 - .1 Steel Fire Rated Doors and Frames: Labelled and listed by organization accredited by Standards Council of Canada for ratings specified or indicated.
 - .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
 - .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow up Service Procedures/Factory Inspection Manuals issued by agency to individual manufacturers.
 - .2 Fabricate rated doors, frames, and screens to labelling authority standard.
 - .3 Affix appropriate label to each fire rated frame.

HOLLOW METAL FRAMES

Part 2 Products

2.1 MATERIALS

- .1 Frames: 1.2mm for interior locations for opening widths smaller than 1200mm and 2.0mm for interior frames with an opening greater than 1200mm, 1.6 mm for exterior doors locations for opening widths smaller than 1200mm and 2.0mm for exterior frames with an opening greater than 1200mm, commercial quality steel cold rolled to ASTM A653M-96; zinc coated to ZF075 coating designation for exterior frames, ZF075 for interior frames.
- .2 Accessories: Glazing stops, floor anchors, channel spreaders, 1.6 mm tee anchors, 1.2 mm wall stud anchors, zinc coated to ASTM A653M, coating designation ZF075. Corrugate tee anchors for masonry bond. Drill stud anchors for wire tie to studs. Lag bolts, shields and bushing for existing or concrete openings.
- .3 Guard Boxes: 0.50 mm steel, ZF075 coating designation zinc finish to ASTM A653M.
- .4 Door Bumpers: black neoprene.
- .5 Reinforcement for Hardware: carbon steel, prime painted, to the following thicknesses:
 - .1 Hinge & Pivot reinforcements 30 mm x 250 mm 3.5 mm
 - .2 Strike reinforcements 1.6 mm
 - .3 Flush Bolt reinforcements 1.6 mm
 - .4 Closer reinforcements 2.5 mm
 - .5 Surface hardware reinforcements 2.5 mm
- .6 Door Jamb Reinforcement: 100 mm x 40 mm structural steel channel to CAN3 G40.21.

2.2 FABRICATION

- .1 Fabricate frames in accordance with details and approved shop drawings. To Underwriters requirements and provide Underwriters labels.
- .2 Mortise, reinforce, drill and tap frames and reinforcements to receive hardware using templates provided. Locate mortising to National Builders Hardware Association Standards.
- .3 Install 2 double stud bumpers on strike jamb of frame for each single door and 2 bumpers at head of double door frames.
- .4 Protect strike, hinge and overhead concealed door closer reinforcement completely by guard boxes welded to frame.
- .5 Weld in 50 mm channel spreaders to frame; ensure proper frame alignment.
- .6 Where frames terminate at finished floor, provide floor plates for anchorage to floor structure.
- .7 Cut mitres accurately and weld on inside of frame profile.
- .8 Grind welded corners to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

HOLLOW METAL FRAMES

- .9 Fill surface depressions and butted joints with metallic paste filler and sand to a uniform smooth finish.
- .10 Touch up frames by priming areas where galvanizing is damaged.
- .11 Reinforce head of frames wider than 1200 mm with 2.5 mm formed steel channel welded in place, flush with top of frame.
- .12 Provide three jamb anchors per jamb for frames up to 2130 mm high and one additional for each 600 mm over 2130 mm high.
- .13 Minimum depth of stop: 15 mm. Glazing stops butt joints, channel shape 15 mm wide with counter screws.
- .14 Reinforce head section at junction with removable mullion.
- .15 Reinforce both jambs where door openings occur in screens. Install reinforcing continuous structure to structure.

Part 3 Execution

3.1 INSTALLATION

- .1 Set frames in plumb and square at correct elevation. Limit of acceptable frame distortion 2 mm out of plumb measured on face of frame, maximum twist corner to corner of 3 mm.
- .2 Secure anchorages and connections to adjacent construction. Anchor door jamb reinforcement securely to structure.
- .3 Brace frames solidly to maintain in position while being built in.
- .4 Install a temporary horizontal wood spreader at mid height of door opening to maintain frame width until building work completed.
- .5 For frames over 1200 mm in width, provide vertical support at the centre of head.
- .6 Remove temporary spreaders only after completion of adjacent work.
- .7 Co ordinate grouting of all frames solid to adjacent construction.
- .8 Provide formed metal drip section full width of frame opening for exterior doors.

END OF SECTION

HOLLOW METAL DOORS

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653 /A653M 09 - Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
 - .2 ASTM B29 03 (R2009) - Refined Lead
 - .3 ASTM B749 03 (R2009) - Lead and Lead Alloy Strip, Sheet and Plate Products
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.181 99 - Ready Mixed Organic Zinc Rich Coating
 - .2 CGSB 41 GP 19Ma 84 - Rigid Vinyl Extrusions for Windows and Doors
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA G40.20 /G40.21 04 - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 CAN/CSA G164 M92 (R2003) - Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 CSA W59 03(R2008) - Welded Steel Construction (Metal Arc Welding)
- .4 Canadian Steel Door Manufacturers' Association (CSDMA):
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990
- .5 Green Seal: Standards:
 - .1 GC-03 - Green Seal Environmental Criteria for Anti-Corrosive Paints, Second Edition, January 7, 1997
 - .2 GS-11 - Green Seal Environmental Criteria for Paint, First Edition, May 1993
- .6 Master Painters Institute:
 - .1 Master Painters Institute Green Performance Standard GPS-1-08
- .7 National Fire Protection Association (NFPA):
 - .1 NFPA 80 Fire Doors and Fire Windows
 - .2 NFPA 252 Fire Tests of Door Assemblies
- .8 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule 1168 June 2006, Adhesives and Sealants Applications
- .9 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC S701 05 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .2 CAN/ULC S702 09 - Thermal Insulation, Mineral Fibre, for Buildings
 - .3 CAN/ULC S704 03 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced

HOLLOW METAL DOORS

- .4 CAN4 S104 M80(R1985) - Fire Tests of Door Assemblies
- .5 CAN4 S105 09 - Fire Door Frames Meeting the Performance Required by CAN4 S104

1.2 REFERENCE STANDARD

- .1 Except as otherwise specified, comply with requirements of Canadian Manufacturing Standards for Steel Doors and Frames published by the Canadian Steel Door and Frame Manufacturers' Association.

1.3 FIRE RATED DOORS

- .1 Provide doors produced under label service program of a testing agency acceptable to authorities having jurisdiction.
- .2 Doors shall bear testing agency label indicating following:
 - .1 At standard size openings: fire endurance rating.
 - .2 At oversized openings: unclassified as to fire rating.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
- .2 Shop Drawings:
 - .1 Clearly indicate each type of door, material, metal thicknesses, mortises, reinforcements, location of exposed fasteners and special features.
 - .2 Reference door types to door schedule. Indicate door numbers where applicable.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Receive and store materials as recommended by materials manufacturer.
- .2 Storage and Handling Requirements:
 - .1 Adequately protect surfaces from damage during moving, handling and storage.

1.6 QUALITY ASSURANCE

- .1 Manufacture fire door and frame components and assemblies to ULC/ULI/Warnock Hersey/Factory Mutual requirements
- .2 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:
 - .1 Steel Fire Rated Doors and Frames: Labelled and listed by organization accredited by Standards Council of Canada for ratings specified or indicated.
 - .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:

HOLLOW METAL DOORS

- .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow up Service Procedures/Factory Inspection Manuals issued by agency to individual manufacturers.
- .2 Fabricate rated doors, frames, and screens to labelling authority standard.
- .3 Affix appropriate label to each fire door.

Part 2 Product

2.1 MATERIALS

- .1 Sheet Steel: to ASTM A653M commercial quality steel, cold rolled, zinc coated to ZF075 coating designation.

2.2 CORE MATERIAL

- .1 Interior Doors: Honeycomb core material, rigid pre expanded resin impregnated kraft paper having maximum 25 mm hexagonal shaped cells.
- .2 Exterior Doors: Polyurethane or Rigid Isocyanurate (R11) insulation with a density of 1.5 lbs per cubic foot.
- .3 Temperature Rise Rated (TRR): (for door assemblies requiring ratings)
 - .1 Core composition to limit temperature rise on unexposed side of door to 250 degrees C at 30 / 60 minutes.
 - .2 Core to be tested as part of a complete door assembly, in accordance with CAN4 S104, NFPA 252.

2.3 REINFORCEMENT

- .1 Reinforcement for Hardware: carbon steel, welded in place, prime painted, to the following thicknesses:
 - .1 Hinge, pivot and panic bar reinforcements: 3.5 mm
 - .2 Lock face, flush bolts, concealed bolts: 2.5 mm
 - .3 Concealed or surface closer reinforcements: 2.5 mm
 - .4 Other surface hardware reinforcements: 2.5 mm

2.4 ACCESSORIES

- .1 Adhesives:
 - .1 Honeycomb Core: Heat resistant spray grade resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
 - .2 Plastic Insulation: Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .2 Primer: Touch-up primer to CAN/CBSB -1.181.
- .3 Glazing stops: 1.0 mm steel, primed, butt joints, counter sink for screws.
- .4 Glazing:

HOLLOW METAL DOORS

- .1 Fire rated interior doors: Wired safety glass to CAN/CGSB 12.11, Type: 1 polished both sides, transparent, Wire Mesh Style: 3 Square.
- .2 Non-fire rated interior doors: Clear tempered safety glass to CAN/CGSB 12.1, Type: 2 – Tempered, Class: B - Float Glass, Category: II 540 J impact resistance.
- .5 Glazing Accessories:
 - .1 Setting Blocks: neoprene, 80 durometer hardness, 100 mm long x 6 mm thick x width required to support full glass thickness for single glazing and full thickness of thermal units.
 - .2 Spacer Shims: neoprene, 80 durometer hardness, 75 mm long x minimum 6 mm thick. Do not use metal, plastic, or wood shims.
 - .3 Glazing Splines and Gaskets: manufacturer's standard dry neoprene glazing splines and gaskets. Provide keyed type for fixed glazing stops and keyed or roll-in type for removable glazing retaining devices. Except where otherwise specified, colour shall match frame colour.
 - .4 Glazing Tape: preformed butyl tape, 10 15 durometer hardness, with integral neoprene shim, 80 durometer hardness, paper release, black colour.

2.5 FABRICATION

- .1 Hollow metal doors shall be of seamless construction with no visible seams or joints on faces at vertical edges.
- .2 Steel face sheet thickness:
 - .1 Interior doors: 1.2 mm.
 - .2 Exterior doors: 1.6 mm.
- .3 Core Construction shall be one of the following:
 - .1 Internally steel stiffened with continuous vertical steel stiffeners at 150 mm O.C. spot welded to both face sheets; fill voids with glass fibre insulation.
 - .2 Composite construction consisting of honeycomb core with steel face sheets pressure laminated to core.
- .4 Refer to door schedule for required classes and ratings of fire doors, glazing or other requirements.
- .5 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided.
- .6 Joint door faces to edges using is to use a tack seam, fill edge and grind smooth. Finish door faces flush without visible joints or distortion.
- .7 Close top and bottom edges of door with recessed 1.2 mm steel channel, full width welded. Provide closure channel at top edge of exterior doors. Provide weep holes in exterior door bottom channel.
- .8 Make provisions for glass, provide glazing stops. Weld stops to door on security side.
- .9 Touch up doors by priming areas where zinc coating is damaged.
- .10 Provide astragals for pairs of doors in accordance with Underwriters requirements.

HOLLOW METAL DOORS

- .11 Profile edge of doors as follows: Single acting swing doors Bevel 3 mm in 50 mm
Double acting swing doors Radius of 54 mm.

Part 3 Execution

3.1 INSTALLATION

- .1 Install doors and hardware in accordance with templates and manufacturer's instructions. Maximum permissible warp of 3 mm measured diagonally across door.
- .2 Adjust operable parts for correct function.
- .3 Apply hardware to doors rated up to 3 hours (Class 'A') prior to delivery.

3.2 GLAZING GENERAL REQUIREMENTS

- .1 Glaze interior and exterior hollow metal doors as follows:
 - .1 Apply butyl tape to fixed stop, back 2 mm from sight line.
 - .2 Remove release tape and press glass into place.
 - .3 Apply butyl tape to removable stop, remove release tape and secure stops in place.
 - .4 Ensure adequate thicknesses of glazing tape to secure glass in place and prevent glass from rattling.

END OF SECTION

ROLLING SERVICE DOOR

Part 1 General

1.1 SECTION INCLUDES

- .1 Furnish, deliver and install finish hardware.

1.2 RELATED SECTIONS

1.3 REFERENCES

- .1 ANSI/DASMA 108 – American National Standards Institute Standard Method For Testing Sectional Garage Doors and Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.
- .2 NFRC 102 – Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.
- .3 ASTM E 90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
- .4 ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .5 ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .6 ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .7 ASTM A 924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .8 ASTM B 221 – Standard Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .9 NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- .10 NEMA MG 1 – Motors and Generators.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- .1 Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- .2 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

ROLLING SERVICE DOOR

1.5 SUBMITTALS

- .1 Submit under provisions of Section 01300.
- .2 Product Data: Manufacturer's data sheets on each produce to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Details of construction and fabrication.
 - .4 Installation instructions.
- .3 Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
- .4 Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- .5 Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- .6 Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- .7 Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.
- .2 Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- .3 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - .1 Finish areas designated by Architect.
 - .2 Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - .3 Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- .3 Store materials in a dry, warm, ventilated weathertight location.

ROLLING SERVICE DOOR

1.8 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits

1.9 COORDINATION

- .1 Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.10 WARRANTY.

- .1 Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.
- .2 Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.
- .3 PowderGuard Finish
 - .1 PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.
 - .2 PowderGuard Zinc Base Coat applied to guides, bottom bar, headplates plus PowderGuard Premium applied to curtain and top coat for guides, bottom bar, headplates: Manufacturer's limited Zinc Finish warranty for 4 years.
 - .3 PowderGuard Textured: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Textured Finish warranty for 3 years.
 - .4 PowderGuard Zinc Base Coat applied to guides, bottom bar, headplates plus PowderGuard Textured applied to curtain and top coat for guides, bottom bar, headplates: Manufacturer's limited Zinc Finish warranty for 4 years.
 - .5 PowderGuard Max: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Max Finish warranty for 5 years.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.
- .2 Substitutions: Not permitted.
- .3 Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 INSULATED ROLLING SERVICE DOORS

- .1 Stormtite Advanced Performance Insulated Rolling Service Doors: Overhead Door Corporation Stormtite AP Model 627.

ROLLING SERVICE DOOR

- .1 Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - .1 Flat profile type FIT-265 for doors up to 40 feet (12.19 m) wide.
 - .2 Front slat fabricated of:
 - .1 18 gauge galvanized steel.
 - .3 Back slat fabricated of:
 - .1 24 gauge galvanized steel.
 - .4 Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.
 - .1 R-Value: 10.9, U-Value: 0.09.
- .2 Performance:
 - .1 Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
 - .2 Installed System Sound Rating: STC-21 as per ASTM E 90.
 - .3 U-factor: 0.84 NFRC test report, maximum U-factor of no higher than 1.00.
 - .4 Air Infiltration: Meets ASHRAE 90.1 and IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft².
- .3 Slats and Hood Finish:
 - .1 Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
 - .1 Polyester Top Coat.
 - .1 Gray Polyester.
 - .2 Tan Polyester.
 - .3 White Polyester.
 - .4 Brown Polyester.
 - .2 Powder Coat:
 - .1 PowderGuard Premium powder coat color as selected by the Architect.
 - .2 PowderGuard Premium powder coat color as selected by the Architect.
 - .3 PowderGuard Max powder coat, color as selected by Architect.
 - .3 Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
 - .2 Stainless Steel: Slats and hood shall be stainless steel finished as follows.
 - .1 Finish: No. 4 satin finish.
 - .3 Aluminum: Slats and hood shall be aluminum finished as follows.
 - .1 Finish: Mill finish.
 - .2 Finish: Powder Coat:
 - .1 PowderGuard Premium powder coat color as selected by the Architect.
 - .2 PowderGuard Textured powder coat color as selected by the Architect.

ROLLING SERVICE DOOR

- .3 PowderGuard Max powder coat, color as selected by the Architect.
- .4 Weatherseals:
 - .1 Vinyl bottom seal and internal hood seals.
 - .2 Interior and exterior EPDM triple-seal finned guide weatherseal.
 - .3 Lintel weatherseal.
 - .4 Air Infiltration Package: IECC 2012/2015 listed; product to meet C402.4.3 2012 Air leakage <1.00 cfm/ft².
 - .1 Air infiltration perimeter seal package includes: guide cover, guide cap, PVC weatherseal on exterior of guide, EPDM triple finned weatherseal on interior of guide, lintel weatherseal and vinyl bottom seal.
- .5 Bottom Bar:
 - .1 Two powder coated black steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
 - .2 Two galvanized steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
 - .3 Two stainless steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
 - .4 Two aluminum angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
- .6 Guides: Three structural steel angles.
- .7 Brackets:
 - .1 Hot rolled powder coated black steel to support counterbalance, curtain and hood.
 - .2 Galvanized steel to support counterbalance, curtain and hood.
 - .3 Stainless steel to support counterbalance, curtain and hood.
- .8 Finish; Guides, Headplate and Brackets:
 - .1 PowderGuard Premium powder coat in black color.
 - .2 PowderGuard Premium powder coat color as selected by the Architect.
 - .3 PowderGuard Zinc base coat, gray.
 - .4 PowderGuard Zinc base coat with PowderGuard Premium powder coat color as selected by the Architect.
 - .5 PowderGuard Textured powder coat color as selected by the Architect.
 - .6 PowderGuard Max powder coat color as selected by the Architect.
- .9 Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
- .10 Hood: Provide with internal hood baffle weatherseal.
 - .1 24 gauge galvanized steel with intermediate supports as required.
 - .2 Stainless steel, 24 gauge hood with intermediate supports as required.
 - .3 Aluminum hood with intermediate supports as required.
- .11 Manual Operation:
 - .1 Chain hoist.
 - .2 Crank operation.

ROLLING SERVICE DOOR

- .12 Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
 - .1 Sensing Edge Protection:
 - .1 Pneumatic sensing edge.
 - .2 Electric sensing edge.
 - .2 Operator Controls:
 - .1 Push-button operated control stations with open, close, and stop buttons.
 - .2 Key operation with open, close, and stop controls.
 - .3 Push-button and key operated control stations with open, close, and stop buttons.
 - .4 Controls for interior location.
 - .5 Controls for exterior location.
 - .6 Controls for both interior and exterior location.
 - .7 Controls surface mounted.
 - .8 Controls flush mounted.
 - .3 Special Operation:
 - .1 Vehicle detector operation.
 - .2 Radio control operation.
 - .3 Card reader control.
 - .4 Photocell operation.
 - .5 Door timer operation.
 - .6 Commercial light package.
 - .7 Explosion and dust ignition proof control wiring.
 - .4 Motor Voltage: 115/230 single phase, 60 Hz.
- .13 Wind Load Design:
 - .1 Standard wind load shall be 20 PSF.
 - .2 FBC certification FL#_____.
 - .3 TDI approval #_____.
- .14 Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
- .15 Locking:
 - .1 Chain keeper locks for chain hoist operation.
 - .2 Interior slide bolt lock for electric operation with interlock switch.
 - .3 Cylinder lock for electric operation with interlock switch.
- .16 Wall Mounting Condition:
 - .1 Face-of-wall mounting.
 - .2 Between jambs mounting.
- .17 Insulated Vision Lites: 10 inches by 1 inch (254 mm by 25.4 mm) uniformly spaced openings.
 - .1 Provide with dual-wall polycarbonate.

ROLLING SERVICE DOOR

Part 3 Execution

3.1 EXAMINATION

- .1 Verify opening sizes, tolerances and conditions are acceptable.
- .2 Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- .3 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- .3 Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- .4 Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- .5 Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- .6 Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- .7 Install perimeter trim and closures.
- .8 Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

- .1 Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- .2 Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- .1 Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- .2 Remove labels and visible markings.

ROLLING SERVICE DOOR

- .3 Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- .1 Protect installed products until completion of project.

END OF SECTION

HARDWARE

Part 1 General

1.1 WORK INCLUDED

- .1 Furnish, deliver and install finish hardware.
- .2 It is intended that the following list of hardware will cover all finish hardware to complete the project. Bring to the Architect's attention any omissions, discrepancies that will affect work in this section during the bidding period.

1.2 RELATED SECTIONS

- .1 General Requirements Division 1
- .2 Section - 08 12 13 Metal Frames
- .3 Section - 08 13 13 Metal Doors

1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED IN THIS SECTION

- .1 Compressor/control boxes, junction boxes installed by Division 26.

1.4 ALLOWANCES

- .1 Allow for cash amount specified in Division 1 Section, hardware to cover cost of specification, drawings, training and inspection of products specified in this section.

1.5 REFERENCES

- .1 Door and Hardware Institute - Recommended locations for Architectural Hardware for Standard Steel Doors and Frames
- .2 Door and Hardware Institute - Recommended locations for Architectural Hardware for Flush Wood Doors
- .3 NFPA 80-Standard for Fire Doors and Windows
- .4 Door and Hardware Institute - Sequence Format for Hardware Schedule
- .5 Door and Hardware Institute - Key Systems and Nomenclature
- .6 Door and Hardware Institute - Abbreviations and Symbols used in Architectural Door and Hardware Schedules and Specifications
- .7 Door and Hardware Institute - Installation Guide for Doors and Hardware
- .8 National Building Code 2023 Alberta Edition

HARDWARE

1.6 SUBMITTALS

- .1 Updated Finish Hardware Schedule: Submit required submittals in accordance with Section 01340. Prepare detailed hardware schedules in Door and Hardware (OHi) vertical format as detailed in Reference 1.5.4.
- .2 Product Data: Provide in a three ring binder six (6) copies of product data sheets with the finish hardware schedule showing all items of hardware to be used on the project.
- .3 Samples: When requested in writing, provide (to the Consultants Site Office) one sample of each hardware item complete with fasteners, within thirty (30) calendar days of award of a purchase order. Samples to be clearly labeled with their hardware schedule designation and manufacturers' name and model number. Samples will be incorporated into the work.
- .4 Templates: Submit templates within to all related trades when requested.
- .5 Keying Schedule: Provide three (3) copies of keying schedule for review prepared and detailed in Reference 1.5.5. Include all special keying notes and stamping instructions. Locks and cylinders are not to be ordered until the key schedule has been approved by the owner.
- .6 Wiring Diagrams: Co-ordinate with related trades, meet with the owner and security provider and submit a written description of the functional use (mode of operation) of all electrical hardware products specified. Include operation for ingress, egress, fire alarm, and after hours use where applicable. Include door and frame elevations showing the location of each item of electrical hardware to be installed, mode of operation including a diagram showing number and size of all conductors. Indicate on elevation drawing items provided by related trades, include for back boxes, and 120V power sources. Provide point to point drawings showing all terminal connections necessary for a complete installation
- .7 Operations and Maintenance Data: Prior to Substantial Completion, furnish to the owner, two (2) copies of an owner's operation and maintenance manuals in a three ring binder with the following information:
 - .1 Name of hardware distributor, address and contact name
 - .2 Copy of final "as-built" finish hardware schedule
 - .3 Wiring diagrams, elevations, risers, point to point
 - .4 Copy of final keying schedule
 - .5 Copies of floor plans with keying nomenclature assigned to door numbers as per the approved keying schedule
 - .6 Maintenance instructions for each product
 - .7 Catalogue cut sheets and product specifications for each product
 - .8 Parts list for each product
 - .9 Installation instructions and templates for each product

1.7 QUALITY ASSURANCE

- .1 Review installation procedures with the Contractor's Designated Installers. Hold instruction meetings with the installers prior to installation and subsequent review meetings during the installation period. Submit minutes of meetings to the Consultant.

HARDWARE

- .2 Alternates: Only approved products specified will be accepted. Make alternate requests in accordance with Division 1. Include product data and indicate benefit to the project.
- .3 Supplier Qualifications: Successful hardware distributor to have a minimum of five (5) years' experience in the door and hardware industry. Distributor to have on staff an Architectural Hardware Consultant (A.H.C.) whose name will be listed on the hardware schedule title page submittal and will be responsible for scheduling, detailing, (see Reference 1.5.4) ordering and co-ordination of the finishing hardware for this project. If so requested by the Architect and or installer this individual will be required to visit the jobsite for any installation problems that may occur.
- .4 Designated Installers: Hardware Installers must have a minimum of five (5) years' experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. All installers to attend review meetings with the Hardware Distributor.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Marking and Packaging: Mark all cartons with heading number, door number, and key-set symbol where applicable in original packaging provided by the manufacturer. Pack packaged hardware in suitable wrappings and containers to protect it from damage during shipping and storage. Enclose accessories, fastening devices and other loose items with each applicable item of hardware.
- .2 Delivery: Deliver hardware to related trades.
- .3 Storage: Store in a clean, dry room with lockable man door and adequate shelving to permit organization so item numbers are readily visible.

1.9 WARRANTY

- .1 Provide warranties by the accepted manufacturers:

Hardware Item	Length of Warranty
Mortise Hinges	Lifetime
Pivot Sets	2 years
Locks (ND Series)	7 years
Locks (Mortise)	3 years
Keypad Locks	1 year
Exit Devices	3 years
Door closers -mechanical	30 years
Door Operators - Electro	2 years
Electric Hold Open Devices -	2 years
Overhead stops/holders	1 year
Floor/Wall stops	1 year
Electric Strikes/Key Switches/Power	1 year
Electromagnetic Locks	Lifetime

1.10 MAINTENANCE

- .1 Maintenance Service: After the building is occupied arrange an appointment with the maintenance staff from the Town of Coaldale for instruction of proper use, servicing, adjusting and lubrication of hardware furnished. Submit to the consultant a list of attendees and meeting date.

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- .2 Extra Materials: Provide the following items in proper manufacturer's cartons once the job has been completed:
- .1 5 of each installation tool used for locks/passage/privacy, all type of door closers, and all exit devices.

Part 2 Products

2.1 MANUFACTURERS

- .1 Products listed in the hardware groups are from the manufacturers listed below:

ITEM	MANUFACTURER NAME
Full Mortise Hinges	Ives
Continuous Hinges	Ives
Locksets, Latchsets/Deadbolts	Schlage
Exit Devices	Von Duprin
Keypad Locks	Schlage
Pivots	Ives
Surface/Flush Bolts	Ives
Door Closers	LCN
Overhead Door Holders/Stops	Glynn Johnson
Door Pulls/Flatware	Ives
Wall/Floor Stops	Ives
Weather/Smoke/Sound Seals	KN Crowder
Door Sweeps/Thresholds	KN Crowder
Automatic Door	LCN
Operators/Actuators	Schlage Electronics
Keyswitch/Magnetic Locks	Von Duprin
Electric Strikes	Schlage Electronics
Access Controllers	Schlage Electronics, Von Duprin
Power Supplies	

2.2 MATERIALS

- .1 Screws and Fasteners: All screws to be matching finish to their product and to be manufacturer's standard. Door closers, door holders and exit devices installed on fire rated wood doors and hollow metal doors to be attached with the appropriate fasteners to meet code requirements.
- .2 Materials-Acceptable Manufacturers (Note: Supply all products in a given category from the same manufacturer):
- .1 Mortise Hinges:
- .1 Provide three (five) knuckle concealed (ball bearing) hinges with NRP option on all reverse bevel doors with locking hardware. Hinge width to accommodate door closer projection, door trim and allow for 180-degree swing. Doors up to 2286mm in height, supply 3 hinges, and doors greater than 2286mm in height add one hinge for every additional 760mm of door height. Doors 915mm wide and less furnish 114 mm high hinges, doors greater than 915mm wide furnish 127mm high hinges, heavy weight or standard weight as specified. Supply ferrous (steel), stainless steel material for all interior and/or fire-rated doors and stainless steel for exterior doors.
- .2 As Specified:

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- .1 Ives Hinges, 3CB1, 3CB1HW or 5BB1, 5BB1HW
- .2 Stanley Hinges, CB1960R, CB1961R or FBB179, FBB168
- .3 Hager Hinges, AB800, AB850 or BB1191, BB1168
- .4 McKinney TA314, TA386 or TA2314, T4A3386
- .2 Continuous Hinges:
 - .1 Continuous hinges to be Ives heavy duty edge mount/edge guard continuous gear type aluminum hinges. Ives aluminum hinges tested and approved to UL 10C (90 minutes). Material 6063-T6 aluminum, clear satin finish (628). Aluminum geared hinges certified to ANSI 156.26 Grade 2. Hinge length to suit door height. Hinge length 25mm (1") less door height.
 - .2 Supply as Specified:
 - .1 Ives 112HD
 - .2 Stanley 661HD
 - .3 Hager 780-112HD
 - .4 McKinney MCK-12HD
 - .5 Pemko FMSLFHD
 - .6 Select SL11HD
- .3 Pivots:
 - .1 Centre I Offset Pivot:
 - .1 High strength forging and casting for rated and non-rated doors combined with precision bearings for smooth operation. Available ½" or 1 ½" offset, centre hung, heavy duty, intermediate and power transfer pivots with all exposed parts made of brass or stainless steel for maximum corrosion resistance. Stainless steel, machine screws standard with positive locking vertical adjustment mechanism which allows the installer to precisely position the door and balance the load. Standard or custom powder coated finishes available.
 - .2 Supply as Specified: Ives 7200 series.
- .4 Surface I Flush Bolts I Co-Ordinators:
 - .1 Surface Bolts:
 - .1 Surface bolts to have 1" throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8' in height.
 - .2 Supply as Specified: Ives SB1630 series.
 - .2 Manual Flush Bolts-Metal Doors:
 - .1 Manual flush boll for metal doors to be cUL listed for 3-hour fire doors with W' diameter bolt tip with %" throw. Standard rod length to be 12", supply longer length rods to suit higher door heights. Supply dustproof strikes with all flushbolts .
 - .2 Supply as Specified: Ives FB458 series.
 - .3 Manual Flush Bolt-Wood Doors:
 - .1 Manual flush bolt for wood doors to be cUL listed for 90min fire doors with 3/4" throw with a 7/8" vertical adjustment. Supply dustproof strikes with all flushbolts.
 - .2 Supply as Specified: Ives FB358 series.

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- .4 Automatic Flush Bolts-Metal Doors:
 - .1 Automatic flush bolts for metal doors to be fully automatic cUL listed for 3 hour fire doors, low actuation forces-top bolt has not spring tension, non -handed with 3A" throw with a 7/8" vertical adjustment. Optional rod lengths for non-rated openings as well as models with auxiliary fire latch that eliminates the bottom bolt for cUL listed doors. Standard rod length 12", supply longer rod length to suit higher door heights. Supply dustproof strikes with all auto flushbolts that incorporate bottom bolt.
 - .2 Supply as Specified: Ives FB30 series.
- .5 Automatic Flush Bolts- Wood Doors:
 - .1 Automatic flush bolts for wood doors to be fully automatic cUL listed for 90min fire doors, low actuation forces-top bolt has not spring tension, non -handed with 3A" throw with a 7/8" vertical adjustment. Models with auxiliary fire latch that eliminates the bottom bolt for cUL listed doors (20min only). Supply dustproof strikes with all auto flushbolts that incorporate bottom bolt.
 - .2 Supply as Specified: Ives FB40 series
- .6 Constant Latching Flush Bolts-Metal Doors:
 - .1 Constant latching flush bolts for metal doors to be cUL listed for 3-hour fire doors. Inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically. Standard rod length 12", supply longer rod length to suit higher door heights. Non-Handed with fire-rated models with auxiliary fire latch to eliminate the use of a bottom bolt. Supply dustproof strikes with all flushbolts.
 - .2 Supply as Specified Ives FB50 series
- .7 Constant Latching Flush Bolts-Wood Doors:
 - .1 Constant latching flush bolts for wood doors to be cUL listed for 90min fire doors. Inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically. Non-Handed with fire-rated models with auxiliary fire latch to eliminate the use of a bottom bolt (20min only). Supply dustproof strikes with all flushbolts.
 - .2 Supply as Specified Ives FB60 series
- .8 Co-ordinators and Filler Bars
 - .1 CUL listed for installation on labeled frames. COR series co-ordinator channels and fillers made of aluminum and normally furnished in 628 finish. Provide co-ordinators of correct size for use on pairs of doors when one door is required to close before the other. Provide filler bar to suit opening width to maintain architecturally clean lines. Provide mounting brackets for other stop applied hardware. Co-ordinator units to be equipped with an override feature which allows the active door to close under extreme pressure.
 - .2 Supply as Specified: Ives COR Series Bar Co-ordinators.
- .9 Roller Latch
 - .1 Roller latch constructed of brass or stainless steel. Roller latch to have maximum projection of 1/2" allowing for variance in the door

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- clearance. Projection of the roller by turning the knurled knob on the back of the latch. Roller latch to fit heavy duty cylindrical latch cutout, non handed, nylon roller standard, optional roller nylon covered brass roller, optional ASA strike.
- .2 Supply as Specified: IVES RL32
- .5 Locksets I Deadlocks I Privacy Sets:
- .1 Cylindrical:
- .1 Extra heavy duty residential, commercial, institutional and industrial applications. Latch bolts to be steel with minimum W' throw deadlocking on keyed and exterior functions. %" throw anti-friction latchbolt on pairs of fire doors. Provide manufacturer's standard wrought box strike for each latch or lock, with curved lip extended to protect frame. Locks and latchsets tested to exceed 3,000,000 cycles. Lock case to be steel, incorporate one piece spring cage and spindle. Precision solid brass 6-pin cylinder with nickel silver keys available in all Schlage keyways. All levers to be solid with no plastic inserts.
- .2 Supply as Specified: Schlage "ND" series lever design.
- .2 Mortise:
- .1 Grade 1 Operational, Grade 1 Security, mortise lock for commercial and institutional buildings. Manufacture lock cases from fully wrapped, heavy 12 gage steel with a protected leading edge and screw configuration that limits access to operating parts. Lock components to be manufactured of zinc dichromate plated steel. Latch bolts to have a standard 2 %" backset with a full %" throw. Latchbolts to be non-handed, field reversible without opening the lock case. Latchbolts to be 2 piece anti-friction, manufactured from stainless steel. Solid latchbolts and/or plastic anti-friction devices are not acceptable.
- .1 Deadbolts to be 1 %" total length have standard 1" throw with a minimum %" internal engagement when fully retracted. Deadbolts to be constructed of stainless steel, incorporating a security roller pin with a minimum Rc60 rating for surface hardness. Lever assembly (external) to be one piece design attached by threaded bushing. Lever assembly (internal) to be attached by screw less shank. Lever attachments by common tools (alien nuts and/or set screws) are not acceptable. Thru bolt lever assemblies through the door for positive interlock. Levers to have independent rotation in both directions. Lever operation to be freewheeling (clutch) when in the locked mode. Spring cages are to be incorporated into the lever assemblies. Hub blocking plate to be solid, cast stainless steel. Manufacturers utilizing open hub designs are not acceptable.
- .2 Spindles to be independent, designed to "break away" at a maximum of 75 psi torque. Mounting tabs are to be automatic self-adjusting, vertically and horizontally for door bevel and strike alignment. Cylinders to be secured by a cast stainless steel, dual retainer.
- .3 Manufacturers utilizing screws and/or stamped retainers are not acceptable.

HARDWARE

- .2 Supply as Specified: Schlage "L" series 06A lever design
- .3 Mechanical Push Button Lock:
 - .1 Supply as Specified: Simplex 5000 Series 502X with lever handle, key override, exterior combination or similar approved.
- .6 Exit Devices/Device Trims/Mullions:
 - .1 Narrow Style:
 - .1 Exit device to be cUL listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on all device mechanism subassemblies and dead latching mechanisms for all active latchbolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Doors greater than 915mm wide supply long bar exit devices, doors greater than 2134mm high supply extension rods where required. Fits door stiles as narrow as 1 %".
 - .2 Supply as Specified: Von Duprin 35A series
 - .2 Heavy Duty
 - .1 Exit device to be cUL listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on all device mechanism subassemblies and dead latching mechanisms for all active latchbolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Roller strikes to be standard on all rim and surface vertical rod devices, mortise exit devices (626) complete with strikes that match the same finish as the device. Doors greater than 915mm wide supply long bar exit devices, doors greater than 2134mm high supply extension rods for surface vertical rod series. 1,000,000 cycle testing independently certified by ETL.
 - .2 Supply as Specified: Von Duprin 98 series
 - .3 Exit Device Trim
 - .1 Supply device trim featuring recessed cylinder mounting and coil compression spring design with shear pin protection for all lever designs. Similar lever designs for exits as specified for locksets.
 - .2 Supply as Specified Von Duprin 996 series 06 lever design.
 - .4 Mullions Non-Rated:
 - .1 Aluminum mullions complete with mullion stabilizers prepared with 1408 strikes for use with all Von Duprin rim devices to provide single door performance and security on double door applications.
 - .2 Supply as Specified: Von Duprin 5754
 - .5 Mullions Non-Rated:
 - .1 Steel mullion prepared for two 264 or 299 strikes for use with all Von Duprin rim devices and key removable kit to provide quick

HARDWARE

- removal to provide single door performance and security on double door applications .
- .2 Supply as Specified: Von Duprin KR4954
- .6 Mullions Rated:
 - .1 Fire rated cUL approved mullion for up to three hour openings up to 8' x 8' using Von Duprin rim devices prepared for 499F strikes. Supply with key removable kit to provide quick removal to provide single door performance and security on double door applications.
 - .2 Supply as Specified: Von Duprin KR9954
- .7 Mullions Rated:
 - .1 Fire rated cUL approved mullion for up to three hour openings up to 8' x 8' using Von Duprin rim devices prepared for 61111 electric strike and one fire rated 499f strike for use with all Von Duprin rim devices and key removable kit to provide quick removal to provide single door performance and security on double door applications.
 - .2 Supply as Specified: Von Duprin 9854 c/w KR54-F Kit
- .8 Mullions Non-Rated:
 - .1 Mullion for up to three hour openings up to 8' x 8' using Von Duprin rim devices prepared for 6111 electric strike and one standard strike for use with all Von Duprin rim devices and key removable kit to provide quick removal to provide single door performance and security on double door applications.
 - .2 Supply as Specified: Von Duprin 4854 c/w KR54 Kit
- .7 Door Closers
 - .1 Door closers to have the following features (see separate closer sections below for further information):
 - .1 Fully hydraulic, rack and pinion action with high strength cast iron cylinders and one piece forged steel pistons
 - .2 Include high efficiency, low friction pinion bearings.
 - .3 Hydraulic fluid of a type requires no seasonal adjustments, ULTRA X TM fluid has constant temperature control from -35° C to +49° C.
 - .4 Hydraulic regulation controlled by tamper-proof , non-critical screw valves, adjustable with a hex wrench.
 - .5 Separate adjustments for backcheck, general speed and latch speed.
 - .6 Door closers with special template (ST-) numbers include all required associated product, information sheets and instructions
 - .7 Size 1 manual door closers to provide less than 5 pounds opening force on a 900mm door leaf.
 - .8 Door closer with Pressure Relief Valves are not accepted.
 - .9 Door closer bodies, arms, covers to be powder coated
 - .10 Closers with powder coat finishes to exceed a minimum 100-hour salt spray test, as described in ANSI A156. 18 and ASTM 8117.
 - .11 Closers detailed with plated finishes to include plated covers (or finish plates), arms and visible fasteners.

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- .2 Heavy Duty Mechanical (Multiple Applications):
 - .1 Non-sized (1-6) and non-handed cylinder body to have 1 1/2" piston diameter with 3/4" journal double heat-treated pinion shaft with 5/8" full compliment bearings. XP closer hydraulic regulation controlled by tamper-proof, non-critical screw valves, abrasion resistant Vitron "O" ring, adjustable with a hex wrench. Closer to have "FAST" Power Adjust speed dial to show spring size power track closers non-sized 1-4. Closers to have forged steel main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever forged arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.
 - .2 Supply as Specified: LCN 4040XP series
- .3 Heavy Duty Single Point Hold-Open (Pull and Push Side Mount):
 - .1 Non-sized (1-4) and non-handed cylinder body to have 1 1/2" piston diameter with 1 1/16" double heat-treated shaft with adjustable single-point hold open function controlled by solenoid assembly located in a head frame mounted track. Track arm to have single lever arm with low friction track and roller assembly. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection.
 - .2 Supply as Specified: LCN 4040SE series
- .4 Heavy Duty Electric Operator:
 - .1 Two in one swing door auto door operator, cUL listed for fire door applications.
 - .2 Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical code.
 - .3 Push 'n go permits non-switch activation
 - .4 Power boost feature provides additional latching force, 9530 and 9540 series
 - .5 Electromechanical unit with microprocessor control Tested internally to over ten million cycles
 - .6 Certified by cUL for use on labeled doors.
 - .7 Adjustable hold open period Of 2 to 30 seconds in automatic or manual mode
 - .8 Provide full covers the width of door rebate opening Push applications
 - .9 Supply as Specified: LCN 9531 9542, series c/w keyswitch 8310-806K
- .8 Actuators:
 - .1 Wall Type:
 - .1 Wall plate switch to be hard-wired actuator with round, stainless steel touch plate 4 W' diameter. Engraved blue filled handicap symbol conforms to most accessibility codes. Units to include heavy grade components for vandal resistant mounting and weather resistant switch standard.
 - .2 Supply as specified: LCN 8310-856 (4") c/w 8310-874 (4 W') escutcheon c/w 8310-800 weather ring on exterior applications

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- .9 Overhead Door Stops/Holders:
 - .1 Heavy Duty Surface Mounted:
 - .1 Surface overhead stops/holders to be stainless steel base, non-handed for single-acting doors with a heavy-duty channel/slide-arm design and offset jamb bracket to allow for simple field modifications of functions. Channel to be surface mounted to the door with thru bolts and the jamb bracket is surface mounted to the jamb .
 - .2 Supply as Specified: Glynn-Johnson 90 series
 - .2 Heavy Duty Concealed Mounting:
 - .1 Concealed overhead stops/holders to be stainless steel base, non-handed for single or double-acting doors with a low profile channel, mortised in the door and jamb bracket is mortised in the doorframe. Unit to be fully concealed when door is in the closed position. Units to be field adjustable for function changes if required.
 - .2 Supply as Specified: Glynn-Johnson 100 series
- .10 Door Pulls/Flatware/Coat Hooks:
 - .1 Door Pulls are to be 19mm, 25.4 mm diameter All flatware to be of stainless steel material, .050 gauge.
 - .1 Supply as Specified:
 - .1 Ives 8100 and 8300 series - size and type as shown in the hardware schedule.
 - .2 Ives 8400 series (Kickplates 40mm less door width single door and 25mm less door width double doors)
 - .3 Bradley 9114 coat hook for administrative offices & public washrooms
 - .4 Ives 572 coat hook for field locker rooms & operation offices
- .11 Sliding Door Track:
 - .1 Sliding door track manufactured from extruded aluminum 6063T5 alloy weighing 1.229 lbs. per foot, load capacity 200 lbs. (2 hangers) Track recessed in the bottom of the door and heavy ball bearing door guides ensure secure and smooth door travel. Door hangs on "Spinwheel" quick release hanger for single face mounted doors. Aluminum fascia manufactured from extruded aluminum 6063T5 alloy weighing 1.269 lbs. per foot, wall thickness is 0.100 inches.C110 fascia interlocks with the C108 track and is to be supplied in a clear anodized finish complete with C110 end caps.
 - .2 Supply as Specified:
 - .1 K.N. Crowder Inc. C-911 hanger
 - .2 K.N. Crowder Inc.C914 mortised bottom channel, C-913 roller
 - .3 K.N. Crowder Inc. C108 track c/w C100-HD stops
 - .4 K.N. Crowder Inc. C110 fascia and C 110 end cap
- .12 Floor/Wall Stops:
 - .1 Floor Stops:
 - .1 Floor stops to be 1" overall height with 3/16" base height for use on doors without thresholds. Heavy-duty cast dome stop

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- constructed of brass/bronze with grey, non-marring rubber bumper.
- .2 Supply as Specified: Ives FS436
- .2 Floor Stops:
 - .1 Floor stops to be 1" overall height with 9/16" base height for use on doors with thresholds or undercut doors. Heavy-duty cast dome stop constructed of brass/bronze with grey, non-marring rubber bumper.
 - .2 Supply as Specified:
 - .1 Ives FS438
 - .2 CRL DL
 - .3 Wall Stops (No Button on Locking Hardware):
 - .1 Wall stops to be constructed of stainless steel base with special retainer cup that makes the rubber stop tamper resistant. Convex design of rubber bumper.
 - .2 Supply as Specified: Ives WS406CVX
 - .4 Wall Stops (Projecting Button on Locking Hardware):
 - .1 Wall stops to be constructed of stainless steel base with special retainer cup that makes the rubber stop tamper resistant. Concave rubber bumper to avoid damage to locks with projecting buttons.
 - .2 Supply as Specified: Ives WS406CCV
- .13 Weather/Smoke/Sound Seals:
 - .1 Supply as Specified:
 - .1 KN Crowder W-20S (Head seal). Note: Mount head seal prior to soffit mounted hardware.
 - .2 KN Crowder W-50S (Jamb seal, head/jamb seal))
 - .3 KN Crowder W-21 (Head/jamb seal)
- .14 Thresholds/Weatherstrip/Door Sweeps:
 - .1 Supply as Specified:
 - .1 KN Crowder W-13S (Door Sweep)
 - .2 KN Crowder CT-45 (Threshold)
 - .3 KN Crowder CT-10 (Threshold)
- .15 Keyswitch/Electric Strikes/Magnetic Locks/Power Supplies, Power Transfers, Mortar Guards:
 - .1 Keyswitch:
 - .1 Keyswitch housing to be cast zinc to protect against vandalism, housing to provide a concealed rear mounting attachment which cannot be compromised when the cylinder is attached with a set screw. Standard stainless steel cover plate.
 - .2 Supply as Specified: Schlage 650 series
 - .2 Electric Strikes:
 - .1 Grade 1, electric strikes to be cUL listed burglary- resistant and electric strike for fire doors and frames. A label for single doors and B label for double doors. Electric strikes to be stainless steel construction, non-handed available in 12V or 24V AC or DC with continuous duty solenoid and accept %" throw latch bolts. Strike box to be adjustable to compensate for any misalignment of the

HARDWARE

- door or frame with two piece plug connector for ease of installation.
- .2 Supply as Specified: Von Duprin 6000 series
- .3 Magnetic Locks:
- .1 Electromagnetic locks to be non-handed, field selectable dual voltage 12/24VDC with a holding force that meets or exceed 1500 lbs and certified to UL 1034 and UL 10C. Electromagnetic locks to be powered by filtered and regulated power supply.
- .2 Electromagnetic locks to be furnished with magnetic bond sensor, door position switch and relock time delay standard. Operating temperature range from 0 to 49 degree celsius. Provide filler bars and angles to mount maglocks as per frame details.
- .3 Supply as Specified: Schlage Electronics M490P I M492P
- .4 Power Supplies:
- .1 Power supplies to be tested and certified to meet UL294. Universal 120-240 VAC input, low voltage DC output, regulated and filtered. Power supplies to have 2A, 4A, 6A output, 12/24VDC field selectable with jumper. Provide emergency release terminals, where required, that allow the release of all devices upon activation of the fire alarm system complete with fire alarm input for initiating "no delay" exiting mode. Power supply to be flat mounting design and polarized locking connections for additional option boards specified.
- .2 Supply as Specified: Schlage Electronics PS-902, PS-904, PS-906
- .3 Power supply to be tested and certified to meet UL294. Universal 120-240 VAC input, low voltage 4 amp DC output, 12/24VDC field selectable with jumper, regulated and filtered. Power supply to provide 4 amp high inrush for Von Duprin, Monarch, Doromatic electric latch retraction exit devices. The power supply to be flat mounting design and polarized locking connections for additional option boards specified.
- .4 Supply as Specified: Von Duprin PS-914
- .5 Electro-Magnetic Door Holders:
- .1 Provide floor and wall mounted units to hold door in open position and to release and automatically close under fire alarm conditions. Electromagnet shall be protected against transients and voltage surges up to 600 volts. Power requirements, tri-voltage field selectable, 12, 24VDC, 120VAC.
- .2 Supply as Specified: LCN SEM7800 series
- .6 Power Transfer
- .1 Provide a means to transfer power from frame to door stile. Devices shall be reversible and allow a full 180° door swing with 4 1/2" x 4 1/2" butt hinges or 3/4" offset pivots. When door is in closed position, transfer unit shall be concealed. Transfer units shall contain ten 24 awg UL approved conductors. Rating: 10 Amps at 24 VDC (Class 1 low voltage)
- .2 Supply as Specified: Von Duprin EPT
- .7 Mortar Guards:

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- .1 Provide and weld in place TA-LD1 or TA-LD2 at all frame locations where electrified hardware components are to be mounted. Provide proper handling of mortar guard boxes to the hollow metal frame supplier. Hollow Metal frame supplier is responsible for ensuring the proper location of all required mortar boxes.
- .8 Junction Box:
 - .1 Provide high quality NEMA junction box to provide convenient installation for electrified hardware. Units are surface mounted 254 mm high, 254 mm wide, 152 mm deep and includes hinged door with twist turn lock, 20 position terminal strip to accept 24 to 12 gauge wire.
 - .2 Supply as Specified: Von Duprin JB7

2.3 FINISHES

- .1 Unless otherwise specified, all finishes to be brushed chrome (626).
- .2 Furnish with antimicrobial coated hardware items designated with AM suffix to the finish, 626AM and /or 630AM. The non-toxic coating to be a natural inorganic silver-ion based antimicrobial added to the clear coating. The powder coat containing the antimicrobial compound to be electro- statically applied to a minimum thickness of 1.5 mils. The antimicrobial coating is to protect the surface of the hardware item by inhibiting the growth of bacteria, mold, mildew, and odor. The antimicrobial coating shall pass the BHMA clear coat requirements and be registered with the Environmental Protection Agency (EPA) and the Food and Drug Agency (FDA) listed.
- .3 Finishes are specified as follows:

Item	BHMA	Description	Base
Hinges	# 630	satin stainless	Materials s
Hinges	626	steel satin	Stainless
		chrome plated	steel
Hinges	652	satin chrome plated	brass/bronze
Continuous Hinges	689	anodized aluminum	steel
Continuous Hinges	630	satin stainless steel	aluminum
Pivots	689	powder coat	stainless steel
		aluminum	steel
Lock Trim	626,	satin chrome plated	brass/bronze
Exit Devices	626,	Satin chrome plated	brass/bronze
Door Closer	689	powder coat	steel
		aluminum	
Door Pulls	630	satin stainless steel	stainless steel
Protective Plate	630	satin stainless steel	stainless steel
Door			
Overhead	630	satin stainless steel	stainless steel
Wall/Floor	626	satin chrome plated	brass/bronze
Thresholds	628	anodized aluminum	aluminum
Weatherstrip	628	anodized aluminum	aluminum
Miscellaneous			

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Coat hooks	626	satin chrome plated	brass/bronze
Mullions	628	powder coat aluminum	steel
Key Switches	630	satin stainless steel	stainless steel
Electric Strikes	630	satin stainless steel	stainless steel
Magnetic Locks	628	anodized aluminum	aluminum

2.4 CYLINDERS, KEYING SYSTEMS AND KEY CONTROL

- .1 Meet with the Owner to finalize keying requirements and obtain keying instructions in writing as outlined in Division 1. Locks, cylinders and keys shall be furnished with Schlage patented "Everest" 29 Primus full size key sections.
- .2 Provide split key construction keying system during construction period. Permanent keys will be furnished to the Owner's Representative prior to occupancy. The Owner or Owner's Security Agent will void the operation of the construction keys by removal of the construction key insert using a Schlage 35-057 extractor tool.
- .3 Permanent cylinders to be keyed by factory, combined in sets or subsets, master keyed or great grand master keyed, as directed by Owner. Permanent keys, key blanks and cylinders shall be stamped with the applicable blind code for identification. These visual key control marks or codes will not include the actual key cuts. Stamp cylinders with concealed visual keying for added security. Permanent keys will also be stamped "Patented". Keys and cylinder identification stamping to be approved by Architect and Owner. Failure to properly comply with these requirements may be cause to require replacement of all or any part of the cylinders and keys involved as deemed necessary at no additional cost to the Owner.
- .4 Equip locks and cylinders with patent protected, full size cylinders with nickel silver blocking pin to check for patented feature on keys. Provide a minimum of six pins with nickel silver bottom pins. Cylinders must allow for multiplex master keying, combined to Owner's instructions.
- .5 Provide complete cross-index system, place keys on markers and hooks in the cabinet as determined by the final key schedule. Provide one each key cabinet of sufficient size to hold all keys plus 50%, hinged panel type cabinet for wall mounting. See hardware groups for model number.
- .6 Deliver all permanent key blanks and other security keys direct to Owner's representative from factory by secure courier, return receipt requested. Failure to properly comply with these requirements may be cause to require replacement of all or any part of the cylinders and keys involved as deemed necessary at no additional cost to the Owner.
- .7 All keying requirements to be confirmed by owner.

Part 3 Execution

3.1 EXAMINATION

- .1
- .2 Ensure that doors and frames are properly prepared and reinforced to receive finish hardware prior to installation.

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- .3 Ensure that door frames and finished floor are plumb and level to permit proper engagement and operation of hardware.
- .4 Submit in writing a list of deficiencies determined as part of inspection required in 3.1.1 and 3.1.2 to supervising consultant prior to installation of finished hardware. Correct door frame installation before proceeding with finish hardware installation.

3.2 INSTALLATION

- .1 Hardware Installers must have a minimum of five (5) years' experience in installation of hardware.
- .2 Provide verification of installer's qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.
- .3 Install hardware at mounting heights as specified in the manufacturer's templates or specific references in approved hardware schedule or approved elevation drawings.
- .4 Where mounting height is not otherwise specified, install hardware at mounting heights as indicated in 1.5.1, 1.5.2.
- .5 Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.
- .6 Ensure that all locksets I latchsets I deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position. Handing is part of installation procedure.
- .7 Ensure that all exit devices are of the correct hand and adjust device cam/drive screw for proper outside trim function prior to installation. Handing is part of installation procedure.
- .8 Follow all manufactures installation instructions. Adjustment of door closers is inclusive of spring power, closing speed, latching speed and back-check, valve screws to achieve backcheck (4040XP series) at the time of installation.
- .9 Delayed action door closers are to be adjusted to forty (40) second delay for barrier free accessibility and movement of materials. Time period to be approved by Owner.
- .10 Install head seal prior to installation of "PA"-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.
- .11 Counter sink through bolt of door pull under push plate during installation.
- .12 Install blocking material of sufficient type and size in cavities of metal and wood stud walls and partitions. Located concave and convex type door bumpers at the appropriate height to properly contact protruding door trim.
- .13 All outlet back boxes, provisions for power, conduit complete with pull strings for security systems power and control boxes for integrating of security system with fire alarm system and coordination of complete system to be furnished under the Electrical Division for the project.

HARDWARE

- .14 The Contract Hardware Distributor shall install all hardware using Factory Trained I Approved Installers. At project completion, prior to turn over, the Contract Hardware Distributor and Security Integrator will jointly inspect each opening, make final adjustments to insure a complete functional installation and turn over to Owner.
- .15 The authorized system Integrator will be responsible for mounting card readers, controllers, master controllers, input panels and interface with EAC hardware and power supplies. They are also responsible for low voltage wiring, wire terminations, final hookup, testing, system setup, warranty and owner turnover with training.

3.3 FIELD QUALITY CONTROL

- .1 Verify each door leaf opens closes and latches properly. Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements. Test access control system and electrified hardware devices for proper operation, owner to sign off on verification of operation. Verify electric door release hardware operates properly upon activation of the fire alarm system.
- .2 Perform bi-monthly on-site inspections during hardware installation and provide inspection reports listing progress of work , unacceptable work and corrective measures. Repair or replace as directed by the Consultant.
- .3 Before completion of the work but after the hardware has been installed, a certificate to the architect will be submitted stating that final inspection has been made and that hardware has been checked for installation and operation by a technician from the manufacturer and hardware consultant.

3.4 ADJUSTING AND CLEANING

- .1 Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.
- .2 Adjust doors with self-closing devices or automatic closing devices for proper operation after the HVAC system is balanced and adjusted. Verify spring power of non-sized door closers is properly adjusted.
- .3 All hardware to be left clean and free of disfigurements.
- .4 Instruct owner personnel in the proper operation, adjustment and maintenance of hardware.
- .5 Check all locked doors against approved keying schedule.

3.5 PROTECTION

- .1 Protect hardware from damage during construction. Wrap locks panic hardware, fire exit hardware, door pull trim with kraft paper or plastic bubble materials to protect finish from damage until date of substantial completion. Remove and reinstall or where necessary, using temporary hardware to maintain finish in new condition and maintain manufacturer's warranty.

END OF SECTION

DIVISION 09 – FINISHES

GYPSUM BOARD

Part 1 General

1.1 REFERENCE DOCUMENT

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C645-08a - Standard Specification for Nonstructural Steel Framing Members
 - .2 ASTM C754-08 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
 - .3 ASTM C840-08 - Standard Specification for Application and Finishing of Gypsum Board (Provide copy on site.)
 - .4 ASTM C1002-07 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 - .5 ASTM C1047-05 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 - .6 ASTM C1278/C1278 M-07a - Standard Specification for Fibre-Reinforced Gypsum Panel
 - .7 ASTM C1280-07 - Standard Specification for Application of Gypsum Sheathing (Provide copy on site.)
 - .8 ASTM C1288-99(2004)e1 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets
 - .9 ASTM C1396/C1396 M-06a - Standard Specification for Gypsum Board
 - .10 GA-216-2011 - Gypsum Association Application and Finishing of Gypsum Panel Products
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-2022- Vapor Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):
 - .1 SCAQMD Rule 1168, June 2006, Adhesives and Sealants Applications
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S101 - Fire Endurance Tests of Building Construction and Materials.

Part 2 Products

2.1 GYPSUM BOARD

- .1 Gypsum board products shall meet or exceed requirements of ASTM C1396M unless specified otherwise.
 - .1 'DensShield' tile backer is to be used throughout.
 - .2 Gypsum board products shall be 1220 mm wide x maximum practical length for application, unless specified otherwise.

GYPSUM BOARD

- .3 Fire Rated board and other board specified with Fire Rated core shall be labeled in accordance with a certification program accredited by the Standards Council of Canada

2.2 FRAMING MEMBERS

- .1 Studs and Tracks: to ASTM C645, metal thickness as specified in Steel Stud Height Schedule for appropriate height and as specified elsewhere, galvanized to ASTM A653/A653M, Z180 zinc coating. Use minimum 0.88 mm studding for fibre-reinforced gypsum board.
- .2 Furring: 0.48 mm thick galvanized sheet steel to ASTM A653M-00, Z180 zinc coating, sizes as indicated on drawings.
- .3 Resilient Furring: 0.48 mm thick galvanized sheet steel to ASTM A653M-00, Z180 zinc coating, pre punched, 35 mm face width, 16 mm high.
- .4 Shaft Wall Framing: meet or exceed requirements of applicable ULC or WHC design.

2.3 SUSPENDED CEILING AND SOFFIT SYSTEM COMPONENTS

- .1 Carrying Channels: Cold rolled steel to ASTM C645, galvanized.
- .2 Tie Wire: to ASTM C754.
- .3 Hangers: to ASTM C754, galvanized.
- .4 Hanger Anchoring Devices:
 - .1 Size devices to develop full strength of hangers, but not less than three times the calculated hanger loading, except size direct pull out concrete inserts for five times calculated hanger loading.
 - .2 Powder actuated fasteners to underside of concrete structure not permitted.
 - .3 Metal decking tabs and clips not permitted.
 - .4 Devices shall be hot dip galvanized steel screws, bolts, cast in place concrete inserts or other devices appropriate for anchorage to the structure indicated.
 - .5 Suitability of devices shall have been proven through standard construction practices or certified test data.

2.4 ACCESSORIES

- .1 Accessories shall meet or exceed requirements of ASTM C1047 unless otherwise required for conformance to fire-rated assemblies.
- .2 Screws: to ASTM C1002, and modified as required for fastening to 1.22 mm and thicker steel studs.
- .3 Nails: to CAN/CSA B111, annular ring type, galvanized.
- .4 Adhesive for laminating gypsum board or panel to gypsum board or panel: as recommended by gypsum board or panel manufacturer, as applicable and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.

GYPSUM BOARD

- .5 Corner Beads: galvanized sheet steel to ASTM A653M, Z180 zinc coating, beaded angle, knurled and perforated, metal and paper flange combination, beaded angle, for installation with joint compound.
- .6 Casing Beads: galvanized sheet steel to ASTM A653M, Z180 zinc coating, beaded edge, knurled and perforated flange 32 mm wide, for joint compound filling.
- .7 Control Joints: pre formed galvanized metal or plastic "V" type, perforated flanges.
- .8 Joint treatment material, joint tape and topping compound: to ASTM C475.
- .9 Joint tape for cementitious wallboard: coated glass fibre tape, 50 mm wide.

2.5 ACOUSTIC TREATMENT MATERIALS

- .1 Acoustic Sealant: non hardening, non skinning, permanently flexible and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.
- .2 Acoustic Insulation: to ASTM C665, Type I, non-combustible, mineral fibre unfaced batts, friction fit, thickness as indicated on drawings.

2.6 VAPOUR RETARDER MATERIALS

- .1 Polyethylene Film: to CAN/CGSB 51.34, 0.15 mm thick.
- .2 Staples: to CAN/CSA B111, galvanized wire, minimum 6 mm leg.
- .3 Sealing Tape: minimum 60 mm width, polypropylene sheathing tape with acrylic adhesive, or duct tape of same width.
- .4 Polyurethane Sealant: use one of the following:
 - .1 One component, to CAN/CGSB 19.13, class 2, low temperature and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.
 - .2 Multi component, to CAN/CGSB 19.24, type 2[and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.

Part 3 Execution

3.1 INSTALLATION, GENERALLY

- .1 Meet or exceed the requirements of ASTM C840 for gypsum board and ASTM C1280 for gypsum sheathing.
- .2 Materials and installation of fire-rated assemblies shall conform to assemblies that have achieved the specified rating when tested to CAN/ULC-S101.

3.2 INSTALLATION OF INTERIOR METAL FRAMING

- .1 Meet or exceed the requirements of ASTM C754.

GYPSUM BOARD

- .2 Provide double studs at partition openings, door and interior window jambs. First stud adjacent to openings shall be minimum 0.88 mm material thickness.
- .3 Provide concealed bracing as required to construct rigid installation. Provide bracing to building structure for partitions extended above ceilings.
- .4 Provide extra length top track flanges to maintain clearance between structure and top of studs, to avoid transmission of structural loads to studs.
- .5 Screw attach studs to top and bottom tracks of partitions less than ceiling height.
- .6 Install steel stud track (as detailed on the drawings) steel channel brake shape with wood lumber or plywood backing (as detailed) for support of fixtures, heavy trim, washroom accessories, wall cabinets and similar construction.
- .7 Frame openings for firestopping and around structural components, cabinets, access panels, and other built in equipment, on four sides. Extend framing into recesses. Check clearances with respective equipment suppliers.

3.3 FURRING

- .1 Furr to form bulkheads between ceilings at different levels. Furr for beams, columns, pipes, and around exposed services, except as otherwise indicated.
- .2 Frame perimeter of openings to support access panels, light fixtures, diffusers, grilles and similar components.
- .3 Install 150mm continuous strip of 13 mm gypsum board or panel along base of partitions where resilient furring is installed.

3.4 INSTALLATION OF METAL FRAMED SUSPENDED CEILINGS AND SOFFITS

- .1 Verify suitability of substrate for hanger anchoring devices.
- .2 Install suspension system to meet or exceed requirements of ASTM C754. Coordinate location of hangers with other work.
- .3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at 600 mm maximum around perimeter of fixture.
- .4 Do not suspend ceiling from metal decking.
- .5 Provide carrying channels at interruptions of continuity and at changes in direction of suspension system.
- .6 Exterior Soffits:
 - .1 Brace suspension over whole area to prevent movement due to wind pressure.
 - .2 Install galvanized drips continuously along edges.
- .7 Maximum deviation of framing from horizontal shall be 3 mm in 3.5 m, non cumulative.

GYPSUM BOARD

3.5 INSTALLATION OF VAPOUR RETARDER MATERIALS

- .1 Install sheet polyethylene where indicated on drawings, as required to form a continuous vapour retarder on warm side of building envelope.
- .2 Use sheets of largest practical size to minimize joints. Join sheets over solid, continuous backing, lapping sheets minimum 150 mm.
- .3 Mechanically fasten or adhere polyethylene sheet to substrates.
- .4 Repair punctures and tears with sealing tape. Where punctures and tears are extensive replace entire damaged section, overlapping perimeter framing on all sides.
- .5 Seal sheet polyethylene to air/vapour hats installed over electrical boxes and other semi-recessed devices, using sealing tape or 15 mm diameter bead of polyurethane sealant.
- .6 Seal penetrations through air/vapour hats using polyurethane sealant. Ensure sealant extrudes to both sides of penetrations.
- .7 Seal along full perimeter and edges with polyurethane sealant.

3.6 ACOUSTIC TREATMENT

- .1 Install acoustic insulation between studs in acoustically rated partitions.
- .2 Ensure acoustic insulation fills spaces between studs, full height of walls, and is continuous over door frames and around openings and corners.
- .3 Ensure insulation is packed around cut openings in board and panels, behind outlet boxes, around plumbing, heating or structural items passing through the system and at abutting walls.
- .4 Apply 15 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to acoustically seal gypsum board and panel junction with abutting fixed building components. Seal full perimeter of cutouts around electrical boxes, ducts, piping, etc.
- .5 Apply sealant in accordance with manufacturer's directions.
- .6 Apply four, 10 mm diameter beads of acoustic sealant 50mm wide x 10mm thick compressible closed cell foam tape] between stud framing and fixed building components, around periphery of acoustically rated partitions.

3.7 APPLICATION OF BOARDS AND PANELS

- .1 Do not apply gypsum board and panels until framing, blocking, mechanical and electrical work have been inspected and approved.
- .2 Erect gypsum board and panels vertically for walls unless horizontal application results in fewer end joints. Locate end joints over framing members.
- .3 Cut holes for penetrating items to minimize gaps between items and board and panels.
- .4 Keep end joints away from prominent locations and central portions of ceilings.

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- .5 Locate vertical joints at least 300 mm from jamb lines of doors, windows and other openings.
- .6 Erect ceiling gypsum board and panels with long dimensions perpendicular to framing members.

3.8 INSTALLATION OF ACCESSORIES

- .1 Provide control joints as follows:
 - .1 At changes in substrate construction.
 - .2 At wall juncture with suspended ceilings.
 - .3 Over control joints in substrate construction.
 - .4 At approximate 9 m spacing on long corridor runs.
 - .5 At maximum 3.5 m spacing in each direction on exterior soffits.
- .2 Install expansion joints at all building expansion joints.
- .3 Erect beads and joints straight and rigid. Use full length pieces only. Mitre and fit corners accurately.
- .4 Install corner beads at external angles. Secure to substrate.
- .5 Install casing beads where gypsum board [and panel] materials terminate against surface having no trim concealing the junction and where indicated on drawings.

3.9 TAPING AND FINISHING

- .1 Meet or exceed requirements of ASTM C840.
- .2 Provide the finish level, specified in ASTM C840, for the following surfaces:
 - .1 Level 1: plenum areas above ceilings and other concealed areas.
 - .2 Level 2: surfaces that are to receive ceramic tile.
 - .3 Level 3: surfaces that are to receive heavy spray or trowel applied finishes.
 - .4 Level 4: surfaces to receive wall coverings, flat paints or light textures.
- .3 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and topping compound.
- .4 Apply joint system according to manufacturer's directions. Feather out onto board and panel faces.
- .5 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of topping compound feathered out 300 mm onto board and panel faces.
- .6 Fill all each screw and nail head depressions individually with joint and topping compounds to bring flush with adjacent surfaces of gypsum board and panels so as to be invisible after painting is completed.
- .7 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surfaces of boards and panels.

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- .8 Use minimum #120 grit sandpaper for first and second sanding. Use minimum #150 grit sandpaper for final sanding.
- .9 Completed installation shall be smooth, level or plumb, free from waves and other defects, ready for painting.

3.10 CUTTING AND PATCHING

- .1 Do all cutting, patching and making good as required to provide a satisfactory finish.

When prime coat has become sufficiently dry, examine surfaces for any final patching that may be required. Use colour tinted patching compound for later visual examination and approval before final prime and paint coats.

3.11 STEEL STUD HEIGHT SCHEDULE

Maximum Stud Height (mm) based on lateral pressure of 240 Pa with deflection limit of L/240

Stud Spacing O.C.	300	400	600	300	400	600
Stud Depth (mm)	0.48 mm Steel Design Thickness			0.88 mm Steel Design Thickness		
64	3630	3430	3230	4240	3910	3530
92	4670	4370	4090	5440	5000	4500
102	5000	4670	4320	6070	5590	5000
152	6730	6020	5110	8150	7470	6580

Based upon tests with 13mm gypsum board both sides with screw fasteners spaced at 300 o.c. Heights also apply to greater gypsum board thickness and multiple gypsum board layers.

END OF SECTION

RIGID-SHEET VINYL WALL COVERING

1. General

1.1 SECTION INCLUDES

- .1 This section includes labor, materials and other services necessary to complete vinyl wall coverings.
- .2 Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the work of this Section.

1.2 RELATED SECTIONS

- .1 Gypsum Board Section 09 29 00

1.3 REFERENCES

- .1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- .2 American Society for Testing & Materials (ASTM):
 - .1 AST ASTM E 84-05 Standard Test Method for Surface Burning Characteristics of Building Materials, Class A.
 - .2 ASTM D5420 Gardner Impact Exceeds 160-inch pounds

1.4 SYSTEM DESCRIPTION

- .1 Performance Requirements: Provide hygienic Altro Whiterock wall covering which has been manufactured by Altro and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.
- .2 Location – Walls to washroom

1.5 SUBMITTALS

- .1 Product Data: Submit manufacturer’s current printed product literature, specifications, installation instructions, and field reports in accordance with Section 01330 - Submittal Procedures.
- .2 Shop Drawings: Submit shop drawings to indicate materials, details, and accessories in accordance with Section 01330 - Submittal Procedures including but limited to the following:
 - .1 A Submit a layout diagram indicating the location of each panel and joining method.
- .3 Selection Samples: Submit duplicate sample pieces of Altro Whiterock material, as well as accessory pieces in accordance with Section 01330 - Submittal Procedures. Submit samples of colors and finishes for selection by Client and Architect.
- .4 Verification Samples: Submit samples of selected materials specified to verify color and finish.
- .5 Industry Certifications and Standards: Submit copy of documentation indicating compliance.

RIGID-SHEET VINYL WALL COVERING

1.6 QUALITY ASSURANCE

- .1 Manufacturer: Minimum of 5-years' experience manufacturing similar products.
- .2 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.
- .4 Manufacturer's Field Reports: Specified herein.
- .5 Closeout Submittals: Submit the following;
 - .1 Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - .2 Warranty: Warranty documents specified herein.

1.7 QUALITY ASSURANCE - CONTRACTOR

- .1 Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 - .1 Training: Installer who has attended an Altro Whiterock installation training clinic.
- .2 Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.
 - .1 Mock-Up Size: One, full shower installation mock-up. Location to be agreed by all parties.
 - .3 Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
 - .4 Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.
- .3 Pre-Installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- .2 Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations.
- .3 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

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- .4 Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
- .5 Store panels in temperature-controlled environments. Leave protective blue film on panel until ready to use.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Deposit all packaging materials in appropriate container on site for recycling or reuse.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Keep all discarded packaging away from children.

1.9 PROJECT CONDITIONS

- .1 Temperature Requirements: If storage temperature is below 65F (18C), the Altro Whiterock wall panel must be moved to a warmer place and allowed to reach this temperature before installation. For further information, refer to current Installation Guide.
- .2 Maintain air temperature and structural base temperature at installation area between 65F (18C) and 80F (26C) for 48 hours before, during and 24 hours after installation.

1.10 WARRANTY

- .1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- .2 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
- .3 Warranty Period for Altro Whiterock shall be 20 years commencing on Date of Substantial Completion.

1.11 EXTRA MATERIAL

- .1 Provide extra materials of product and adhesives in accordance with Section 01780 - Closeout Submittals.
- .2 Provide approx. 200sf (6-4ft x 8ft sheets) of each colour, pattern and type material required for project for maintenance.
- .3 Provide approx. 4ft x 8ft sheets of extra materials in one piece and from same production run as installed materials.
- .4 Clearly identify each wall panel and each container of adhesive.
- .5 Deliver to Client, upon completion of the work of this section and store where directed.

2. Products

2.1 MANUFACTURERS

RIGID-SHEET VINYL WALL COVERING

- .1 Manufacturer: Altro
.1 USA: 80 Industrial Way, Wilmington, MA
01887 Toll-free: 800.377.5597 Fax: 978.694.0433
Email: support@altrofloors.com Web Site: www.altrofloors.com.

2.2 HYGIENIC WALL COVERINGS

- .1 Altro WhiterockTM is 100% pure vinyl, extruded, semi-rigid PVCu sheet. Altro Whiterock contains no plasticizers or fillers. Altro Whiterock is homogenous.
.2 Acceptable material: All material selected for project shall be a minimum of 3mm thick.

Altro WhiterockTM

(measurements and product weighs given below are approximate):

- .1 Standard White 3 / 4: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.2 Cream / Line 41: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.3 Champagne / Oyster: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.4 Praline / Fenland 219: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.5 Sage / Promenade 212: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.6 Lagoon / Flint: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.7 Snowdrift / Ice 44: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.8 Sapling / Seafoam 43: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.9 Jasmine / Cesco 53: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.10 Ghost / Echo 208: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.11 Platinum / Urban 210: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.12 Mocha / Fawn 206: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
.13 Mint 203: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).

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- .14 Ozone 211: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
- .15 Vibrance 213: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
- .16 Olea 218: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
- .17 Bergamot 220: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
- .18 Zandra 217: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
- .19 Viola 214: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).
- .20 Scarlett 221: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).

2.3 ACCESSORIES

- .1 Vinyl welding rod: Acceptable material:
 - .1 Altro weld rod - WSR01 White, WSR/** color
- .2 Joint Strips:
 - .1 1-Part Joint Strip – [G831/25 White] Length 98.5"
 - .2 1-Part Joint Strip – [G831/30 White] Length 118"
 - .3 2-Part Joint Strip – [A831/25 White] [A831/25/** color] Length 98.5"
 - .4 2-Part Joint Strip – [A831/30 White] [A831/30/** color] Length 118"
- .3 Cut-tile Transition Strips:
 - .1 1-Part Transition Strip - Transition Strip – [G832/25 White] Length 98.5"
 - .2 1-Part Joint Strip – [A832/25 White] [G831/30/** color] Length 98.5"
 - .3 2-Part Joint Strip – [C4 CAP White] Length 72"
- .4 Start and Edge Trim:
 - .1 1-Part Start and Edge Trim – [G833/25 White] Length 98.5"
 - .2 1-Part Start and Edge Trim – [G833/30 White] Length 118"
 - .3 2-Part Start and Edge Trim – [A833/25 White] [A833/25/** color] Length 98.5"
 - .4 2-Part Start and Edge Trim – [A833/30 White] [A833/30/** color] Length 118"
- .5 Stainless Steel Accessories:
 - .1 Stainless Steel Corner Protector – [A861/12 Brushed Steel]
 - Dimensions: 4' x 3" x 3"
 - .2 1-Part Stainless Steel Joint Strip – [A855 Brushed Steel] Length 7'
 - .3 Stainless Steel Capping – [A865 Brushed Steel] Length 8'
 - .4 18-Gauge Stainless Steel 304 Sheet – [W 123/20 Brushed Steel] 6'6" X3'3"
 - .5 18 Gauge Stainless Steel 304 Sheet – [W123/25 Brushed Steel] 8'2" X4'
- .6 Acrylic Adhesive: For dry, climate-controlled areas, use AltroFix W 157, a one-part, water-based, acrylic adhesive as recommended by manufacturer.

RIGID-SHEET VINYL WALL COVERING

- .7 Polyurethane Adhesive: The default adhesive for most installations, suitable for wet area, non-climate-controlled areas, and non-absorbent surfaces, use AltroFix W 39, a two-part resin-based polyurethane adhesive as recommended by manufacturer.
- .8 Caulking and Sanitary Sealant Sealant Compounds and Tools:
 - .1 Altro Sanitary Sealant Sealant – [A802 White, A803 Clear, A806/** color) 10.5 oz Tube.

2.4 SOURCE QUALITY

- .1 Source Quality: Obtain wall products from a single manufacturer.

3. Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog, installation instructions and product label instructions for installation.

3.2 EXAMINATION

- .1 Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 SUBSTRATE PREPARATION

- .1 Walls should be smooth and level. High points must be removed and low points filled with filler intended for the substrate and environmental conditions.
- .2 Wall tiles must be fixed firmly to the wall. As long as the tile edges do not protrude you do not have to skim grout joints.
- .3 Surfaces must be permanently dry and free from all substances that may contribute to adhesive bond failure.
- .4 Remove loose paint and conduct an adhesive bond test with paint.
- .5 Exterior walls must be adequately damp-proofed and insulated.
- .6 Dry wall substrates should be paint ready.

3.4 PREPARATION

- .1 All surfaces must be free from dust and cleaned prior to Altro Whiterock installation. The working environment must also be dust free. Failure to comply with these conditions will reduce the bond strength between the adhesive and substrate, and may cause the Altro Whiterock panels to debond.
- .2 Very absorbent / porous substrates (particularly plaster finishes and unprimed sheetrock) must have a proprietary sealer e.g. PVA primer or similar, applied to the surface a minimum of 12 hours prior to the installation.
- .3 All electrical switches, power points etc., should be in a first fix / installation state. All electrical equipment should only be moved or altered by a qualified electrician.

RIGID-SHEET VINYL WALL COVERING

- .4 All plumbing should have pipe-work removed to a first fix or installation state and “tails” left protruding from the substrate. Altro Whiterock panels can then be drilled and slid over the pipe tails. All holes should be drilled 1/8” (3mm) oversize to allow for expansion, then sealed with Altro Sanitary Sealant. Plumbing should always be done by a qualified plumber.
- .5 Hot pipes and steam pipes should be insulated and a 1/8” to 1/4” (3-6mm) expansion gap should be created when installing panels around these pipes, then sealed with Altro Sanitary Sealant.
- .6 All pipes, fixing bolts, etc. extending through the Altro Whiterock panels should have a minimum 1/8” (3mm) expansion gap and be sealed using Altro Sanitary Sealant.
- .7 If fitting to door frames, these must be in place prior to installation of Altro Whiterock.
- .8 Prior to installation, it is advisable to complete any painting which comes in contact with Altro Whiterock, as sealant used at junctions is non-paintable.
- .9 Panels should be stored flat and be pre-conditioned a minimum of 24 hours in ambient temperatures similar to the prevailing operational conditions.
- .10 The panels must be stored on a level flat surface off the ground (risk of condensation on the panels if stored on damp surfaces). Storage on uneven surfaces could cause the panels to distort prior to installation.
- .11 First, check the room using a 6’ (2 m) level to ensure all walls are flat, paying particular attention to the corners, window reveals, and door entrances. These need to be inspected to ensure they are free of any debris or irregularities, which could prevent the panels laying flat to the substrate after the adhesive has been applied and the panel installed.

3.5 INSTALLATION

- .1 Hygienic Wall Installation: Install Altro Whiterock in accordance with the current published Altro Installation Guide. All joints should be joined by approved methods as detailed in the installation guide. Failure to install Altro Whiterock in accordance with recommended procedures will void the Altro Limited Product Warranty.

3.6 FIELD QUALITY REQUIREMENTS

- .1 Manufacturer’s Field Services: Upon Owner’s request, provide manufacturer’s field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer’s instructions.
 - .1 Site Visits: Suggest five and duration of periodic site visits; Mock-Up, three during construction (review each floor level) and Final.

3.7 CLEANING

- .1 Altro Whiterock can be cleaned with a diluted soap/detergent solution, such as Altro 44 Cleaner.
- .2 When cleaning the Altro Whiterock surface, we recommend the temperature of water does not exceed 140° F (60° C).

RIGID-SHEET VINYL WALL COVERING

- .3 Pressure cleaning with hot water may be used with the pressure nozzle a minimum of 2 feet (600mm) away from the surface.
- .4 To reduce the buildup of static, cleaning the panels with an anti-static solution is recommended.
- .5 Stubborn stains use AltroClean 44 cleaner or equivalent alkaline cleaner.

3.8 PROTECTION

- .1 Replace Do not install near open heat sources (ovens, etc). Stainless steel panels should be used in such areas.

END OF SECTION

PAINTING AND FINISHING – GENERAL REQUIREMENTS

Part 1 General

1.1 INTENT

- .1 This Section specifies general requirements for all painting and finishing work to be performed on site.

REFERENCE DOCUMENTS

- .2 Canadian General Standards Board ([CGSB](#)):
- .1 CGSB 1-GP-71 Set of 3 Standards 2003 - Methods of Testing Paints and Pigments - Set includes 1-GP-71 No. 5-96, 1-GP-71 No. 38-96 and 1-GP-71 No. 73-96
- .3 Green Seal ([GS](#)):
- .1 Green Seal Standards GS-11 - Paints, First Edition, May 20, 1993
- .2 Green Seal Standard GC-03 - Anti-Corrosive Paints, Second Edition, January 7, 1997
- .4 Master Painters Institute ([MPI](#)):
- .1 The painting and finishing specifications for new, not previously painted or finished, substrates are based on and make reference to the "Architectural Painting Specification Manual", November 2007 issue, including the latest edition of the "Approved Products Lists", published by the Master Painters Institute (MPI).
- .2 The painting and finishing specifications for previously painted or finished substrates are based on and make reference to the "Maintenance Repainting Manual", August 2004 edition, including the latest edition of the "Approved Products Lists", published by the Master Painters Institute (MPI).
- .3 The reference documents are available from:

Master Painters Institute (HQ)	OR	Alberta Painting Contractors Association
4090 Graveley St. Burnaby, BC V5C 3T6 tel: 888-674-8937 toll free fax: 888-211-8708 toll free www.paintinfo.com		2725 - 12th Street N.E. Calgary, AB T2E 7J2 Tel: 403-250-0903 Fax: 403-291-9562

- .5 South Coast Air Quality Management District ([SCAQMD](#)), California State
- .1 SCAQMD Rule 1113, January 2004 - Architectural Coatings

1.2 SUBMITTALS

- .1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheets.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Leave on premises not less than 4 litres of new material of each colour and finish sheen used.
 - .2 Provide maintenance materials in new containers, full, tightly sealed and clearly labelled. Remnants of used materials are not acceptable.

1.4 QUALITY ASSURANCE

- .1 Installation:
 - .1 The following requirements establish the standard of acceptance for the Work, when viewed using the final lighting source.
 - .1 Vertical surfaces: No defects visible from a distance of 1 metre at 90 degrees to surface.
 - .2 Horizontal surfaces: No defects visible from a distance of 1 metre at 45 degrees to surface.
 - .3 Ceilings: No defects visible from floor at 45 degrees to surface.
 - .4 Final coat shall exhibit uniformity of sheen across full surface area.
 - .2 Defects include brush marks, streaks, runs, laps, drips, heavy stippling, pile up of paints, roller tracking, inadequate hiding of substrate, skipped or missed areas, and foreign materials in paint.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials in sealed original labelled containers bearing manufacturer's name, type of material, brand name, colour designation, and where applicable, instructions for mixing and reducing.
- .2 Storage and Handling Requirements:
 - .1 Store paint and other materials in a single heated and well-ventilated area with a minimum ambient temperature of 7°C.
 - .2 Take precautionary measures to prevent fire hazards or spontaneous combustion.

1.6 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Interior Conditions:
 - .1 Temperature: Maintain temperature at minimum 10°C for at least 24 hours before and during application and until coatings have cured.
 - .2 Ventilation: Adequately ventilate areas where coatings are being applied and maintain a reasonably dust free atmosphere.
 - .3 Lighting: Maintain bright and uniform levels of lighting in areas where coatings are being applied.
 - .2 Exterior Conditions:
 - .1 Temperature: Apply coatings only when temperature is above 10°C.
 - .2 Precipitation: Do not apply coatings during periods of precipitation nor when precipitation is imminent.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .3 Wind: Do not apply coatings under high wind conditions resulting in wind blown dust and debris.

Part 2 Products

2.1 MATERIALS

- .1 Refer to Schedule Sections for required finishing systems.
- .2 Use only MPI approved products from the MPI Approved Product Lists corresponding to the specified finishing systems.
- .3 Where the MPI Approved Products List identifies products for a given product type meet GPS-01-08 or GPS-02-08, designated by E1, E2 or E3, select products as follows:
- .1 Use a product with either an E2 or E3 designation, where available.
- .2 Where a product with an E2 or E3 designation is not available, use a product with a E1 designation.
- .4 Thinners: Odorless paint thinner, pure and clean with no deleterious material.
- .5 Patching compounds: Spackling compound or oil base putty for substrates receiving a paint finish. Oil base putty, coloured to match finish, for substrates receiving a transparent finish.

2.2 MIXING

- .1 Except as otherwise specified, paint shall be ready mixed. Re-mix prior to application to ensure colour and gloss uniformity. Materials in paste or powder form, or to be field catalyzed, shall be field mixed in accordance with manufacturer's directions. Perform colour tinting operations prior to delivery to site.
- .2 Thinning of materials to extent permitted by paint manufacturer will be permitted only where specified herein. Do not use solvent for thinning.
- .3 Strain materials thoroughly prior to application.
- .4 Accent colours and deep tints shall have factory added colour pigments wherever possible.

2.3 COLOURS

- .1 Colour Scheme: For bidding purposes, colour scheme will be generally as follows:
- .1 Maximum 4 field colours and 2 accent colours for interior.
- .2 Generally, no more than 2 colours to be used in any one area.
- .3 Allow approximately 30 % of interior painted surfaces for deep colour tones.

2.4 GLOSS LEVELS

- .1 Specified gloss levels are based on the MPI standard, which is as follows:
- .1 Level G1 – Matte or Flat: gloss rating of 0 to 5 units at 60 degrees and sheen rating of a maximum of 10 units at 85 degrees.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .2 Level G2 - Velvet: gloss rating of 0 to 10 units at 60 degrees and a sheen rating of 10 to 35 units at 85 degrees.
- .3 Level G3 - Eggshell: gloss rating of 10 to 25 units at 60 degrees and a sheen rating of 10 to 35 units at 85 degrees.
- .4 Level G4 - Satin: gloss rating of 20 to 35 units at 60 degrees and a sheen rating of 35 units minimum at 85 degrees.
- .5 Level G5 - Semi-gloss: gloss rating of 35 to 70 units at 60 degrees.
- .6 Level G6 - Gloss: gloss rating of 70 to 85 units at 60 degrees.
- .7 Level G7 – High-gloss: gloss rating of more than 85 units at 60 degrees.
- .2 Gloss levels for individual finishing systems are specified in specific painting Section 09 91 13 and 09 91 23.

Part 3 Execution

3.1 VERIFICATION OF CONDITIONS

- .1 Ensure all dust generating activities have been terminated and dust removed.
- .2 Prior to commencement of painting and finishing work, thoroughly examine substrates scheduled to receive coatings.
- .3 Do not apply coatings to substrates whose condition will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work specified herein.
- .4 Ensure that site applied paints and finishes are compatible with primers or other finishes applied in the shop or factory.
- .5 Verify compatibility of any previously applied coatings with specified coatings.
- .6 Notify Consultant of any incompatibilities.

3.2 PROTECTION OF EXISTING SURFACES

- .1 Protect adjacent surfaces from spray, splashings, and droppings.
- .2 Remove electrical plates, surface hardware, fittings and fastenings prior to painting and finishing operations. Carefully store and replace these items on completion of work in each area.
- .3 Keep sprinkler heads and smoke detectors free of paint. Replace those that do receive paint.

3.3 CONDITION OF SUBSTRATES

- .1 Substrates shall be sound, non dusting, and free of grease, oil, dirt and other matter detrimental to adhesion and appearance of coatings.
- .2 Temperature: minimum 8°C.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .3 Test moisture content using electronic moisture meter. Maximum moisture content as follows:
 - .1 Plaster and wallboard: 12%
 - .2 Concrete: 12%
 - .3 Concrete block and brick: 12%
 - .4 Wood: 15%
- .4 Alkalinity: test cementitious substrates for alkalinity using litmus paper test. If greater than 7, refer to manufacturer's requirements.

3.4 PREPARATION OF NEW/UNFINISHED SUBSTRATES

- .1 Prepare substrates in accordance with requirements of the MPI Manual, Chapter 2 and 3, Section 3-Surface Preparation, and as specified herein.
- .2 All Substrates: thoroughly broom, vacuum and wipe clean as required to produce acceptable surface. Sand lightly and dust prior to application of each coat. Use recommended type and grade of sandpaper to avoid scratching or gouging of surfaces.
- .3 Wood Generally: clean soiled surfaces, sand smooth and dust. Fill nail holes, splits, scratches, small joints and other minor imperfections with patching compound after paint prime coat or first varnish coat has been applied and dried. Apply putty with putty knife, press firmly in place, and finish flush with surface.
- .4 Wood for Paint Finish: clean knots, pitch streaks, and sappy sections of residue and seal such areas with shellac or knot sealer before applying prime coat.
- .5 Wood for Transparent Finish: clean knots, pitch streaks, and sappy sections of residue and seal with sanding sealer or shellac after applying stain, if stain is required. Sand between coats using minimum #400 grit wet and dry sandpaper.
- .6 Bare Ferrous Metal: Prepare in accordance with MPI 5.1 requirements for the system specified.
- .7 Previously Primed Metal: remove loose shop primer and rust; make good shop coat, feather out edges of touch up.
- .8 Zinc Coated Metal: Prepare in accordance with MPI 5.3 requirements for the system specified.
- .9 Unit Masonry and Concrete: fill minor cracks, holes and fissures with cement grout and smooth to a flush surface. Include bonding agent in cement grout mix.
- .10 Gypsum Board and Plaster: fill minor cracks, holes, and imperfections with tinted patching compound after prime coat has been applied and dried. Allow patching compound to dry, sand smooth and remove dust. Use minimum #150 grit sandpaper.
- .11 Alkaline Surfaces: wash and neutralize using recommended type of solution compatible with paint to be used.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

3.5 APPLICATION OF COATINGS, GENERALLY

- .1 Applied and cured coatings shall be uniform in thickness, sheen, colour, and texture and be free of defects detrimental to appearance and performance. Edges of paint adjoining other materials shall be clean and sharp with no overlapping.
- .2 Use rollers that will produce the least possible stipple effect; maximum 10 mm pile for smooth substrates. Heavier pile rollers may be permitted for use on rough substrates, subject to Consultant's approval.
- .3 Back roll airless spray application.
- .4 Use a single manufacturer's products for all coats required for each finish system.
- .5 Vary slightly the colour of successive coats to visibly differentiate between coats.
- .6 Allow each coat to dry hard before succeeding coats are applied with a minimum of 24 hours between coats, except where manufacturer's instructions state otherwise.
- .7 For woodwork to receive a stain finish, apply paste wood filler to open grain wood followed by uniform coats of stain and wipe off if required. Wood shall have a uniform shade. Match stain so that dissimilar woods have uniform finished appearance.
- .8 For open grain woods to receive a clear finish, tint paste wood filler to match wood. Work filler well into grain and before it sets, wipe off excess to provide a clean surface.

3.6 FINISHING OF NEW/UNFINISHED SUBSTRATES

- .1 Site paint or finish all work and substrates indicated as requiring site painting or finishing in Schedules, Drawings, or Specifications.
- .2 Site apply all prime and finish coats as scheduled, whether or not factory prime coats have been applied.

3.7 BACK PRIMING INTERIOR WOOD

- .1 Except for architectural woodwork having factory applied finishes as specified in Section 06 40 00, back prime following concealed surfaces of interior wood components, prior to their installation:
 - .1 Surfaces in contact with concrete or masonry.
 - .2 Surfaces in contact with any floors or floor finishes.
 - .3 Cut outs for sinks, drains and other mechanical services.
 - .4 Underside of front edges of countertops and toe spaces.
 - .5 Other surfaces which may be subjected to moisture during normal use or cleaning operations.
 - .6 Backboards for mechanical and electrical equipment.
- .2 Use white alkyd wood primer for components scheduled to receive paint finish.
- .3 Use semi transparent stain for components scheduled to receive solid or semi transparent stain finish.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .4 Use gloss varnish, reduced 25% with thinner, for components scheduled to receive varnish finish.

3.8 FINISHING NEW/UNFINISHED DOORS AND FRAMES

- .1 Finish edges of doors in accordance with specified finish system. For top and bottom edges, final coat may be omitted.
- .2 Finish wood doors after doors have been hung and adjusted. Refinish tops, bottoms and edges after fitting.
- .3 Apply finishes specified for exterior doors to both door faces and edges.

3.9 FINISHING MISCELLANEOUS SUBSTRATES

- .1 Paint substrates behind surface mounted fixtures, wall mounted heating units and unbacked cabinet work with specified finish systems, including specified number of coats.
- .2 Finish shelving tops, bottoms and edges with specified finish systems, including specified number of coats.

3.10 PATCHING OF COMPLETED WORK

- .1 Repair, touch up, and refinish damaged finishes and finishes unsatisfactory to Minister.
- .2 Refinish entire wall or area where deemed necessary by Consultant.

3.11 CLEANING

- .1 Place cotton waste, cloths and other material that may constitute a fire hazard in metal containers and remove from site daily.

END OF SECTION

EXTERIOR PAINTING AND FINISHING SCHEDULE

Part 1 General

1.1 INTENT

- .1 Read this Section in conjunction with Section 09 91 05 - Painting and Finishing General Requirements.

Part 2 Products

Not used.

Part 3 Execution

3.1 EXTERIOR PAINTING AND FINISHING SCHEDULE

- .1 The following code numbers, finishing system descriptions, gloss levels, coats and product descriptions are derived from the MPI Architectural Painting Specification Manual and the MPI Approved Products List.

Ext. 5.3 – Galvanized Metal (Metal Doors and Frames)			
EXT 5.3B	Alkyd	1 st	Cementitious Primer
	Gloss Level G5	2 nd	Alkyd
		3 rd	Alkyd

END OF SECTION

INTERIOR PAINTING AND FINISHING SCHEDULE

Part 1 General

1.1 INTENT

- .1 Read this Section in conjunction with Section 09 91 05 Painting and Finishing General Requirements.

Part 2 Products

Not used.

Part 3 Execution

3.1 INTERIOR PAINTING AND FINISHING SCHEDULE

- .1 The following code numbers, finishing system descriptions, gloss levels, coats and product descriptions are derived from the MPI Architectural Painting Specification Manual and the MPI Approved Products List.
- .2 Gloss Levels:
- .1 G1 – a traditional matte finish
- .2 G2 – a high side sheen flat - a 'velvet-like' finish
- .3 G3 – a traditional 'egg-shell-like' finish
- .4 G4 – a 'satin-like' finish
- .5 G5 – a traditional semi-gloss
- .6 G6 – a traditional gloss
- .7 G7 – a high gloss

Int 3.2 – Concrete Horizontal Surfaces			
Int 3.2C	Epoxy	1 st	Epoxy
	Sikafloor 261	2 nd	Epoxy
		3 rd	Epoxy

Int 3.2 – Concrete Curbs Vertical Surfaces (184mm high)			
Int 3.2C	Epoxy	1 st	Epoxy
	Sika Duroplast-100N	2 nd	Epoxy
		3 rd	Epoxy

Int 5.3 – Galvanized Metal (not chrome passivated) (Interior Doors and Frames)			
Int 5.3C	Alkyd	1 st	Cementitious Primer
	Gloss level G5	2 nd	Alkyd
		3 rd	Alkyd

INTERIOR PAINTING AND FINISHING SCHEDULE

RIN 9.2 – PLASTER AND GYPSUM BOARD

RIN 9.2A	Latex Gloss level G6	1 st	Primer
		2 nd	Latex
		3 rd	Latex

END OF SECTION

DIVISION 10 – SPECIALTIES

WASHROOM ACCESSORIES

1. General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract and all Sections of Divisions 00 and 01, shall form an integral part of the requirements of this Section.
- .2 All addenda or corrections issued during the time of the bidding process shall also become part of the contract documents, and shall be covered in the Trade Contractor's bid.
- .3 Cooperate and coordinate with the requirements of other Trade Contractors specified in other Sections.

1.2 SECTION INCLUDES

- .1 Washroom accessories.

1.3 REFERENCES

- .1 All Standards listed below are to be the most current edition at the time of tender regardless of any older dates that may be listed herein unless specifically noted otherwise. Withdrawn or obsolete standards may still apply unless it has been replaced with a different Standard in which case the new Standard shall apply. Report any withdrawn Standards to the Consultant for instructions.
- .2 CAN/CSA-B651 -07(R2017): Accessible Design for Self-Service Interactive Devices
- .3 CAN3-A172-M79 (R1996): High pressure, paper base, decorative laminates.
- .4 ASTM A123/A123M -17: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .5 ASTM A269/A269M -15a(2019): Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- .6 ASTM A480/480M -20a: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .7 ASTM A1008/A1008M -21: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- .8 ASTM B456 -17: Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
- .9 ASTM F446 -19: Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area
- .10 ANSI/NEMA LD 3 -2005: High-Pressure Decorative Laminates (HPDL)

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and/or catalogue illustration in accordance with Section 01 33 23.
- .2 Clearly indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in frame.

WASHROOM ACCESSORIES

- .3 Indicate mounting heights and locations.

1.4 DELIVERY, STORAGE, & HANDLING

- .1 Deliver materials to the job site in their original packages. Maintain in an undamaged condition, with the manufacturer's seals and labels intact. Keep all items in locked storage until ready for use.

1.5 SAMPLES

- .1 If requested, submit samples of components for review.

2. Products

2.1 MATERIALS

- .1 Provide cut sheets of all products to the Consultant for approval prior to ordering.
- .2 Provide exposed surfaces of washroom accessories, except as noted, with No. 304 satin stainless steel finish.
- .3 Provide units of manufacturer's best quality standards with smooth edges and uniform neat finish.
- .4 Do not display graphic symbols on units.
- .5 Galvanize all ferrous metal components.
- .6 Weld fabricated components and grind smooth. Minimize exposed locations.
- .7 Form exposed surfaces from one sheet of stock, free of joints.
- .8 Brake form sheet metal work with 2 mm radius bends.
- .9 Form all surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .10 Back paint all components where contact is made with building finishes to prevent electrolysis.

2.2 SCHEDULE OF ACCESSORIES

- .1 Toilet paper dispenser: Stainless steel, Frost 165 multi-roll toilet tissue or similar approved.
- .2 Paper Towel dispenser: Stainless steel, Frost 165 multi-roll toilet tissue or similar approved.
- .3 Soap dispenser: Stainless steel, Frost 714-S Automatic soap dispenser or similar approved.
- .4 Wall mirror: Stainless face mirror, Frost 941-2436 SS 24" x 36" framed mirror or similar approved. Surface mounted.
- .5 Coat Hook: Frost 1150 Safety Coat Hook Stainless Steel

3. Execution

3.1 EXAMINATION & PREPARATION

WASHROOM ACCESSORIES

- .1 Verify exact location of accessories for installation.
- .2 Deliver inserts and rough-in frames to site. Provide templates and rough-in measurements as required.

3.2 INSTALLATION

- .1 Install accessories in accordance with the manufacturer's instructions.
- .2 Rigidly anchor items in a substantial manner straight and plumb, with horizontal lines level, in accordance with manufacturer's recommendations. Use tamperproof fasteners where exposed.
- .3 Install and secure accessories rigidly in place as follows:
 - .1 Stud Walls: install steel back plate to stud prior to drywall finish. Provide plate with threaded studs or plugs.
 - .2 Concrete and masonry walls: drill holes and insert wall plugs with screws.
- .4 Provide stainless steel exposed fasteners. Provide stainless steel or non-corrosive concealed fasteners.
- .5 Conceal evidence of drilling, cutting and fitting, in the finished work.
- .6 Provide clean finished surfaces free of imperfections.

END OF SECTION

DIVISION 22 – PLUMBING

FIRE PROTECTION SPECIALTIES

Part 1 General

1.1 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA):
 - .1 NFPA 10-2022, Standard for Portable Fire Extinguishers
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S504-12, Standard for Dry Chemical Fire Extinguishers
 - .2 CAN/ULC-S508-02, Standard for the Rating and Fire Testing of Fire Extinguishers
 - .3 CAN/ULC-S532-2014, Standard for the Regulation of the Servicing of Portable Fire Extinguishers

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate wall framing and wall depth to accommodate recessed and semi-recessed extinguisher cabinets with Division 09 – Non-Structural Framing.
- .2 Pre-Installation Meetings: Hold a meeting in accordance with Section 01 31 19 – Project Meetings with Contractor, impacted Subcontractors, and Consultant to discuss locations and exact mounting heights of extinguisher cabinets.
- .3 Sequencing: Install identification labels, decals, and lettering on site-painted extinguisher cabinets after painting is complete and completely dry.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's product literature and data sheets. Include product characteristics, performance criteria, listed temperature range, dimensions, colours, finishes, and limitations.
 - .1 Portable fire extinguishers: Indicate capacity.
 - .2 Extinguisher Cabinets in Fire-Resistance Rated Walls: Indicate listing by organization acceptable to the authority having jurisdiction (AHJ).
- .3 Shop Drawings: Submit schedule of portable fire extinguisher types, extinguisher cabinet types, finishes, accessories, and dimension from finished floor to top of portable fire extinguisher for each room/area.
- .4 Manufacturers' Instructions: Submit manufacturer's installation instructions, special handling criteria, and recommendations for owner's regular inspection and testing of portable fire extinguishers.
- .5 Qualification Statements: Submit evidence of installer's qualifications.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals, and as follows:
 - .1 Operation and Maintenance Data: Submit portable fire extinguisher

FIRE PROTECTION SPECIALTIES

manufacturer's instruction manual describing installation, operation, inspection, and maintenance; refill or recharge schedules; and re-certification requirements.

- .2 Submit a permanent file record in accordance with NFPA 10 for each portable fire extinguisher with the following information:
 - .1 Maintenance date and name of person and agency performing the maintenance, if applicable.
 - .2 Date of the last recharge and name of person and agency performing the recharge, if applicable.
 - .3 Hydrostatic retest date and name of person and agency performing the hydrostatic test, if applicable.
 - .4 Description of dents remaining after passing of the hydrostatic test, if applicable.

- .2 Warranty Documentation: Submit manufacturer's warranties.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers: Provide all extinguisher cabinets of the same type from a single manufacturer.
 - .2 Installer: Holding an approval certificate of training from a public post-secondary educational institution, and employed by an agency that is certified annually by a recognized certification body as being compliant with CAN/ULC-S532.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements, and as follows:
 - .1 Package and handle extinguisher cabinets to avoid scratching paint and glazed materials. Store extinguisher cabinets to avoid corrosion and portable fire extinguishers to avoid freezing.
 - .2 Maintain portable fire extinguishers in operating condition.

1.7 SITE CONDITIONS

- .1 Ambient Conditions: Install portable fire extinguishers after indoor temperatures are maintained within manufacturer's recommended range.

1.8 WARRANTY

- .1 Manufacturer's Warranty: Warranty portable fire extinguishers against defects in materials and fabrication for three years.

Part 2 Products

2.1 DESCRIPTION

- .1 Regulatory Requirements: Provide portable fire extinguishers that are listed and labelled in accordance with National Fire Code 2020, and conform to CAN/ULC-S508.
- .2 Portable fire extinguishers and extinguisher cabinets marked in accordance with recommendations of NFPA 10 and CAN/ULC-S508 including the following:

FIRE PROTECTION SPECIALTIES

- .1 Listing and labeling organization of extinguisher.
- .2 Protect category, type of extinguisher.
- .3 Extinguisher classification.
- .4 Performance and fire test standards of extinguisher.

2.2 PORTABLE FIRE EXTINGUISHERS

- .1 Multi-Purpose Dry Chemical Extinguishers: To CAN/ULC-S504, stored pressure rechargeable type with hose and shut-off nozzle, aluminum valve, ULC listed.
 - .1 ULC Classification: Class A, B, and C fires.
 - .2 Capacity: As indicated on Drawings.
 - .3 Cylinder Finish: Polyester powder coat paint, red colour.

2.3 ACCESSORIES

- .1 Extinguisher Hangers: To NFPA 10, factory fabricated, type recommended by extinguisher manufacturer, steel with polyester powder coat paint or stainless steel.
- .2 Key all lockable extinguisher cabinets the same.

2.4 IDENTIFICATION

- .1 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for future service dates on tag/label. A bar coding system may be used if acceptable to AHJ and Owner.

Part 3 Execution

3.1 INSTALLATION

- .1 Install extinguisher hangers plumb, level, and in accordance with NFPA 10.
- .2 Mount portable fire extinguisher hangers at heights such that the top of the cabinet or bracket is 1.5m above the floor, at locations indicated on Drawings and in accordance with NFPA 10.
 - .1 Place portable fire extinguisher with operating instruction label facing outward. Do not obstruct the view of the operating instructions label with maintenance labels, test labels, or other labels.

END OF SECTION

COMMON WORK RESULTS FOR PLUMBING

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 09 - Interior Painting
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 REFERENCE STANDARDS

- .1 ANSI/ASME B31.1-2022 Power Piping

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Alberta Canada.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.

COMMON WORK RESULTS FOR PLUMBING

- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit a copy of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5

MAINTENANCE MATERIAL SUBMITTALS

COMMON WORK RESULTS FOR PLUMBING

- .1 Submit in accordance with Section Division 01 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in a dry location and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant 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 Consultant.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Division 01 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

COMMON WORK RESULTS FOR PLUMBING

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section Division 01 - Quality Control and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Domestic Cold Water.
 - .2 Domestic Hot Water.
 - .3 Sanitary Drainage.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Consultant will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section Division 01 - Cleaning.

3.7 PROTECTION

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

COMMON WORK RESULTS FOR PLUMBING

END OF SECTION

PLUMBING SPECIALTIES AND ACCESSORIES

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A126-04(2019), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 CSA Group (CSA)
 - .1 CSA-B64 Series-21, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08, Commercial and Residential Drains and Cleanouts.
- .3 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
- .4 Plumbing and Drainage Institute (PDI)
 - .1 PDI-WH201-R2010, Water Hammer Arresters Standard.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning on-site installation, with contractor's representative and Consultant in accordance with Division 01 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit a copy of WHMIS SDS in accordance with Division 01 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.

PLUMBING SPECIALTIES AND ACCESSORIES

- .2 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details, and accessories.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Sustainable Design Submittals:

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in a dry location, and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.
 - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to CSA B79
- .2 General duty; cast iron body as indicated, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar.

2.2 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

PLUMBING SPECIALTIES AND ACCESSORIES

- .2 Access Covers:
 - .1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze round, gasket, vandal-proof screws.

2.3 WATER HAMMER ARRESTORS

- .1 Copper construction, bellows or piston type: to PDI-WH201.

2.4 BACK FLOW PREVENTERS

- .1 Preventers: to CSA-B64 Series, application as indicated, reduced pressure principle type, double check valve assembly, back flow preventer with intermediate atmospheric vent or vacuum breaker.

2.5 VACUUM BREAKERS

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

2.6 INTERIOR HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.7 TRAP SEAL PRIMERS

- .1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

2.8 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant 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 Consultant.

PLUMBING SPECIALTIES AND ACCESSORIES

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada (NPC), provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures.

3.6 BACK FLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code
 - .1 Drains.
 - .2 Backwater Valves.
- .2 Pipe discharge to terminate over nearest drain.

3.7 BACKWATER VALVES

- .1 Install where indicated.
- .2 Install in access pit as indicated.

3.8 INTERIOR HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

- .1 Install mechanical trap seals for running traps.
- .2 Install trap primers on cold water supply lines where indicated, to approval of Consultant.
 - .1 Install plastic tubing to floor drain.

3.10 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.
- .2 Pipe discharge from relief valve to nearest floor drain.

PLUMBING SPECIALTIES AND ACCESSORIES

3.11 START-UP

- .1 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.

3.12 TESTING AND ADJUSTING

- .1 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .2 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .3 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
- .5 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
- .6 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .7 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.

PLUMBING SPECIALTIES AND ACCESSORIES

- .8 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.

- .9 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.

- .10 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.

3.13 CLOSEOUT ACTIVITIES

- .1 Commissioning Reports: in accordance with Division 01 - General Commissioning Requirements: reports, supplemented as specified.
- .2 Training: provide training in accordance with Division 01 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.

3.14 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01 - Cleaning.

3.15 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

PLUMBING PIPING INSULATION

Part 1 General

1.1 SUMMARY

- .1 Thermal insulation for plumbing piping and piping accessories.

1.2 RELATED REQUIREMENTS

- .1 Division 09 – Joint Sealants
- .2 Section 22 05 00 – Common Work Results for Plumbing

1.3 DEFINITIONS

- .1 For the purposes of this Section:
 - .1 Concealed means insulated mechanical services in suspended ceilings, or in non-accessible chases, or in furred-in spaces.
 - .2 Exposed means not concealed.
 - .3 Jacketing is synonymous with insulation cladding and lagging.
 - .4 Mineral fibre is synonymous with glass fibre, rock wool, or slag wool.

1.4 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES 90.1-2022, Energy Standard for Buildings Except Low-Rise Residential Buildings
- .2 ASTM International (ASTM):
 - .1 ASTM C335/C335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
 - .2 ASTM C449/C449M-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .3 ASTM C547-22a, Standard Specification for Mineral Fiber Pipe Insulation
 - .4 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
- .3 ULC Standards (ULC):
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications, and datasheets. Include product characteristics, performance criteria, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS).
- .3 Shop Drawings:

PLUMBING PIPING INSULATION

- .1 Submit a schedule with a list of insulation for each service location, insulation type, thickness, and jacketing type.
- .4 Samples:
 - .1 When requested, submit small samples of jacketing showing the full range of manufacturer's colours for Consultant's initial selection.
 - .2 When requested, submit for review a complete assembly of each type of insulation system, coating, and adhesive. Mount sample on a 12-mm plywood board. Affix label beneath each sample indicating service.
- .5 Certificates: When requested, submit manufacturer's certificates certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturers' Instructions: Submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section with at least three years successful experience in this type and size of project.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Division 01 - Common Product Requirements.
- .2 Protect insulation, canvas, and other moisture-sensitive materials from moisture.

Part 2 Products

2.1 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Combustible piping materials, including adhesives in accordance with CAN/ULC-S102:
 - .1 Flame-spread rating: Maximum 25.
 - .2 Smoke developed classification: Maximum 50.

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
- .2 Type 1: Rigid moulded mineral fibre with factory-applied vapour retarder jacketing.
 - .1 Mineral fibre: To ASTM C547.
 - .2 Maximum "k" factor: 0.035 W/m×°C.
 - .3 Service Temperature: up to 150°C.
- .3 Type 2: Glass mineral wool with factory-applied vapour retarder jacketing.
 - .1 Mineral fibre: To ASTM C547.
 - .2 Maximum "k" factor: 0.035 W/m×°C.
 - .3 Service Temperature: -40°C to 100°C.

PLUMBING PIPING INSULATION

2.3 JACKETING

- .1 Polyvinyl Chloride (PVC) Jacketing:
 - .1 One-piece moulded type, in accordance with ASTM C921, with pre-formed shapes as required.
 - .2 Colours: As selected by Consultant from manufacturer's standard colour range.
 - .3 Minimum service temperature: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: Maximum 0.02 perm.
 - .6 Thickness: 0.38 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Pressure sensitive vinyl tape in matching colour.
 - .8 Covering adhesive: Compatible with insulation.
- .2 Canvas Jacketing: 220 g/m² cotton, plain weave, and treated with diluted fire retardant.
 - .1 Lagging adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Weatherproof Sealant for Jackets Installed Outdoors: In accordance with Division 07 - Joint Sealants.
- .2 Tape: Self-adhesive, aluminum, plain, minimum 50 mm wide.
- .3 Contact Adhesive: Quick setting type.
- .4 Canvas Adhesive: Washable.
- .5 Tie Wire: Stainless steel, minimum 1.5 mm diameter.
- .6 Bands: Stainless steel, 19 mm wide, minimum 0.5 mm thick.
- .7 Thermal Insulating and Finishing Cement: To ASTM C449, air drying type, on mineral wool.
- .8 Vapour Retarder Lap Adhesive: Water-based and fire retardant type, compatible with insulation.
- .9 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that pressure testing of piping systems and adjacent equipment is complete, witnessed, and certified.
- .2 Verify that surfaces are clean, dry, and free from foreign material.

3.2 INSTALLATION

- .1 Install to manufacturer's instructions and in accordance with MICA, NACIIS Manual.

PLUMBING PIPING INSULATION

- .2 Provide two layers of insulation with staggered joints when required nominal wall thickness exceeds 75 mm.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .4 Supports and Hangers:
 - .1 Hangers and supports in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - .2 Install hangars and supports outside vapour retarder jacket.
 - .3 Apply high compressive strength insulation that is suitable for piping service at oversized saddles and shoes where insulation saddles have not been provided.
- .5 Insulate 3 m portion of sanitary vents measured from roof outlet back.

3.3 INSTALLATION - REMOVABLE PRE-FABRICATED INSULATION AND ENCLOSURES

- .1 At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.
 - .1 Install components to permit movement of expansion joints and to permit periodic removal and replacement without damage to adjacent insulation.
 - .2 Install insulation, fastenings, and finishes that are compatible with piping system.
 - .3 Install PVC insulation jacketing.

3.4 PIPING INSULATION SCHEDULE

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings, unless otherwise specified.
- .2 Type 1:
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: Vapour retarder lap seal adhesive, vapour retarder lagging adhesive.
- .3 Type 2:
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: Vapour retarder lap seal adhesive, vapour retarder lagging adhesive.
- .4 Provide insulation thickness as listed in the following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.
 - .3 Insulation thickness (mm):

Application	Piping Insulation Type	Run-out	Pipe sizes (NPS) to 1	Pipe sizes (NPS) 1 1/4 to 2	Pipe sizes (NPS) 2 1/2 to 4	Pipe sizes (NPS) 5 to 6	Pipe sizes (NPS) 8 & over
Domestic Hot Water and Recirculation	Type 1	25 mm	25 mm	38 mm	38 mm	38 mm	38 mm
Domestic Cold Water	Type 2	12 mm	25 mm	25 mm	25 mm	25 mm	25 mm

PLUMBING PIPING INSULATION

Sanitary Vents	Type 2	25 mm	25 mm	25 mm	25 mm	25 mm	25 mm
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- .5 Finishes:
 - .1 Exposed indoors: Canvas.
 - .2 Concealed, indoors: Canvas on valves, fittings. No additional finish.
 - .3 Exterior: PVC.
 - .4 Wet Areas: PVC.

3.5 SITE QUALITY CONTROL

- .1 Non-Conforming Work: Replace insulation where there is damage to the vapour barrier and insulation is saturated with moisture.

END OF SECTION

PLUMBING PUMPS

Part 1 General

1.1 SUMMARY

- .1 Section Includes: Materials and installation for plumbing pumps.

1.2 RELATED REQUIREMENTS

- .1 Section 22 11 16 - Domestic Water Piping

1.3 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting: Convene pre-installation meeting one week prior to beginning on-site installations in accordance with Division 01 - Project Meetings.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop Drawings: Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or site assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Site Reports: manufacturers' site reports specified.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and engineering data for incorporation into manual specified in Division - Closeout Submittals, include:
 - .1 Manufacturers name, type, model year, capacity and serial number.

PLUMBING PUMPS

- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list with names and addresses.

1.7 QUALITY ASSURANCE

- .1 Health and Safety: Do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

Part 2 Products

2.1 MATERIALS

- .1 Materials and resources in accordance with Division 01 - Sustainable Requirements: Construction.

2.2 DOMESTIC WATER BOOSTER SYSTEM

- .1 Packaged system, factory assembled, tested and adjusted, ready for site piping and electrical connections.
- .2 Total Capacity:
 - .1 Flow rate: 1.26 L/s.
 - .2 System pressure: 5.98 kPa.
 - .3 Available pressure at metre outlet: 275.79 kPa.
- .3 Construction: horizontal, end suction, closed coupled centrifugal, cast-iron casing, bronze impeller, stainless steel shaft sleeve, mechanical shaft seal.
- .4 Valves: to Section 22 11 16 - Domestic Water Piping. Suction and discharge gate or butterfly valves and pressure reducing and check valve for each pump connected to common suction and discharge headers.
- .5 Motor: 1119 W, 1.5 hp
- .6 Supports: install complete package on structural housekeeping pad.
- .7 Anchor Bolts and Templates:
 - .1 Supply for installation.
- .8 Control Panel: CSA 1 enclosure complete with:
 - .1 Externally operated disconnect switch.
 - .2 Magnetic fused starter.
 - .3 Overload protection for each phase.
 - .4 Adjustable pressure switch.
 - .5 Low pressure safety cut-out.
 - .6 Control circuit transformer with fused secondary.
 - .7 Adjustable time delay relay.
 - .8 Hand-off-automatic selector switch for pumps.
 - .9 Pilot lights; power on, low suction pressure.
 - .10 Lead/lag selector switch.

PLUMBING PUMPS

- .11 Alarm: visual and audible with silencing switch for abnormal conditions.
- .9 Operation:
 - .1 Pump to operate continuously during demand.
 - .2 Low suction pressure switch to stop pump.

Part 3 Execution

3.1 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.

3.2 SITE QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust impeller shaft stuffing boxes, packing glands.

3.3 START-UP

- .1 Refer to Division 01 - General Commissioning Requirements for commissioning requirements.
- .2 General: In accordance with Division 01 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
 - .1 Procedures:
 - .1 Check power supply.
 - .2 Start pumps, check impeller rotation.
 - .3 Check for safe and proper operation.
 - .4 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
 - .5 Test operation of hands-on-auto switch.
 - .6 Test operation of alternator.
 - .7 Adjust shaft stuffing boxes.
 - .8 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
 - .9 Check base for free-floating, no obstructions under base.
 - .10 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .11 Adjust alignment of piping and conduit to ensure full flexibility.
 - .12 Eliminate causes of cavitation, flashing, air entrainment.

PLUMBING PUMPS

- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system.
- .15 Verify lubricating oil levels.

3.4 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS

- .1 General: In accordance with Division 01 - General Commissioning Requirements: General Requirements, supplemented as specified.
- .2 Obtain manufacturer's approval, before performing PV, to ensure warranties remain intact.
- .3 Application tolerances:
 - .1 Flow: +/- 10%.
 - .2 Pressure: Plus 20%, minus 5%.
- .4 PV procedures:
 - .1 Open pump balancing valve fully.
 - .2 Measure differential pressure (DP) across pump.
 - .3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.
 - .4 If suction is different size than discharge connection, add velocity head correction factor to DP.
 - .5 Mark this DP on manufacturer's pump curve.
 - .6 If flow rate is higher than specified, slowly close balancing valve until specified DP is reached.
 - .7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.
 - .8 Calculate BHP and compare with nameplate data.

3.5 REPORTS

- .1 In accordance with Division 01 - General Commissioning Requirements: reports, supplemented as specified. Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information report forms.
 - .3 Pump performance curves (family of curves) with final point of actual performance.

3.6 TRAINING

- .1 In accordance with Division 01 - General Commissioning Requirements: Training of O&M personnel, supplemented as specified.

END OF SECTION

DOMESTIC WATER PIPING

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 23.01 - Valves - Bronze
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME):
 - .1 ANSI/ASME B16.15-2024, Cast Copper Alloy Threaded Fittings, Classes 125 and 250
 - .2 ANSI/ASME B16.18-2021, Cast Copper Alloy Solder Joint Pressure Fittings
 - .3 ANSI/ASME B16.22-2021, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - .4 ANSI/ASME B16.24-2021, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500
- .2 ASTM International (ASTM):
 - .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .2 ASTM B88M-20, Standard Specification for Seamless Copper Water Tube (Metric)
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA):
 - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- .4 CSA Group (CSA):
 - .1 CSA B242-05(2021), Groove and Shoulder Type Mechanical Pipe Couplings
- .5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
 - .1 MSS-SP-71-2018, Grey Iron Swing Check Valves, Flanged and Threaded Ends
 - .2 MSS-SP-80-2019, Bronze Gate, Globe, Angle and Check Valves
- .6 National Research Council (NRC):
 - .1 National Plumbing Code of Canada (NPC) 2020

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Division 01 - Submittal Procedures.
- .2 Product Data: Provide manufacturer's product literature and datasheets for insulation and adhesives. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.

DOMESTIC WATER PIPING

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Division 01 - Closeout Submittals.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L: to ASTM B88M

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15
- .3 Cast copper, solder type: to ANSI/ASME B16.18
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22
- .5 NPS 2 and larger:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242
- .6 NPS 1 ½ and smaller:
 - .1 Wrought copper to ANSI/ASME B16.22 or cast copper to ANSI/ASME B16.18; with stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

DOMESTIC WATER PIPING

2.5 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.6 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 To ANSI/ASME B16.15, Class 125.
 - .2 Forged Brass body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with NPC and local authority having jurisdiction.
- .2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards
- .3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .4 Valves:
 - .1 Isolate equipment, fixtures and branches with ball valves.

3.2 HANGERS AND SUPPORTS

- .2 Install hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

3.3 PRESSURE TESTS

- .1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

DOMESTIC WATER PIPING

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.7 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring DWH storage tank up to design temperature slowly.
 - .4 Monitor piping systems for freedom of movement.
 - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

DOMESTIC WATER PIPING

- .3 Sterilize DHW and DHWR systems for Legionella control.
- .4 Verify performance of temperature controls.
- .5 Verify compliance with safety and health requirements.
- .6 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
- .7 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Division - General Commissioning Requirements: Reports, using report forms as specified in Division 01 - General Commissioning Requirements: Report Forms and Schematics.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 OPERATION REQUIREMENTS

- .1 Coordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products.
- .2 Operational requirements in accordance with Division 01 - Closeout Submittals, include:
 - .1 Cleaning materials and schedules.
 - .2 Repair and maintenance materials and instructions.

3.10 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.

END OF SECTION

SANITARY WASTE AND VENT PIPING

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 07 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM D2235-22, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D2564-20, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-Series B1800-21, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies WHMIS SDS - Safety Data Sheets in accordance with Division 01 - Health and Safety Requirements

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Division 01 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

SANITARY WASTE AND VENT PIPING

Part 2 Products

2.1 MATERIAL

- .1 Adhesives and Sealants: In accordance with Division 07 - Joint Sealants.

2.2 PIPING AND FITTINGS

- .1 For buried and above ground spaces outside of air plenums and concealed spaces:
 - .1 DWV piping to CAN/CSA B1800
- .2 For air plenums and concealed spaces:
 - .1 XFR piping to CAN/CSA B1800

2.3 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564
- .2 Solvent weld for ABS: to ASTM D2235

2.4 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.3 HANGERS AND SUPPORTS

- .1 Install hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

3.4 TESTING

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

3.5 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.

SANITARY WASTE AND VENT PIPING

- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.6 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DOMESTIC WATER HEATERS

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 03 - Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.2 No. 64:19, Household Cooking and Liquid-Heating Appliances
- .2 National Research Council Canada (NRC):
 - .1 National Plumbing Code of Canada 2020 (NPC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.
 - .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and site assembled.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in Division 01 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle in accordance with Division 01 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.6 WARRANTY

- .1 For the Work of this Section, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.
- .2 Contractor hereby warrants domestic water heaters in accordance with CCDC2, but for number of years specified for each product.

Part 2 Products

2.1 ELECTRIC INSTANTANEOUS WATER HEATER

- .1 To CSA C22.2 No. 64, with copper sheathed heating elements, 2-stage heating, integral temperature controls and high limit switch.
- .2 Input Rating: 5.4 kW.

2.2 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation in wood framed construction in accordance with Division 06 – Rough Carpentry for Minor Works.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Provide structural wood mounting of instantaneous heaters.
- .3 Provide insulation between water heater and wall.

3.3 SITE QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission domestic water heaters.
- .2 Refer to Division 01 - General Commissioning Requirements for commissioning requirements.

3.4 CLEANING

- .1 Clean in accordance with Division - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

COMMERCIAL WATER CLOSETS AND URINALS

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9)
 - .2 CSA B125.3-22, Plumbing Fittings
- .2 National Research Council Canada (NRC):
 - .1 National Building Code – Alberta Edition 2023 (NBC-AE)
 - .2 National Plumbing Code of Canada 2020 (NPC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for washroom fixtures and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
 - .3 For water closets, urinals: minimum pressure required for flushing.

1.3 CLOSEOUT SUBMITTALS

- .1 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

COMMERCIAL WATER CLOSETS AND URINALS

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series
- .2 Trim, fittings: manufacture in accordance with CSA B125.3
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: as indicated.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Water closets: As indicated on drawings.
- .8 Fixture piping:
 - .1 Cold water supplies to fixtures:
 - .1 Chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for washroom fixtures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install each fixture with its own trap, easily removable for servicing and cleaning.
- .2 Install each fixture with its own chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.
- .3 Install wall mounted urinals and water closets with approved wall carriers, model to suit installation.
- .4 Solidly attach floor mounted water closets to floor with lag screws. Lead flashing shall not hold closet in place.

COMMERCIAL WATER CLOSETS AND URINALS

3.3 FIXTURE ROUGH-IN SCHEDULE

- .1 Rough in fixture piping connections in accordance with following table of minimum sizes or as required for particular fixtures.
 - .1 Water Closets
 - .1 Cold Water: 15 mm
 - .2 Waste: 75 mm

3.4 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
 - .4 Adjust urinal flush timing mechanisms.
 - .5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
 - .1 Water closets, urinals: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventers: operation under all conditions.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01 - Cleaning.

END OF SECTION

COMMERCIAL LAVATORIES AND SINKS

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9)
 - .2 CSA B125.3-22, Plumbing Fittings
- .2 National Research Council Canada (NRC)
 - .1 National Building Code – Alberta Edition 2023 (NBC-AE)
 - .2 National Plumbing Code of Canada 2020 (NPC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data in accordance with Division 01 - Closeout Submittals.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle in accordance with Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

COMMERCIAL LAVATORIES AND SINKS

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series
- .2 Trim, fittings: manufacture in accordance with CSA B125.3
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures to be product of one manufacturer.
- .6 Trim to be product of one manufacturer.
- .7 Washroom Lavatories: As indicated on drawings.
- .8 Stainless steel counter-top sinks: As indicated on drawings.
- .9 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install each fixture with its own trap, easily removable for servicing and cleaning.
- .2 Install each fixture with its own chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.
- .3 Install wall mounted lavatories and sinks with approved wall carriers, model to suit installation.
- .4 Mount fixtures the following heights above finished floor:
 - .1 Wall hung lavatory or sink
 - .1 Standard: 780 mm to top of basin rim

3.3 FIXTURE ROUGH-IN SCHEDULE

- .1 Rough in fixture piping connections in accordance with following table of minimum sizes or as required for particular fixtures.
 - .1 Lavatories, stainless steel & service sinks:

COMMERCIAL LAVATORIES AND SINKS

.1	Hot Water:	15 mm
.2	Cold Water:	15 mm
.3	Waste:	50 mm
.4	Vent:	50 mm

3.4 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
 - .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.5 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

**DIVISION 23 – HEATING, VENTILATING, AND AIR
CONDITIONING (HVAC)**

OPERATION AND MAINTANANCE OF HVAC SYSTEMS DURING CONSTRUCTION

Part 1 General

1.1 USE OF SYSTEMS

- .1 Use of new permanent heating, cooling, and or ventilating systems for supplying temporary heat or ventilation is not permitted.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

AIR DUCT CLEANING FOR HVAC SYSTEMS

Part 1 General

1.1 DEFINITIONS

- .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
 - .1 Rigid supply and return ductwork;
 - .2 Flexible ductwork;
 - .3 Mixing plenum boxes;
 - .4 Return air plenums including ceiling plenums;
 - .5 Cooling and heating coils and compartments;
 - .6 Condensate drain pans, eliminator blades and humidifiers;
 - .7 Fans, fan blades and fan housing;
 - .8 Filter housing and frames;
 - .9 Acoustically insulated duct linings;
 - .10 Diffusers, registers and terminal units;
 - .11 Dampers and controls;

1.2 REFERENCE STANDARDS

- .1 National Air Duct Cleaners Association (NADCA)
 - .1 ACR Standard, 2021 edition: Assessment, Cleaning and Restoration of HVAC Systems.
- .2 North American Insulation Manufacturers Association (NAIMA)
 - .1 NAIMA 2005, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.

1.3 PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICES

- .1 Engage and pay for services of independent testing laboratory in accordance with Division 01 - Payment Procedures for Testing Laboratory Services.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Division 01 - Submittal Procedures.
- .2 Submit video survey and cleaning plan.
 - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.

AIR DUCT CLEANING FOR HVAC SYSTEMS

- .2 Provide two copies of WHMIS SDS in accordance with Division 01 - Health and Safety Requirements Division 01- Environmental Procedures for antimicrobial agents or coatings.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Division - Closeout Submittals.
- .2 Post Cleaning Inspection Report: submit 4 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
 - .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems with identifying systems cleaned;
 - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Comments complete with photographs of each sampling location and other observed system features;
 - .6 Identify systems tested, observations, actions taken and recommendations for future maintenance.
- .3 Record post cleaning video survey: submit 2 copies of video survey USB Drive media, and include on video survey following:
 - .1 Areas of special interest and location;
 - .2 Special internal features;
 - .3 Problems such as broken or damaged controls or components;
 - .4 Ensure system tested, locations, observations, actions taken and recommendations are clearly identified in English on video using text or voice over.

1.6 EXTRA MATERIALS

- .1 Extra Stock Materials:
 - .1 Supply 4 extra filters for each HVAC System cleaned.
 - .2 Ensure filters are correct match, size, type and configuration of existing HVAC Systems.

1.7 QUALITY ASSURANCE

- .1 Contractor: Verification of membership in NADCA.
- .2 Project Co-ordinator: Air System Cleaning Specialist (ASCS) certified by NADCA on full time basis.

Part 2 Products

2.1 ACCESS DOORS AND PANELS

- .1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.
 - .1 Size access doors and panels in equipment to allow for inspection and cleaning.

AIR DUCT CLEANING FOR HVAC SYSTEMS

- .2 Ductwork Access Doors: construct access doors from 1.27 mm minimum galvanized sheet steel with gasketed seal.
 - .1 Ensure access door is 25 mm greater in every dimension than access opening.
 - .2 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.
- .3 Access Doors and Panels Acoustic Lining:
 - .1 Install acoustic lining to match existing.
 - .2 Self-adhesive glass fibre tape capable of adhering to both acoustic lining and metal access door or panel materials.
 - .3 Water-based duct sealer for repairing cut acoustic lining.

2.2 SYSTEM FILTERS

- .1 Supply and install new filters for each HVAC System cleaned.

2.3 AIR DUCT CLEANING EQUIPMENT

- .1 Manually propelled full contact brushes:
 - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
 - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.
 - .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- .2 Brushes: manually propelled with integrally-mounted drive and nylon, polypropylene, or other non-metallic material bristles.
 - .1 Ensure drive has capacity to continue to push brush after bristles are distorted.
 - .2 Replace worn and ineffective brushes when required.

2.4 HEPA FILTER EVACUATION FAN

- .1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.

2.5 HEPA VACUUM UNIT

- .1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

Part 3 Execution

3.1 PREPARATION

AIR DUCT CLEANING FOR HVAC SYSTEMS

- .1 Close down HVAC system.
- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
 - .1 Control devices;
 - .2 Fire and smoke control dampers;
 - .3 Balancing dampers: indicate and record positions for resetting;
 - .4 Air volume control boxes: indicate and record positions for resetting;
 - .5 Fire alarm devices;
 - .6 Monitoring devices and controls;
- .3 Cut openings in ductwork as required for access to system interior.
 - .1 Square or rectangular opening sizes: 200 mm minimum each side.
 - .2 Circular opening sizes: 200 mm minimum diameter.
- .4 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.
 - .1 Install access doors for inspection and cleaning of equipment as follows:
 - .1 Heating and cooling coils;
 - .2 Fan units;
 - .3 Filters;
 - .4 Dampers;
 - .5 Sensors;
 - .2 Access door installation is not permitted in flexible ductwork.
 - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.
- .5 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.
 - .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.
- .6 Remove and reinstall ceiling tiles and panels to gain access to HVAC system as required.
 - .1 Replace ceiling tiles and panels damaged or soiled by air duct cleaning procedures.

3.2 EXAMINATION / PRE-CLEANING INSPECTION

- .1 Verification of Conditions:
 - .1 Make visual inspection of interior of HVAC system using camera.
 - .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
- .2 Evaluation and Assessment:
 - .1 Identify location and type of internal components.
 - .2 Identify extent of potential problems.

AIR DUCT CLEANING FOR HVAC SYSTEMS

3.3 DUCT CLEANING

- .1 Do duct cleaning in accordance with NADCAACR Standard
- .2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.
 - .1 Isolate zone of duct using closed-cell polyurethane foam or air inflated zone bag before cleaning.
- .3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
- .4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.
- .5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square meter.
- .6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square meter.
- .7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.
 - .1 Pass brushes through sections as often as necessary to achieve required cleanliness.
 - .2 Change brush sizes as required to ensure positive contact with duct and component interiors.
 - .3 Clean corners and pockets where dirt and debris can accumulate.
- .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.
- .9 Clean diffusers, registers, louvers, and other terminal units.
- .10 Remove perforated supply diffusers from suspended tee-bar ceiling.
 - .1 Dismantle and clean perforated plates and supply diffuser duct collars.
 - .2 Re-assemble perforated plate diffusers and reconnect to HVAC system using supply diffuser duct collar after cleaning.
- .11 Advise Consultant 72 hours minimum before deactivation of fire alarm and smoke detectors for duct cleaning operations.

3.4 ACOUSTICALLY LINED DUCTWORK CLEANING

- .1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices

3.5 COMPONENTS AND EQUIPMENT CLEANING

- .1 Brush and vacuum coils, humidifiers, air handling unit enclosures, and heat exchanger surfaces to achieve required cleanliness.
- .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Consultant for cleaning.
 - .1 Pressure wash with water and cleaning solution until required cleanliness is achieved.

AIR DUCT CLEANING FOR HVAC SYSTEMS

- .2 Clean equipment and components in place only if there is no hazard to adjacent materials.
- .3 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Consultant:
 - .1 Fan blades;
 - .2 Dampers;
 - .3 Turning vanes;
 - .4 Controls;
 - .5 Sensor bulbs;
 - .6 Fire alarms;
 - .7 Smoke detectors;

3.6 FIELD QUALITY CONTROL/FINAL INSPECTIONS

- .1 Post Cleaning Inspection: carry out final inspection using robotic camera and other visual inspection methods after final cleaning has been completed.
 - .1 Carry out video survey as directed by Consultant.
 - .2 Include in final survey areas inspected by Contractor prior to cleaning.
 - .3 Identify on HVAC system record drawings access points used for inspection and cleaning.
 - .4 Re-collect and analyse particulates collected at same locations where original samples were collected before cleaning.
 - .5 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

3.7 SYSTEM STARTUP

- .1 Install new system filters after cleaning operations are completed.
- .2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.
- .3 Restart each HVAC system.

3.8 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.

END OF SECTION

COMMON WORK RESULTS FOR HVAC

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, product literature, and data sheets for products and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data and incorporate into manual.
 - .1 Operation and maintenance manual approved by, and final copies submitted to Consultant before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task

COMMON WORK RESULTS FOR HVAC

- time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .5 Approvals:
 - .1 Submit draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Consultant will provide a set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Supply spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.

COMMON WORK RESULTS FOR HVAC

- .3 One head gasket set for each heat exchanger.
- .4 One glass for each gauge glass.
- .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .6 One set of belts for each size of belt driven equipment.
- .7 One fusible link for every ten fire dampers installed.
- .8 One seat and washer for each size and type of valve.
- .3 Supply one set of special tools required to service equipment as recommended by manufacturers.
- .4 Supply one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

Part 2 Products

2.1 Not Used

- .1 Not Used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 SITE QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Division 01 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Site Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Site Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.3 ADJUSTING

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Perform painting in accordance with Division 01 - Interior Painting.

COMMON WORK RESULTS FOR HVAC

- .3 Restore finishes which have been damaged to a "like new" condition.

3.4 CLEANING

- .1 Final Cleaning: Perform in accordance with Division 01 - Cleaning and clean interior and exterior of all systems including strainers. Perform cleaning of ductwork and air handling equipment in accordance with Section 23 01 31 – Air Duct Cleaning for HVAC Systems.

3.5 DEMONSTRATION

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
- .1 Unit heaters
 - .2 Ventilation Equipment.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate Sections.
- .6 Contractor will record these demonstrations for future reference.

3.6 PROTECTION

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

END OF SECTION

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C390:10, Test methods, marking requirements, and energy efficiency levels for three-phase induction motors
- .2 National Research Council Canada (NRC):
 - .1 National Energy Code of Canada for Buildings 2020 (NECB)
- .3 National Electrical Manufacturers Association (NEMA):
 - .1 ANSI/NEMA MG 1-2021, Motors and Generators
 - .2 NEMA MG 10009-2022, Energy Management Guide for Selection and Use of Single-Phase Motors

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications, and datasheets, including product characteristics, performance criteria, wiring characteristics, and limitations.
 - .2 Submit a complete list of HVAC motors and identify their locations before beginning installation of motors.
- .3 Shop Drawings: Submit drawings, indicating work of other Subcontractors, and identify areas that might have congestion or conflicts.
- .4 When requested, submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 – Closeout Submittals.
- .2 Submit maintenance data for motors, drives, and guards and incorporate into operation and maintenance manual.
- .3 Submit field test reports.

1.4 MAINTENANCE MATERIALS SUBMITTALS

- .1 Supply one set of spare belts for each set installed in accordance with Section 23 05 00 – Common Work Results for HVAC.

1.5 QUALITY ASSURANCE

- .1 Where multiple motors are required for the same application, provide the same manufacturer's motor model for all identical conditions.
- .2 Health and Safety Requirements: Comply with Division 01 - Health and Safety

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading: Perform in accordance with Division - Common Product Requirements, and as follows:
 - .1 Protect motors from dust and corrosion.

Part 2 Products

2.1 REGULATORY REQUIREMENTS

- .1 Comply with NECB 2020.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified in other Sections.
- .2 Motors: High efficiency, in accordance with NECB requirements.
- .3 Motor Speed: as indicated on drawings.
- .4 Motors under 373 W (1/2 hp): To NEMA MG 10009, speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated on Drawings.
- .5 Motors 373 W (1/2 hp) and larger: To ANSI/NEMA MG 1, and CSA C390, squirrel cage induction, speed as indicated, continuous duty, drip-proof, ball bearing, maximum temperature rise 40°C, 3 phase, 600 V, motor windings inverter rated class F, unless otherwise indicated.
- .6 Temporary Motors: Motor with adequate performance for temporary use.

2.3 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 hp): Standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified motor rpm.
- .4 For motors 7.5 kW (10 hp) and over: Sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Determine correct sheave size during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Provide motor slide rail adjustment plates to allow for center line adjustment.

2.4 DRIVE GUARDS

- .1 Provide guards for unprotected drives.

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame
 - .2 Minimum 1.2-mm-thick sheet metal tops and bottoms
 - .3 38-mm diameter holes on both shaft centers for insertion of tachometer
 - .4 Removable for servicing
- .3 Drive Guards: Designed to allow motor maintenance (lubrication and use of test instruments) with guards in place.
- .4 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6-mm-thick galvanized mild steel
 - .2 Fasten securely in place
 - .3 Removable for servicing
- .5 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19-mm mesh
 - .2 Net free area of guard: not less than 80% of fan openings
 - .3 Fasten securely in place
 - .4 Removable for servicing

Part 3 Execution

3.1 INSTALLATION

- .1 Install according to manufacturer's instructions and supplemented by the requirements of the Contract Documents.
- .2 Locate motors with adequate access space to allow safe and unimpeded maintenance services.
- .3 Install with minimum interference with other equipment and services.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Fasten motors and equipment securely in place.
- .6 Replace temporary motors with specified motors.

3.2 CLEANING

- .1 Comply with Division 01 - Cleaning.
- .2 Remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

VALVES - BRONZE

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 22 11 16 – Domestic Water Piping

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1-2013 (R2018), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-2021, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International (ASTM)
 - .1 ASTM A276/A276M-24a, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283/B283M-24, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M-23, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 ANSI/MSS-SP-25-2018, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2019, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS - Safety Data Sheets in accordance with Division 02 - Hazardous Materials.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in a province of Canada.
 - .2 Submit data for valves specified in this Section.

VALVES - BRONZE

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Division 01 - Closeout Submittals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
 - .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:

1.6 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Copper tube systems: solder or grooved ends to ANSI/ASME B16.18
- .3 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

VALVES - BRONZE

- .4 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62
 - .2 Pressure rating: Class125, 860 kPa steam.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 03 – Cast-in-Place Concrete
- .2 Division 05 – Structural Steel for Buildings
- .3 Section 22 11 16 – Domestic Water Piping
- .4 Section 22 13 16 – Sanitary Waste and Vent Piping
- .5 Section 23 31 13 – Metal Ducts

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-2024, Power Piping.
- .2 ASTM International (ASTM)
 - .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A563/A563M-24, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2018, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
- .4 National Research Council Canada (NRC)
 - .1 National Building Code – Alberta Edition (2023) (NBC-AE)
 - .2 National Plumbing Code of Canada 2020 (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in a Province of Canada.
 - .2 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
 - .1 Contractor will make available 1 copy of systems supplier's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Division 01 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58
- .2 Performance Requirements:
 - .1 Design supports and hangers to withstand seismic events as prescribed by NBC-AE.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58 and ANSI B31.1.

2.3 INSERTS

- .1 Inserts shall be galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .2 Size inserts to suit threaded hanger rods.

2.4 HANGER RODS:

- .1 Threaded rod material to MSS SP58.
- .2 Ensure that hanger rods are subject to tensile loading only.
- .3 Provide linkages where lateral or axial movement of pipework is anticipated.

2.5 PIPE HANGERS AND SUPPORTS

- .1 Sway braces for seismic restraint systems to NBC-AE.
- .2 Use insulation shields for insulated pipework.
- .3 Oversize pipe hangers and supports.
- .4 Design hangers and supports so that they cannot become disengaged by the movements of supported pipes.
- .5 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
- .6 Hangers:
 - .1 Pipe sizes 15 mm to 40 mm: Adjustable wrought steel ring.
 - .2 Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes 150 mm Over: Adjustable wrought steel clevis.
 - .3 Pipe sizes 150 mm: Adjustable steel yoke and cast-iron roll.
 - .4 Pipe sizes 150 mm and above: Trapeze hangers, steel channels with welded spacers and hanger rods, cast iron roll and stand.
- .7 Wall Supports:
 - .1 Pipe Sizes to 80 mm: Cast iron hook.
 - .2 Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast-iron roll for hot pipe sizes 150 mm and over.
- .8 Floor Supports:
 - .1 Pipe Sizes to 100 mm and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
 - .2 Hot Pipe Sizes 150 mm and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69

2.6 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307
- .4 Nuts: to ASTM A563/A563M

2.7 INSULATION PROTECTION SHIELDS

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69

2.8 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 05 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSE-KEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 100 mm larger than equipment; chamfer pad edges.
- .2 Concrete: Division 03 - Cast-in-Place Concrete.

2.11 SLEEVES

- .1 Pipes through Floors: Form with 1.2 mm galvanized steel.
- .2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or 1.2 mm thickness galvanized steel.
- .3 Roof Drains: form sleeves with 0.7 mm thick sheet steel galvanized with Z275 zinc coating to ASTM A653M.
- .4 Round Ducts: Form sleeves with galvanized steel.
- .5 Rectangular Ducts: Form sleeves with galvanized steel or wood.
- .6 Size large enough to allow for expansion with continuous insulation.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSERTS

- .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 100 mm or ducts over 1500 mm wide.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .3 Where concrete slabs form the finished ceiling, finish inserts flush with slab surface.

3.3 PIPE HANGER AND SUPPORT SPACING

- .1 Support horizontal steel and copper piping as follows:
- .1 15 mm to 40 mm: 10 mm hanger rod, 1.8 m spacing.
 - .2 50 mm to 65 mm: 10 mm hanger rod, 3.0 m spacing.
 - .3 80 mm to 100 mm: 16 mm hanger rod, 3.6 m spacing.
 - .4 150 to 300 mm: 22 mm hanger rod, 4.3 m spacing.
 - .5 350 to 450 mm: 25 mm hanger rod, 6.1 m spacing.
- .2 Install hangers to provide minimum 12 mm clear space between finished covering and adjacent work.
- .3 Within 300 mm of each elbow.
- .4 Hangers are to be vertically adjustable 40 mm minimum after piping is erected.
- .5 Support vertical piping at every floor. Support vertical soil pipe at each floor at hub.
- .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .7 Where practical, support riser piping independently of connected horizontal piping.
- .8 Provide additional supports for concentrated loads such as valves, specialties and pipe fittings or changes in direction.
- .9 Support horizontal cast iron sanitary pipe and storm sewer pipe that is buried, in crawlspace or in wells as follows:
- .1 At intervals not exceeding 3.0 m.
 - .2 At each pipe section
 - .3 At each change in direction
 - .4 At each branch connection
- .10 Support plastic horizontal exposed sanitary pipe and storm sewer pipe that is buried, in crawlspace or in wells as follows:
- .1 At intervals not exceeding 1.2 m
 - .2 At the ends of branches
 - .3 At changes of direction or at traps more than 1 m from the fixture drain

3.4 LOW VELOCITY DUCT HANGERS AND SUPPORTS

- .1 Hanger Minimum Sizes:
- .1 Up to 750 mm wide: 25 x 1.6 mm at 3 m spacing.
 - .2 790 to 1200 mm wide: 40 x 1.6 mm at 3 m spacing.
- .2 Horizontal Duct on Wall Supports Minimum Sizes:
- .1 Up to 450 mm wide: 40 x 1.6 mm or 25 x 25 x 3 mm at 2.4 m spacing.
 - .2 480 x 1000 mm wide: 40 x 40 x 3 mm at 1.2 m spacing.
- .3 Vertical Duct on Wall Supports Minimum Sizes at 3.65 m spacing:
- .1 Up to 610 mm wide: 40 x 1.6 mm.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .2 640 to 900 mm wide: 25 x 25 x 3 mm.
- .3 940 to 1200 mm wide: 30 x 30 x 3 mm.
- .4 Over 1520 mm wide: 50 x 3 mm.
- .4 Vertical Duct Floor Supports Minimum Sizes, riveted or screwed to ducts:
 - .1 Up to 1520 mm wide: 40 x 40 x 3 mm.
 - .2 Over 1520 mm wide: 50 x 3 mm.

3.5 MEDIUM AND HIGH VELOCITY DUCT HANGERS AND SUPPORTS

- .1 Hanger Minimum Sizes:
 - .1 Up to 900 mm wide: 2 at 25 x 1.6 mm at 3 m spacing.
 - .2 940 x 1520 mm wide: 2 at 25 x 1.6 mm at 2.4 m spacing and 50 x 50 x 6 mm trapeze.
 - .3 1550 x 3050 mm wide: 2 at 38 x 2.6 mm at 2.4 m spacing and 50 x 50 x 7 mm trapeze.
 - .4 3070 x 6700 mm wide: 3 at 10 mm diameter at 1.2 m spacing and 65 x 65 x 5 mm trapeze.
- .2 Round Duct Hangers Minimum Sizes at 3 m spacings:
 - .1 Up to 460 mm diameter: 25 x 1.6 mm.
 - .2 480 to 900 mm diameter: 25 x 2.6 mm.
 - .3 940 to 1270 mm diameter: 40 x 2.6 mm.
 - .4 1300 to 2130 mm diameter: 2 at 40 x 2.6 mm from girth reinforcing angle.
- .3 Vertical Duct Floor Supports Minimum Sizes:
 - .1 Up to 1220 mm wide: 40 x 40 x 3 mm.
 - .2 Over 1220 mm wide: 50 x 50 x 30 mm.
 - .3 Rivet to duct and tie angles together with rod, angles, or band Iron.
- .4 Angle reinforcing may be used for support omitting trapeze.

3.6 HANGER INSTALLATION

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

3.7 SLEEVES

- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- .2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.
- .3 Where piping or ductwork passes through floor, ceiling, or wall, close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .4 Install chrome plated escutcheons where piping passes through finished surfaces.

3.8 HORIZONTAL MOVEMENT

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

3.9 FINAL ADJUSTMENT

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

3.10 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

IDENTIFICATION FOR HVAC, PIPING AND EQUIPMENT

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
- .2 Related Requirements

1.2 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-20, Natural Gas and Propane Installation Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Division 01 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Division 01 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Dispose of unused paint and coating materials at official hazardous material collections sites.
 - .2 Do not dispose of unused paint and coating materials into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

IDENTIFICATION FOR HVAC, PIPING AND EQUIPMENT

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: 20 x 100 mm, 5 mm letters.
 - .2 Equipment in Mechanical Rooms: 35 x 200 mm, 20 mm letters.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.
 - .2 Propane gas: to CSA/CGA B149.1.
 - .3 Sprinklers: to NFPA 13
 - .4 Standpipe and hose systems: to NFPA 14

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3
- .4 Arrows showing direction of flow:

IDENTIFICATION FOR HVAC, PIPING AND EQUIPMENT

- .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
- .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
- .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Consultant.
 - .2 Background, lettering, and arrow colour marking and legends for piping systems:

Contents	Background	Lettering & Arrows	Legend
Domestic hot water supply	Green	White	DOM. HW SUPPLY
Domestic cold water supply	Green	White	DOM. CWS
Plumbing vent	Green	White	SAN. VENT
Natural gas	to Codes	to Codes	to Codes

2.5 IDENTIFICATION OF DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.
- .3 Legends for ductwork systems:

Service	Legend
Supply Air	SUPPLY AIR
Outdoor Air	OUTDOOR AIR
General Exhaust Air	EXHAUST AIR
Washroom Exhaust Air	TOILER EXHAUST AIR

2.6 VALVES

- .1 Brass tags with 12 mm stamped identification data filled with black paint.

2.7 CONTROLS COMPONENTS IDENTIFICATION

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

2.8 LANGUAGE

IDENTIFICATION FOR HVAC, PIPING AND EQUIPMENT

- .1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting specified Division 09 - Interior Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise
- .2 Provide ULC and or CSA registration plates as required by respective agency
- .3 Identify systems, equipment to conform to PWGSC PMSS

3.4 NAMEPLATES

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

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

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

IDENTIFICATION FOR HVAC, PIPING AND EQUIPMENT

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

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Number valves in each system consecutively.

3.7 CLEANING

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

END OF SECTION

TESTING, ADJUSTING AND BALANCING FOR HVAC

Part 1 General

1.1 SUMMARY

- .1 Testing, adjusting, and balancing of HVAC equipment to achieve specified performance requirements.

1.2 REFERENCE STANDARDS

- .1 Associated Air Balance Council (AABC):
 - .1 ANSI/AABC National Standards for Total System Balance, Seventh Edition, 2016.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Test and balance each system independently and where interlocked with other systems, in unison with those systems.
- .2 Scheduling:
 - .1 Schedule time required for work of this Section (including repairs, and re-testing) into Project schedules to ensure completion before scheduled completion date.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit proposed methodology and procedures for performing work of this Section.
- .2 Before starting work of this Section, submit names and documented qualifications of personnel to perform work of this Section.
- .3 Submit list of instruments and include serial numbers and calibration certificates.
- .4 Preliminary Report: Submit for checking and approval by Consultant before submission of formal report. Include:
 - .1 Details of instruments used
 - .2 Details of procedures employed
 - .3 Calculations procedures
 - .4 Summaries
- .5 Testing and Balancing Report:
 - .1 Format in accordance with ANSI/AABC National Standards for Total System Balance and show results in SI units.
 - .2 Include:
 - .1 Project record drawings
 - .2 System schematics
 - .3 Submit six copies of the report to Consultant, in English, in D-ring binders, complete with index tabs, and a digital copy.

TESTING, ADJUSTING AND BALANCING FOR HVAC

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Test and balance systems regulated by codes to the satisfaction of the authority having jurisdiction.
- .2 Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience, certified by AABC.
- .3 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 During construction, coordinate location and installation of measurement and balancing devices, equipment, accessories, measurement ports, and fittings.
- .2 Calibrate instruments in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate instruments within three months of work. Submit certificate of calibration.
- .4 Notify Consultant seven days before start of work.

3.2 VERIFICATION OF CONDITIONS

- .1 Verify that building is substantially complete, including:
 - .1 Installation of ceilings, doors, windows, and other construction affecting the Work.
 - .2 Application of weatherstripping, sealing, and sealants.
 - .3 Pressure, leakage, and other tests specified elsewhere in Division 23.
 - .4 Provisions for Work are installed and operational.
- .2 Verify proper, normal, and safe operation of mechanical and associated electrical and control systems affecting Work including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place are clean.
 - .2 Duct systems are clean.
 - .3 Ducts, air shafts, and ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Volume control dampers are installed and open.
 - .6 Coil fins are combed and clean.

TESTING, ADJUSTING AND BALANCING FOR HVAC

- .7 Access doors are installed and closed.
- .8 Outlets are installed and volume control dampers are open.

3.3 SYSTEM START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified in equipment Sections.

3.4 ADJUSTING

- .1 Operate systems as required to perform the work and as required by Consultant for verification of reports.
- .2 Test to verify proper and safe operation, to determine actual point of performance, and to evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .3 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .4 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.
- .5 Equipment Noise: Measure noise from equipment as scheduled.

3.5 AIR SYSTEMS

- .1 Test and balance air systems to ANSI/AABC National Standards for Total System Balance.
- .2 Take measurements as appropriate for application, including but not limited to air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, and vibration.
- .3 Document locations of equipment measurements in report, including:
 - .1 Inlet and outlet of dampers, filter, coil, fan, and other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
 - .3 Main ducts, main branch, sub-branch, and terminals (grille, register or diffuser).

3.6 TOLERANCES

- .1 HVAC systems: +5%, -5% of design.
- .2 Accuracy: +/-2% of actual values.

3.7 SITE QUALITY CONTROL

- .1 Reported results may be subject to verification by Consultant. Verify number and location of results as directed by Consultant.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Repeat work as required until results fall within specified performance values.

TESTING, ADJUSTING AND BALANCING FOR HVAC

3.8 CLOSEOUT ACTIVITIES

- .1 After work is completed to satisfaction of Consultant replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

3.9 MAINTENANCE

- .1 Measure WBT (or %RH), NC levels, air flow patterns, DBT, air velocity, in all spaces.
- .2 Participate in systems checks twice during Warranty Period - #1 approximately three months after acceptance and #2 within one month of termination of Warranty Period.

END OF SECTION

PRESSURE TESTING OF DUCTED AIR SYSTEMS

Part 1 General

1.1 SUMMARY

- .1 Section Includes: Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return, or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.3 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 ANSI/SMACNA 016-2012, HVAC Air Duct Leakage Test Manual

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing:
 - .1 Test ducts before installation of insulation or other forms of concealment.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Submit details of test instruments to be used at least three months before anticipated start date.
- .3 Certificates: Submit instrument calibration certificates no more than 28 days before start of tests.
- .4 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format for approval at least three months before proposed date of first series of tests.
 - .2 Prepare report of results and submit within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final testing and balancing report specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .4 Submit manufacturers' site reports to Consultant.

PRESSURE TESTING OF DUCTED AIR SYSTEMS

1.6 QUALITY ASSURANCE

- .1 Work of this Section shall be performed by an agency complying with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

Part 2 Products

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test Apparatus Accuracy: Within +/-3% of flow rate and pressure.
- .3 Calibration: Calibrate instruments at minimum interval of six months and submit certificates of calibration.

Part 3 Execution

3.1 TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by the system. Pro-rate specified system leakage tolerances.
- .2 Leakage Rates: Leakage shall not exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: Leakage -2%.
 - .2 VAV box and duct on downstream side of VAV box: Leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: Leakage 2%.
 - .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.2 TESTING

- .1 Test when ambient temperature will not affect effectiveness of seals and gaskets.
- .2 Test flexible connections to VAV boxes.
- .3 Test lengths of ducts consistent with test equipment capacity.
- .4 Test fittings, branch ducts, tap-ins.
- .5 Repair leaks and repeat tests until specified pressures are attained.
- .6 Base partial system leakage calculations on ANSI/SMACNA 016.

PRESSURE TESTING OF DUCTED AIR SYSTEMS

- .7 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.
Retest after seals have cured.

3.3 CLEANING

- .1 Comply with Division 01 - Cleaning.
- .2 Upon completion of work, remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

DUCT INSULATION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.2 DEFINITIONS

- .1 For purposes of this Section:
 - .1 "Concealed" – means insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "Exposed" – means "not concealed" as previously defined.
 - .3 "Insulation systems" – means insulation material, fasteners, jackets, and other accessories.
 - .4 "Jacketing" – synonymous with cladding and lagging.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C335/C335M-23, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
 - .2 ASTM C449-07 (R24), Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .3 ASTM C921-10 (2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
 - .4 ASTM C1729-21, Standard Specification for Aluminum Jacketing for Insulation
 - .5 ASTM C1767M-21, Standard Specification for Stainless Steel Jacketing for Insulation
- .2 Midwest Insulation Contractors Association (MICA):
 - .1 National Commercial and Industrial Insulation Standards Manual
- .3 ULC Standards (ULC):
 - .1 CAN/ULC-S102-2019 (R2024), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S702.1-2014, Standard For Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finishes, and limitations.
- .3 Shop Drawings: Submit drawings.
- .4 Samples:

DUCT INSULATION

- .1 When requested, submit for approval: Complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
- .2 Mount sample on 12-mm plywood board.
- .3 Affix typewritten label beneath sample indicating service.
- .5 Manufacturers' Instructions:
 - .1 Submit manufacturers' duct insulation jointing recommendations and special handling criteria, installation sequence, and cleaning procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Division 01 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address, and ULC markings.
- .3 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products

2.1 DUCT INSULATION

- .1 Mineral Fibre: Glass fibre, rock wool, or slag wool.
- .2 Fire/Smoke Rating: To CAN/ULC-S102.
 - .1 Maximum flame-spread rating: 25.
 - .2 Maximum smoke developed classification: 50.
- .3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
- .4 Type: Mineral fibre blanket to CAN/ULC S702.1 faced with factory applied vapour retarder jacket.
 - .1 Maximum "k" factor: 0.038 W/m°C.
 - .2 Service temperature: -40°C to 65°C

2.2 ACOUSTIC INSULATION

- .1 Mineral Fibre: Glass fibre, rock wool, or slag wool.
- .2 Fire/Smoke Rating: To CAN/ULC-S102.
 - .1 Maximum flame-spread rating: 25.
 - .2 Maximum smoke developed classification: 50.
- .3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
- .4 Type: Rigid mineral fibre board to CAN/ULC S702.1.
 - .1 Maximum "k" factor: 0.035 W/m°C.
 - .2 Service temperature: -40°C to 65°C
 - .3 Surface finish: Air stream side coated or mat faced to prevent fibre erosion.

2.3 JACKETS

DUCT INSULATION

- .1 Canvas jacketing: 220 g/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Vapour Retarder Lap Adhesive: Water based, fire retardant type, and compatible with insulation.
- .2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: Hydraulic setting on mineral wool, to ASTM C449.
- .4 Outdoor Vapour Retarder Finishes:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing Fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: Self-adhesive, aluminum, plain, 50-mm-wide minimum.
- .6 Contact Adhesive: Quick-setting
- .7 Canvas Adhesive: Washable.
- .8 Tie wire: 1.5-mm stainless steel.
- .9 Banding: 19-mm-wide, 0.5-mm-thick stainless steel.
- .10 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on both faces of insulation.
- .11 Fasteners: 4-mm-diameter pins with 35-mm-diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that pressure testing of ductwork systems is complete, witnessed, and certified.
- .2 Verify that surfaces are clean, dry, and free from foreign material.

3.2 INSTALLATION

- .1 Install to manufacturer's instructions, and in accordance with MICA National Commercial and Industrial Insulation Standards Manual.
- .2 Apply materials in accordance with manufacturer's instructions.
- .3 Use two layers of insulation with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes. Duct insulation shall be continuous through wall and ceiling openings and sleeves, except where firestopping is required.
 - .1 Ensure hangers and supports are outside vapour retarder jacket and in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

DUCT INSULATION

- .5 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: Install at 300-mm on centre in horizontal and vertical directions, minimum two rows each side.
- .7 At chilled ductwork, secure with banding. Fasteners penetrating puncturing the underlying vapour barrier are not acceptable.

3.3 SITE QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Replace insulation with vapour barrier damage and moisture-saturated insulation.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation Types and Thicknesses: Conform to following table:

Service Type	Insulation Type	Insulation Thickness (mm)
Exhaust and relief within 3 m of exterior opening	Duct Insulation	25
Relief ducts and plenums	Duct Insulation	25
Combustion air	Duct Insulation	25
Outdoor air	Duct Insulation	50
Mixing plenums	Duct Insulation	50
Supply air plenums	Duct Insulation	25
Supply ducts	Duct Insulation	25
Supply and return ducts exposed to outdoors	Duct Insulation	100
Supply ducts, where indicated on drawings	Acoustic Insulation	25
Return ducts, where indicated on drawings	Acoustic Insulation	25

3.5 CLEANING

- .1 Clean in accordance with Division 01 - Cleaning.

END OF SECTION

ELECTRIC AND ELECTRONIC SYSTEM FOR HVAC

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 34 00 – HVAC Fans
- .2 Section 23 82 39.23 – Unit Heaters - Electric

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect electric and electronic control systems from nicks, scratches, and blemishes.

Part 2 Products

2.1 THERMOSTAT (LOW VOLTAGE)

- .1 Low voltage wall thermostat:
 - .1 For use on 24V circuit at 1.5A capacity.
 - .2 With heat anticipator adjustable 0.1 to 1.2 A.
 - .3 Temperature setting range: 10 degrees C to 25 degrees C.
 - .4 Without sub-base.

2.2 THERMOSTAT GUARDS

- .1 Thermostat guards: clear plastic. Slots for air circulation to thermostat.

ELECTRIC AND ELECTRONIC SYSTEM FOR HVAC

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for electric and electronic control systems installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied Consultant.

3.2 INSTALLATION

- .1 Install control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.
- .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

END OF SECTION

METAL DUCTS – LOW PRESSURE TO 500 Pa

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .2 Section 23 05 94 - Pressure Testing of Ducted Air Systems

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2020.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
- .3 Submit in accordance with Division 01 - Submittal Procedures.
- .4 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .5 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in a Province of Canada.
- .6 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

METAL DUCTS – LOW PRESSURE TO 500 Pa

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape, or combination thereof.
- .3 Class C: transverse joints and connections made airtight with gaskets, sealant, tape, or combination thereof. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius, centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 407 mm: with single thickness turning vanes.
 - .2 Over 407 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.

METAL DUCTS – LOW PRESSURE TO 500 Pa

- .6 Offsets:
 - .1 Full radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

Part 3 Execution

3.1 EXAMINATION

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

3.2 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.3 HANGERS AND SUPPORTS

- .1 Install hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

3.4 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

METAL DUCTS – LOW PRESSURE TO 500 Pa

3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 Do leakage tests in sections.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Do not install additional ductwork until trial test has been passed.
- .5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .6 Complete test before performance insulation or concealment Work.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

AIR DUCT ACCESSORIES

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2020.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 25 mm thick with fabric clenched by means of double locked seams.

AIR DUCT ACCESSORIES

- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.

2.4 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.5 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:

AIR DUCT ACCESSORIES

- .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA
- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors:
 - .1 Size:
 - .1 300 x 300 mm for servicing entry.
 - .2 Locations:
 - .1 Control dampers.
 - .2 Devices requiring maintenance.
 - .3 Required by code.
 - .4 Reheat coils.
 - .5 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .2 For temperature readings:

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

DAMPERS - BALANCING

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2020.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.

DAMPERS - BALANCING

- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA
- .3 Maximum blade height: 150 mm.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

DAMPERS - OPERATING

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 33 00 - Air Duct Accessories

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed and or parallel blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

DAMPERS - OPERATING

- .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

HVAC FANS

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- .2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- .3 Section 23 33 00 - Air Duct Accessories

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):
 - .1 ANSI/AMCA Standard 99-16, Standards Handbook
 - .2 ANSI/ASHRAE 51-16 (ANSI/AMCA 210-16), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
 - .3 ANSI/AMCA Standard 300-24, Reverberant Room Method for Sound Testing of Fans
 - .4 ANSI/AMCA Standard 301-22, Methods for Calculating Fan Sound Ratings from Laboratory Test Data
- .2 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manua, [current edition]
 - .1 MPI #18, Primer, Zinc Rich, Organic

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide:
 - .1 Fan performance curves showing point of operation, kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .2 Indicate:
 - .1 Motors, sheaves, bearings, shaft details or belt details.
 - .2 Minimum performance achievable with as appropriate.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Spare Parts:
 - .1 Submit in accordance with Division 01 - Closeout Submittals.
 - .1 Supply: One set of belts for each size of belt driven equipment.

HVAC FANS

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Division 01 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.

Part 2 Products

2.1 PERFORMANCE CRITERIA

- .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.
 - .1 Capacity: flow rate, total static pressure, external static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .2 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Provide unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated.
 - .4 Motor Speed: single.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, inlet outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

HVAC FANS

2.3 UTILITY SETS

- .1 Characteristics and construction: for axial fans.
- .2 Preassemble single width centrifugal fan with removable weatherproof protective hood with vents, and 12 mm mesh bird screens.
- .3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.4 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

- .1 Casings: welded steel with welded motor support, hinged access plates, streamlined inlet cone and discharge bell sections and integral silencer casing.
- .2 Blade material: steel or aluminum.
- .3 Hub material: steel or aluminum.
- .4 Supports:
 - .1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.
- .5 Bearings: ball or roller with extension tubes to outside of casing.
- .6 Belt drive:
 - .1 Drive adjustable blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.
 - .2 Adjust blades for varying range of volume and pressure. Hubs to facilitate indexing of blade angle. Provide automatic adjustment stops to avoid overloading motor.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for HVAC fans installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

END OF SECTION

DIFFUSERS, REGISTERS AND GRILLES

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.2 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Division 01 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect diffusers, registers and grilles from nicks, scratches, and blemishes.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

DIFFUSERS, REGISTERS AND GRILLES

2.2 GENERAL

- .1 To meet capacity, as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as directed by Consultant.

2.3 MANUFACTURED UNITS

- .1 Grilles, registers, and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

- .1 General: Integral opposed blade dampers, steel construction, 0° double deflection, 20 mm blade spacing, NC 30 maximum.
- .2 Type S-1: as indicated on drawings.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: Integral opposed blade dampers, aluminum construction, 0° deflection, 12 mm x 12 mm x 12mm grid, NC 30 maximum.
- .2 Type E-1: as indicated on drawings.

2.6 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: Integral opposed blade dampers, aluminum construction, 0° deflection, 12 mm x 12 mm x 12mm grid, NC 30 maximum.
- .2 Type T-1: as indicated on drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with oval head screws in countersunk holes where fastenings are visible.

3.3 CLEANING

DIFFUSERS, REGISTERS AND GRILLES

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

LOUVERS, INTAKES AND VENTS

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 07 – Sheet Metal Flashing and Trim
- .2 Division 09 – Exterior Painting

1.2 REFERENCE STANDARDS

- .1 Air Movement and Control Association (AMCA):
 - .1 ANSI/AMCA Standard 500-L-23, Laboratory Methods of Testing Louvers for Rating
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 ANSI/SMACNA 006-2020, HVAC Duct Construction Standards – Metal and Flexible

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate installation of exterior louvres and vents with Division 07.
 - .2 Coordinate compatibility of factory-applied primer with finish paints indicated in Division 09 – Exterior Painting.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature, and data sheets for louvres intakes and vents. Indicate product characteristics, performance criteria, physical size, finishes, and limitations.
 - .2 Show anchorage details, elevations, sections, and specific details for each louver. Include a list of all louvres and their locations in the Project using the identification numbers on the Drawings.
 - .3 Indicate the following:
 - .1 Pressure drop
 - .2 Face area
 - .3 Free area
- .3 Certificates: When requested submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: Submit certified data from independent laboratory substantiating:
 - .1 Acoustic and aerodynamic performance to ASTM E90.
 - .2 Louvres tested to ANSI/AMCA Standard 500-L for pressure drop, airflow leakage, water penetration, wind-driven rain, wind-driven sand.

1.5 DELIVERY, STORAGE, AND HANDLING

LOUVERS, INTAKES AND VENTS

- .1 Perform in accordance with Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in a clean, dry, well-ventilated location, and in accordance with manufacturer's recommendations.
 - .2 Store and protect louvres, intakes, and vents from nicks, scratches, and blemishes.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: Obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standards.

2.2 FIXED LOUVRES - ALUMINUM

- .1 Construction: Welded with exposed joints ground flush and smooth.
- .2 Material: Extruded aluminum alloy 6063-T5, 6063-T6, or 6061-T6.
- .3 Blade: Stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150-mm-deep one-piece extruded aluminum, minimum 3-mm thick with approved slot for sealant, integral to unit.
- .5 Mullions: At a maximum 1500-mm centres.
- .6 Fastenings: Aluminum nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, stainless steel washer and aluminum body.
- .7 Screen: 2.7-mm diameter wire aluminum bird screen on inside face of louvres in formed U-frame.
 - .1 Exhaust Screens: 12-mm mesh aperture.
 - .2 Intake Screens: 19-mm mesh aperture.
- .8 Finish: Prime coated, ready for finish painting in accordance with Section 09 91 13 - Exterior Painting.
- .9 Colour: As selected by Consultant from manufacturer's standard colour range.

LOUVERS, INTAKES AND VENTS

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrates previously installed are acceptable for louvers, intakes, and vents installation in accordance with manufacturer's instructions.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Perform in accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with sealant to ensure weather tightness.
- .4 Install screens where indicated. Where screen joints are unavoidable, overlap edges and ends by a minimum of 25 mm.

3.3 CLEANING

- .1 Progress and Final Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .2 Division 26 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE 84-2024, Method of Testing Air-to-Air Heat/Energy Exchangers
- .2 ASTM International (ASTM):
 - .1 ASTM C1071-19, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sounds Absorbing Material)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for energy recovery equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports:
 - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
 - .2 Provide confirmation of testing.
- .5 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Division 01 - Closeout Submittals.
- .2 Extra Materials:
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .2 List of specialized tools necessary for adjusting, repairing or replacing.

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Division 01 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

Part 2 Products

2.1 GENERAL

- .1 Comply with ASHRAE 84.

2.2 AIR TO AIR FIXED PLATE EXCHANGER

- .1 Cabinet: 0.8 mm thick galvanized steel with rounded exposed corners and edges, removable panels, and glass fibre insulation.
 - .1 Insulation materials: to ASTM C1071; ensure surfaces exposed to airstream have erosion resistant coating to prevent erosion of glass fibres.
 - .1 Thickness: 25 mm.
 - .2 Thermal Conductivity (k-value): 0.037 W/m x K at 24°C mean temperature.
 - .3 Fire-hazard classification flame-spread index of 25 maximum and smoke-development index of 50 maximum to CAN/ULC-S102.
 - .2 Finish with factory applied baked enamel.
- .2 Fan: variable speed, centrifugal, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted, individual fans for each airstream.
- .3 Heat transfer surfaces: corrugated aluminum, edge sealed and bonded to casing, cross contamination: not permitted.
- .4 Controls: factory mounted controller, integral speed control, defrost control, motorized damper contacts, remote on/off and speed contacts.
- .5 Connections:
 - .1 Supply, Return, Exhaust, and Outdoor air duct connections: as indicated.
 - .2 Condensate drain: NPS 3/4.
- .6 Accessories: MERV 1 washable filters.
- .7 Performance characteristics: as indicated.

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for energy recovery equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories.

3.3 SITE QUALITY CONTROL

- .1 Tests:
 - .1 Perform tests in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.
- .2 Refer to Section 23 08 00 – Commissioning of HVAC for commissioning requirements.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

ELECTRIC-RESISTANT AIR COILS

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 00 - Common Work Results for HVAC
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- .4 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.2 No.155-M86 (R2022), Electric Duct Heaters

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for duct heaters and controls and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings showing:
 - .1 Element support details.
 - .2 Unit support.
 - .3 Internal components wiring diagrams.
 - .2 Submit duct heater schedule indicating quantities, sizes, mounting arrangement and the following performance data:
 - .1 Electrical: total kW rating, voltage, phase.
 - .2 Heater element watt/density.
 - .3 Controller type.
 - .4 Number of stages and kW rating.
 - .5 Minimum operating airflow.
 - .6 Maximum discharge temperature.
 - .7 Pressure drop at operating airflow.
 - .8 Accessories included.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Division 01 - Common Product Requirements and Section 23 05 00 - Common Work Results for HVAC.

Part 2 Products

ELECTRIC-RESISTANT AIR COILS

2.1 OPEN COIL DUCT HEATERS

- .1 Duct heater approved to CSA C22.2 No.155 and listed for zero clearance to combustible material.
- .2 Performance/Design Criteria:
 - .1 Refer to duct heater schedule for size, electrical requirements (volts, phases), capacity (kW), operating airflow, controller type, number of stages and special accessories.
 - .2 Heater Element Watt/Density: maximum 242 W/mm².
 - .1 Provide derated coils with low-watt density and low airflow controls when faced velocities are lower than 2.0 m/s or duct heaters are used in variable-air-volume applications.
 - .3 Heater Rated Load: provide built-in load fuses for duct heaters with rated load exceeding 48 Amps.
 - .4 Disconnect Switch: provide main disconnect for each duct heater assembly.
- .3 Construction:
 - .1 Frame: corrosion-resistant galvanized steel.
 - .2 Heating elements: helical coils of high grade nickel-chrome alloy resistance wire supported and insulated by floating ceramic bushings fastened to the frame and supporting brackets.
 - .3 Coil terminal pins: mechanically secured and insulated from the frame with high temperature ceramic bushings.
 - .4 Mounting: as indicated on duct heater schedule.
 - .5 Protective Screens: installed on both sides of heater.
- .4 Safety Controls:
 - .1 High Temperature Cutouts: include fail-safe thermal protection devices which automatically de-energize the heater on overheating condition.
 - .1 Primary High Limit Switch: automatic reset disc type thermal cutout.
 - .2 Secondary High-Limit Switch: additional manual reset disc type thermal cutout for duct heaters of 30 kW and less.
 - .2 Airflow Proving Switch: diaphragm type air pressure switch with automatic reset, screw type setpoint adjustment and static pressure probe; switch to de-energize duct heater circuits in case of insufficient air flow.
- .5 Panel:
 - .1 Factory mounted enclosure with terminal blocks for single point power connections and connection of wiring to thermostat, airflow proving switch and/or external controls.
 - .2 All built-in controls and electrical components to be factory mounted and wired inside the panel; wiring to be terminated on clearly identified terminal blocks.
 - .3 Provide unit specific wiring diagram permanently attached inside the panel.
- .6 Controls:
 - .1 Duct heater to include the following built-in controls: magnetic contactors, control transformer, safety controls and controllers.
 - .2 Controller Type: as indicated on duct heater schedule.

ELECTRIC-RESISTANT AIR COILS

- .1 Proportional Control: single-stage proportional control providing full modulation of the heater's capacity.

2.2 ACCESSORIES

- .1 Provide accessories where indicated on duct heater schedule.
- .2 Pilot Lights: factory mounted and wired on heater panel showing staging, power supply status, overheating condition, no airflow, heating status.
- .3 Thermostats: low voltage electronic thermostat compatible with duct heater controller.
 - .1 Duct Thermostats: insertion type with casing and adjustable supply air temperature setpoint.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify site conditions are acceptable for duct heater installation in accordance with manufacturer's written instructions.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Perform installation in accordance with manufacturer's instructions.
- .2 Locate duct heater in accordance with manufacturer's minimum recommended distances for operation, service access and unit removal.
- .3 Provide additional hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment where duct heater weight cannot be supported solely by existing duct.
- .4 Make power and control connections to CSA C22.2 No.155
- .5 Verify that ductwork and casings are free of debris before operating and testing duct heaters.

3.3 SITE QUALITY CONTROL

- .1 Duct Heater Controls: test operation of safety controls and duct heater staging/modulation by simulating a demand from the local thermostat or external control signal.
- .2 Site Adjustments: test and adjust airflow controls during system testing, adjusting and balancing in coordination with Sect. 23 05 93-Testing, Adjusting and Balancing for HVAC.
- .3 Submit test report and include copy with Operations and Maintenance Manuals.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

COMMERCIAL CONVECTORS

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 09 33 - Electric and Electronic Control System for HVAC
- .2 Division 26 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.2 No.46-13 (R2022), Electric Air-Heaters

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for convectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for convectors for incorporation into manual.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Division 01 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect convectors from nicks, scratches, and blemishes.

Part 2 Products

2.1 BASEBOARD CONVECTORS

- .1 Heaters: to CSA C22.2 No.46 wattage density as indicated with connection box on one end.
 - .1 Element through-type fitted with aluminum convector vanes and stainless steel tubular heating element.
- .2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.
- .3 Cabinet: to CSA C22.2 No.46, pre-drilled back for securing to wall. Integral air diffusion reflector.

COMMERCIAL CONVECTORS

- .1 Front inlet/top outlet.
- .2 Panel: extruded aluminum, metal thickness, bottom 1 mm, front 1.6 mm thick.
- .3 Finish: phosphatized and finished with powder coated finish, standard colour.

2.2 CONTROLS

- .1 Integral line voltage thermostat, 1 pole to control load as indicated.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Install baseboard convector heaters, blank sections and controls.
- .2 Make power and control connections.

3.3 SITE QUALITY CONTROL

- .1 Perform tests in accordance with Division 26 - Common Work Results for Electrical.
- .2 Ensure heaters and controls operate correctly.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

UNIT HEATERS - ELECTRIC

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- .2 Section 23 09 33 - Electric and Electronic Control System for HVAC
- .3 Division 26 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.46-13 (R2022), Electric Air-Heaters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect unit heaters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

UNIT HEATERS - ELECTRIC

Part 2 Products

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as per manufacturer recommendations and Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- .5 Elements: mineral insulated stainless-steel sheath with steel brazed fins.
- .6 Cabinet: Steel, 1.2 mm thick, fitted with brackets for rod or wall mounting.
 - .1 Phosphatized and finished with powder coat, standard colour.

2.2 CONTROLS

- .1 Wall mounted thermostats: type low voltage electronic, to Section 23 09 33 - Electric and Electronic Control System for HVAC.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for unit heaters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated.
- .3 Make power and control connections.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Division 26 - Common Work Results for Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

3.4 CLEANING

UNIT HEATERS - ELECTRIC

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

DIVISION 26 – ELECTRICAL

BASIC ELECTRICAL REQUIREMENTS

1. REGULATORY REQUIREMENTS

- .1 Comply with Safety Codes Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code.
- .2 Unless otherwise indicated, all references to "Canadian Electrical Code" or "CEC" shall mean the edition of the Canadian Electrical Code, Part I, CSA C22.1, and the variations made thereto by Alberta regulation, which are in force on the date of bid closing for the Contract.
- .3 All electrical products shall be tested, certified and labeled in accordance with a certification program accredited by the Standards Council of Canada. Where a product is not so labeled, provide written approval by the authority having jurisdiction.
- .4 Submit to authority having jurisdiction and Utility Company, necessary number of drawings and specifications for examination and approval prior to commencement of electrical work. Pay associated fees.
- .5 Submit to Owner, copy of electrical permit obtained from authority having jurisdiction.
- .6 If authority having jurisdiction conducts an electrical inspection, submit copy of certificate of acceptance provided by authority having jurisdiction.

2. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples, as specified, indicating details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment and materials.

3. OPERATION AND MAINTENANCE DATA

- .1 Provide the following for all systems and components:
 - .1 Manufacturer's product data, including performance curves and schematic and wiring diagrams for all electrical control systems.
 - .2 Manufacturer's installation instructions.
 - .3 Manufacturer's operation instructions.
 - .4 Manufacturer's maintenance instructions, including complete parts list for all serviceable components.
- .2 Provide a comprehensive list of Subcontractors, Sub-subcontractors and suppliers who supplied and installed systems and components.
- .3 Provide copies of all inspection certification reports from authorities having jurisdiction.

BASIC ELECTRICAL REQUIREMENTS

4. RECORD DRAWINGS

- .1 Record actual locations of all pull boxes, panelboards, luminaires, feeders, electrical equipment and electrical site services.
- .2 Record any changes to circuit designations.
- .3 Indicate on record drawings exact dimensioned locations of buried services and embedded or concealed conduits in floors and masonry walls. Obtain acceptance of this information by Engineer before commencing backfilling or concrete placement.
- .4 Include on record drawings all revisions due to engineering change orders, site alterations, additions and field ordered changes made during construction.

5. COORDINATION

- .1 Coordinate work specified in Division 26 with work specified in other Divisions. Ensure that proper arrangements and provisions are made for work specified in Division 26.

6. SOURCE OF SUPPLY

- .1 All like materials shall be by a single manufacturer.

7. REFERENCE STANDARDS

- .1 Comply with standards of following organizations:
 - .1 Electrical and Electronic Equipment Manufacturers Association of Canada (EEMAC).
 - .2 Institute of Electrical and Electronic Engineers (IEEE).

8. PRODUCT OPTIONS AND SUBSTITUTIONS

- .1 Product Options
 - .1 For products specified by Non–proprietary Specification:
 - .1 Select any product by any manufacturer that meets the requirements of the Contract Documents.
 - .2 For products specified by Proprietary Specification:
 - .1 Select any product or manufacturer named; or
 - .2 Select a substitute product or manufacturer in accordance with substitutions.

BASIC ELECTRICAL REQUIREMENTS

- .3 For products specified by Proprietary Specification and accompanied by words indicating that substitutions will not be accepted:
 - .1 Select any product or manufacturer named; Substitutions will not be permitted.
- .2 Substitutions
 - .1 Where Substitute Products are permitted, unnamed products will be authorized by the Owner, subject to the following:
 - .1 Substitute Products shall be the same types as, be capable of performing the same functions as, and meet or exceed the standards of quality and performance of the named product(s). Substitute Products shall not require revisions to the Contract Documents nor to work of Other Contractors.
 - .2 Do not order or install Substitutions without the Owner's authorization.
 - .3 If, in the Owner's opinion, a Substitution does not meet the requirements of the Contract Documents, provide a product that, in the Owner's opinion, does meet the requirements of the Contract Documents.
- .3 Changes to Authorized Products and Manufacturers
 - .1 Do not change products or manufacturers, authorized by the Owner for use in performance of the Work, without the Owner's written authorization.

9. DISCONNECTS

- .1 Disconnects: to CAN/CSA C22.2 No.4-M89, heavy duty, lockable, non-fused, with poles, voltage, amperage, kw ratings and enclosures as indicated on drawings and required by CEC to suit application.

10. SUPPORTING DEVICES

- .1 Provide metal brackets, frames, clamps, channels, straps and related devices to adequately support weight of equipment and raceways.

BASIC ELECTRICAL REQUIREMENTS

11. TESTING

- .1 Prior to energizing any portion of the electrical system, perform megger tests on all parts of the distribution system. Results shall meet the requirements of the CEC, authority having jurisdiction and the Contract Documents.

12. ARC FLASH STUDY

- .1 An arc flash study will be performed by the Owner's representative. The contractor will carry an allowance for this work. Invoices for the work will be issued to the Contractor for payment. Contractor will not mark up invoices. As this work is not completed by, nor involves suppliers and/or subcontractors, the Contractor shall not retain a 10% Lien Holdback relative to this work.

END OF SECTION

WIRE AND CABLE

1. GENERAL

- .1 Not Applicable

2. PRODUCTS

2.1 BUILDING WIRING

- .1 Building Wiring: to CSA C22.2 No. 75-M1983 and as follows:
- .1 Conductors: solid copper for No. 14 AWG and smaller, stranded copper for No. 12 AWG and larger.
 - .2 Insulation: RW90 X-link.
 - .3 Insulation Rating: 600V.
 - .4 Sizes: as indicated in Wire Size Schedule.

2.2 CABLES

- .1 Type TECK 90 Cable: to CSA C22.2 No. 131-M89 and as follows:
- .1 Conductor: copper.
 - .2 Insulation: cross linked polyethylene (XLP).
 - .3 Rating: 600V.
 - .4 Size: as indicated.
 - .5 Configuration: as indicated.
 - .6 Inner Jacket: PVC -40°C.
 - .7 Armour: aluminum.
 - .8 Outer Jacket: PVC -40°C.
- .2 Control Cable for Class 2 Remote Control and Signal Circuits:
- .1 Conductor: copper.
 - .2 Insulation: 300 V insulation, rated 60°C.
 - .3 Configuration: individual conductors twisted together, foil shielded, and covered with a PVC jacket.

2.3 CONNECTORS

- .1 Provide factory fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated.

WIRE AND CABLE

3. EXECUTION

3.1 WIRING, GENERAL

- .1 Wires shall not be spliced unless approved by the Engineer. Splices can only be made in junction or outlet boxes.
- .2 Conductor length for parallel circuits shall be identical.
- .3 Neatly train and lace conductors inside cabinets, equipment and panelboards.

3.2 WIRING INSTALLATION IN RACEWAYS

- .1 Swab raceway system before installing wiring.
- .2 Use pulling lubricant for conductors No. 4 AWG and larger.

3.3 WIRE CONNECTIONS AND TERMINATIONS

- .1 Use solderless pressure connectors with insulated covers for copper wire splices and taps, No. 8 AWG and smaller.
- .2 Use insulated spring wire connectors with plastic caps for conductors No. 10 AWG and smaller.
- .3 Use split bolt connectors for copper wire splices and taps, No. 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150% of insulation value of conductor.

3.4 WIRE SIZE SCHEDULE

- .1 Lighting Circuits: No. 12 AWG minimum.
- .2 Power Circuits: No. 12 AWG minimum.
- .3 Motor Circuits: No. 12 AWG minimum, except as otherwise indicated on drawings or in schedules.
- .4 Feeder Circuits: as indicated on drawings or in schedules.

3.5 WIRING INSTALLATION IN CABLE TRAYS

- .1 All TECK cable shall be installed in cable trays as indicated on the drawings and according to the Canadian Electrical Code.
- .2 All 4-20mA signal, 24VDC, 24VAC and general data cables shall be run in separate cable trays from 120VAC and higher voltage cables where possible. Where a single tray is shared, the cables shall be separated by a grounded cable tray barrier.
- .3 Cables of unlike signal and voltages shall only cross each other at 90° angles.

WIRE AND CABLE

- .4 TECK cable drops to equipment shall be supported by vertical cable tray risers. Single or double TECK cable drops may be run in vertical cantruss.
- .5 All power and lighting cables shall be separated in the cable tray according to the Canadian Electrical Code. It will be the responsibility of the Contractor to de-rate the conductors if the ventilation spacing requirements are not met.

END OF SECTION

GROUNDING

1. GENERAL

- .1 Not Applicable

2. PRODUCTS

2.1 MATERIALS

- .1 Grounding and bonding equipment for the Bingham Crossing Potable Water Pump Station and Reservoir Equipment: to CSA C22.2 No. 41-M1987 and as follows:
- .1 Ground Rods: 20 mm x 3 m copper clad
 - .2 Ground Wells:
 - .1 22GA galvanized steel construction
 - .2 Lift off cover
 - .3 Minimum 250 mm diameter and 300 mm height
 - .3 Ground Conductors: as specified in Section 26 05 19.
 - .4 Ground Grid:
 - .1 No of ground rods: as shown on drawings
 - .2 Interconnect conductors: bare copper of size as shown on drawings
 - .3 Ground conductors to system neutral point: bare copper of size as shown on drawings.

3. EXECUTION

3.1 INSTALLATION

- .1 Comply with requirements of CSA C22.2 No. 0.4-M1982 and Canadian Electrical Code.
- .2 Install complete permanent grounding system including electrodes, conductors, connectors and accessories.
- .3 Protect exposed ground conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes using pressure connectors.

GROUNDING

- .5 Make connections within ground wells where possible.
- .6 Use mechanical connectors for ground connection to equipment provided with lugs.
- .7 Do not solder joints.
- .8 Install bonding wire in flexible metal conduit connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.
- .9 Install separate insulated ground conductor in conduit runs installed in concrete which is subject to moisture penetration and underground.
- .10 Install a separate insulated ground conductor in all conduit runs.

3.2 SYSTEM GROUNDING

- .1 Provide ground grid with one ground conductor from grid through the system neutral point to the main ground bus bar.
- .2 Provide ground conductor from steel piping headers to ground grid.
- .3 Provide ground conductor from gas pipe to ground grid.
- .4 Provide ground conductor from control panel isolated ground to nearest ground rod of ground grid.

3.3 GROUND CONDUCTORS

- .1 Use bare ground conductors for the following:

	<u>Size</u>
.1 Service Entrance	see drawings
.2 Telephone Service Entrance	#6
- .2 Use green insulated ground conductors for the following:

	<u>Size</u>
.1 Circuit Ground Conductors	#12
.2 Bonding Jumpers	#1
.3 Gas Pipe Grounding	#1
.4 Lightning Arrestor	#6
.5 Control Panel Instrument Ground	#6

END OF SECTION

CONDUIT

1. GENERAL

1.1 COORDINATION

- .1 Coordinate with other work including wire and cable, boxes and fittings and panel work, as necessary to interface installation of conduit with other work.
- .2 Coordinate installation of conduit in concrete with concrete work specified other Divisions.
- .3 Coordinate installation of conduit which penetrates fire rated walls, floors and ceilings with firestopping work specified in other Divisions. Ensure that integrity of the fire rated element is maintained.

2. PRODUCTS

2.1 CONDUIT, GENERAL

- .1 Except where otherwise required by Canadian Electrical Code (CEC), provide conduit of types specified in Conduit Installation Schedule and sizes indicated on drawings or specified.
- .2 Conduit embedded in concrete floors shall be maximum 50 mm size.
- .3 Where sizes are not indicated, select proper sizes to suit intended use, fulfill wiring requirements, and comply with Canadian Electrical Code (CEC).

2.2 METAL CONDUIT AND TUBING

- .1 Rigid Metal Conduit: to CSA C22.2 No. 45-M1981, and as follows:
 - .1 Galvanized Rigid Steel Conduit: zinc coated steel.
 - .2 Fittings: same material as conduit.
- .2 Flexible Metal Conduit: to CSA C22.2 No. 56-1977, and as follows:
 - .1 Liquid-Tight Flexible Metal Conduit: continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 12 mm diameter.
 - .2 Liquid-Tight Flexible Metal Conduit Fittings: cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.
- .3 Miscellaneous Fittings: locknuts, bushings, reducers, chase nipples, 3 piece unions, split couplings, plugs, and expansion fittings specifically designed for their particular application.

2.3 NON-METALLIC CONDUIT

- .1 Rigid PVC (Unplasticized) Conduit: to CSA C22.2 No. 211.2-M1984

CONDUIT

3. EXECUTION

3.1 INSTALLATION OF CONDUIT, GENERAL

- .1 For existing building and new pre-fabricated buildings, conduit shall be surface mounted on walls and ceilings.
- .2 Conduit system shall be weatherproof in areas with process piping.
- .3 EMT with raintight fittings will be allowed where it is not subject to mechanical injury such as along walls and above 1200 mm from walkway surface. Where a conduit may be stepped on or bumped during typical operation and maintenance, rigid metal conduit shall be used.
- .4 Conduit shall be rigid pipe with proper support. The final 500 mm conduit connection into field instruments and equipment shall be liquid tight flexible metal. This is to allow easy disconnection and replacement of the device when required.
- .5 Plug conduit ends to prevent entry of dirt and moisture.
- .6 Seal conduit with duct seal compound or fiberglass where conduit leaves heated area and enters unheated area.
- .7 Provide necessary flashing and pitchpockets, making watertight joints where conduit passes through roof or waterproofing membranes.
- .8 Where conduit crosses building expansion joints, install expansion fitting approved by authority having jurisdiction, complete with grounding jumper. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.

3.2 INSTALLATION OF RIGID METAL CONDUIT

- .1 Cut conduit straight, properly ream, cut threads and brush threads clean.
- .2 Fasten conduit terminations in sheet metal enclosures with two locknuts and terminate with bushing. Install locknuts inside and outside enclosure.
- .3 Conduit installed underground shall be painted with two coats of corrosion inhibiting compound before backfilling.

3.3 INSTALLATION OF LIQUID TIGHT FLEXIBLE METAL CONDUIT

- .1 Liquid tight conduit is only to be installed for the final connection to instruments and equipment.
- .2 The length of liquid tight conduit shall be limited to two meters unless otherwise noted in the specifications or drawings.

CONDUIT

3.4 INSTALLATION OF NON-METALLIC CONDUIT

- .1 Make field bends and solvent cemented joints in accordance with manufacturer's instructions.

3.5 INSTALLATION OF EXPOSED AND SEMI-CONCEALED CONDUIT

- .1 Comply with the following when installing conduit exposed in service areas, unfinished areas, finished areas, and in accessible spaces behind ceilings, walls and floors:
 - .1 Install conduit to conserve headroom and cause minimum interference in spaces through which conduit passes.
 - .2 Install conduit so as not to interfere with ceiling inserts, luminaires or ventilation ducts or outlets.
 - .3 Alter routing to avoid structural obstructions, keeping crossovers to a minimum.
 - .4 Install exposed conduit and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls and structural members.
 - .5 Run conduit for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

3.6 INSTALLATION OF CONDUIT IN CONCRETE SLABS

- .1 Place conduit between bottom reinforcing steel and top reinforcing steel.
- .2 Separate conduit by not less than diameter of largest conduit to ensure proper concrete bond.
- .3 Ensure minimum 20 mm concrete cover.

END OF SECTION

BOXES AND FITTINGS

1. GENERAL

1.1 COORDINATION

- .1 Coordinate with other divisions for placement of boxes.

2. PRODUCTS

2.1 METAL OUTLET BOXES

- .1 Outlet boxes: to CAN/CSA-C22.2 No. 18-92 and as follows:
 - .1 Sheet Steel Boxes: pressed sheet steel, galvanized, blanked for conduit, integral locating lugs.
 - .2 Cast Boxes: corrosion resistant cast aluminum, factory threaded hubs, weatherproof.

2.2 NON-METALLIC OUTLET BOXES

- .1 Outlet boxes: to CAN/CSA-C22.2 No. 85-M89 and as follows:
 - .1 Same as sheet steel boxes, except of rigid PVC material.

2.3 PULL AND JUNCTION BOXES

- .1 Surface mounted pull and junction boxes: to CSA C22.2 No. 40-M1989 and as follows:
 - .1 Type: NEMA 4
 - .2 Material: 14 gauge steel, continuously welded seams ground smooth
 - .3 Covers: screw-on, closed cell, oil resistant neoprene gasket, stainless steel screws and clamps on four sides of cover to assure water tight seal.
 - .4 Barriers: where indicated and required
- .2 Recessed pull and junction boxes or surface mounted boxes in areas above 3000AFF: to CSA C22.2 No. 40-M1989 and as follows:
 - .1 Material: sheet steel
 - .2 Covers: screw-on
 - .3 Barriers: where indicated

BOXES AND FITTINGS

2.4 BUSHINGS, KNOCKOUT CLOSURES, AND LOCKNUTS

- .1 Bushings, Knockout Closures and Locknuts: to CAN/CSA-C22.2 No. 18-92, corrosion resistant.

2.5 AIR/VAPOUR HATS

- .1 Air/vapour Hats: polyethylene, minimum 0.40 mm thick, with minimum 25 mm wide flanges, designed to be installed over electrical boxes and provide an effective air/vapour seal.

3. EXECUTION

3.1 OUTLET BOX INSTALLATION

- .1 Provide boxes where indicated and as required for:
 - .1 Splices.
 - .2 Taps.
 - .3 Wire pulling.
 - .4 Equipment.
 - .5 Device location.
- .2 Install boxes flush mounted where applicable.
- .3 Except where otherwise indicated, install boxes for vertical mounting of devices.
- .4 Support boxes independent from conduit.
- .5 Use metal outlet boxes, except in following locations where non-metallic outlet boxes shall be used:
 - .1 Where subject to moisture or corrosive material.

3.2 LOCATION OF WALL OUTLET BOXES

- .1 Outlets are indicated on drawings schematically. Consider locations indicated as approximate. Verify locations prior to rough in.
- .2 Confirm size and location of equipment supplied and installed under other Sections, prior to rough in.
- .3 Do not install boxes back to back. Allow minimum:
 - .1 150 mm separation in conventional walls.
 - .2 600 mm separation in acoustic rated walls.

BOXES AND FITTINGS

- .4 Position boxes in masonry walls to suit masonry course lines.
- .5 Except where otherwise indicated, mount boxes at following heights:
 - .1 Local switches: 1200 mm
 - .2 Receptacles:
 - .1 General: 300 mm
 - .2 Above counters: 150 mm
 - .3 Above baseboard heaters: 200 mm
 - .4 Utility rooms: 1200 mm
 - .3 Telephone/data outlets:
 - .1 General 300 mm
 - .2 Beside local receptacle box
 - .3 Wall Mounted Speakers 2500 mm
 - .4 Fire Alarm:
 - .1 Pull Stations 1400 mm
 - .2 Bells/Horns/Strobes/Combinations 2500 mm
 - .5 Local Emergency Battery Receptacle: 2400 mm
- .6 Measure mounting height from finished floor to center line of device.
- .7 Owners representative reserves the right to change location of outlets prior to installation with no change in Contract Price, provided that distance does not exceed 3 m from originally indicated location.

3.3 PULL AND JUNCTION BOX INSTALLATION

- .1 Locate above accessible ceilings and in unfinished areas.
- .2 Locate so as to minimize need for access doors.
- .3 Support boxes independent from conduit.

3.4 AIR/VAPOUR HAT INSTALLATION

- .1 Install air/vapor hats around electrical boxes located in walls and ceilings.

END OF SECTION

CABLE TRAY, RACEWAY, WIREWAYS

1. GENERAL

1.1 COORDINATION

- .1 Coordinate with other work, including wire and cable, boxes and fittings and panel work, as necessary to interface installation of electrical raceways and components with other work.
- .2 Coordinate installation of cable trays which pass through fire rated walls, floors or ceilings with fire stopping work.

1.2 WORK INCLUDED

- .1 Design, supply and install cable tray arrangements and support fittings necessary to complete service wiring of equipment supplied by the contractor.

2. PRODUCTS

2.1 RACEWAYS, GENERAL

- .1 Provide raceways of types and sizes required to handle the cable capacity with 40% spare capacity.
- .2 Where not indicated, select proper types and sizes to fulfill wiring requirements and comply with Canadian Electrical Code.

2.2 CABLE TRAYS

- .1 Cable trays and fittings: to CSA C22.2 No. 126-M91 and EEMAC-F5-1, and as follows:
 - .1 Type: Ladder with 225mm (9") rung spacing and 150mm (6") side rails.
 - .2 CSA class: D1
 - .3 Size: Sized to handle cable capacity with 40% spare.
 - .4 Material: Aluminum.
 - .5 Accessories and fittings: Horizontal elbows, end plates, dropouts, vertical risers and drops, tees, wyes, expansion joints and reducers, manufactured for cable tray supplied.
 - .6 Radii on Fittings: Minimum 300 mm.

CABLE TRAY, RACEWAY, WIREWAYS

2.3 WIREWAYS

- .1 Wire ways, Auxiliary Gutters and Associated Fittings: to CSA C22.2 No. 26-1952 and as follows:
 - .1 Material: Sheet steel.
 - .2 Accessories: Elbows, tees, couplings, and hanger fittings manufactured for wire way supplied.

3. EXECUTION

3.1 INSTALLATION OF CABLE TRAYS

- .1 Support cable trays with quantity of hangers, clips, support channels at all bends and tee fittings to satisfactorily carry the loads and forces encountered: CSA standard require couplers to be not located farther from support than one-quarter of the span length. Recommend support is every 3 meters.
- .2 Provide cable tray grounding as to the Canadian Electrical Code. Effective grounding must be permanent and continuous, and have ample capacity to conduct any currents liable to be imposed on it.

END OF SECTION

ELECTRICAL IDENTIFICATION

1. GENERAL

1.1 RELATED SECTIONS

- .1 Not Applicable

2. PRODUCTS

2.1 IDENTIFICATION MATERIALS

- .1 Lamacoid Nameplates: 3 mm thick plastic engraving sheet, black face, white core, mechanically attached, sizes as follows:
 - .1 Size 1: 12 mm high with 5 mm high letters.
 - .2 Size 2: 20 mm high with 8 mm high letters.
 - .3 Size 3: 25 mm high with 12 mm high letters.
- .2 Wire Identification Materials: Use only the following:
 - .1 Machine printed heat shrink sleeves.
- .3 Colour Banding Tape: Adhesive backed plastic tape, integrally coloured.

3. EXECUTION

3.1 COLOUR IDENTIFICATION OF EQUIPMENT

- .1 Electrical equipment shall be prefinished in coded colours designating voltage or system, as indicated in Equipment Identification Schedule.
- .2 Voltage colour identification for line voltage equipment shall be as follows:

Voltage	Colour
.1 120/208 V or 120/240 V:	Grey
.2 347/600 V:	Grey
- .3 In addition to color identification of line voltage as stated in items 1&2, line voltage equipment with voltage greater than 300 volts (line to line) may be identified via clearly visible lamacoid (size 3).

3.2 NAMEPLATE IDENTIFICATION OF EQUIPMENT

- .1 Identify equipment with lamacoid nameplates, as indicated in Equipment Identification Schedule.

ELECTRICAL IDENTIFICATION

3.3 PANELBOARD DIRECTORIES

- .1 Identify loads controlled by each overcurrent protective device in each panelboard, by means of a typewritten panelboard directory.

3.4 COLOUR IDENTIFICATION OF WIRING

- .1 Identify No. 2 AWG wiring and smaller by continuous insulation colour.
- .2 Identify wiring larger than No. 2 AWG by continuous insulation colour or by colour banding tape applied at each end and at splices.
- .3 Colour coding shall be in accordance with Canadian Electrical Code, and as follows:

Voltage

Colour

- .1 120/208 V, 3 phase: Red, black and blue.
- .2 120/208 V emergency: Red, black and blue with yellow tracer.
- .3 347/600 V 3 phase: Orange, brown and yellow.
- .4 347/600 V emergency: Orange, brown and yellow with red tracer.
- .4 Where multi-conductor cables are used, use same colour coding system for identification of wiring throughout each system.
- .5 Maintain phase sequence and colour coding throughout each system.

3.5 COLOUR IDENTIFICATION OF WIRING

	Equipment	Size
.1	MCCs	3
.2	All compartments on MCCs	2
.3	HOA switches	1
.4	Thermostats and Dehumidstats	1
.5	All equipment and instruments, smaller than 300 mm X 300 mm X 300 mm, listed in Section 40 91 00 and P&I drawings.	1
.6	All instruments and equipment, greater than 300 mm X 300 mm X 300 mm, listed in Section 40 91 00 and P&I drawings.	2
.7	All HVAC equipment	3
.8	All Electrical Panels	2
.9	Junction boxes over 100 mm X 100 mm	1

END OF SECTION

ELECTRICAL STARTING AND TESTING

1. GENERAL

Not Used.

2. PRODUCTS

Not Used.

3. EXECUTION

3.1 BASIC ELECTRICAL START-UP AND TESTING

.1 Energizing Main Electrical System:

.1 Prior to energizing main electrical system:

.1 Verify supply authority voltage and phase rotation.

.2 Testing of Wiring and Wiring Devices:

.1 Test conductors at distribution centers and panelboards for insulation resistance to ground (megger test).

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation and circuitry.

.3 Ground Resistance Testing:

.1 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4-M1982 and Canadian Electrical Code.

.4 Starting Motors:

.1 Prior to starting motors:

.1 Confirm motor nameplate data with motor starter heater overloads, setting of MCP's and sizing of fuses.

.2 Verify rotation.

.3 Ensure disconnects are installed.

.4 Confirm labeling of motors, disconnects and starters.

ELECTRICAL STARTING AND TESTING

3.2 MOTOR CONTROL CENTRES

- .1 Ensure all starters are properly labeled prior to testing.

3.3 STANDBY POWER GENERATION SYSTEM

- .1 Factory Testing: See Section 26 32 13.0
- .2 Starting Standby Power Generation System:
 - .1 Prior to energizing power generation units on site:
 - .1 Ensure generating system is disconnected from normal power supply.
 - .2 Ensure all auxiliary support devices are operational, including ventilation and exhaust systems.
 - .3 Ensure that engine has proper lubricant levels, coolant levels and fuel supply.
 - .4 Ensure all testing on emergency distribution equipment and transfer switch as specified has been completed.
- .3 Site Testing:
 - .1 Conduct Site Testing in conjunction with manufacturer and in presence of the owner representative.
 - .2 Simulate operation of:
 - .1 Automatic starting cycle.
 - .2 Automatic shutdown.
 - .3 Refer to Section 26 32 13.0 for site test duration and requirements.

END OF SECTION

SERVICE AND DISTRIBUTION

1. GENERAL

Not used.

2. PRODUCTS

2.1 SERVICE

.1 Not Applicable.

2.2 METERING

.1 Not Applicable.

2.3 SERVICE EQUIPMENT

.1 Not Applicable.

2.4 PANELBOARDS

.1 Panelboards: to CSA C22.2 No. 29-M1989 and as follows:

.1 Bus Characteristics:

.1 Construction: Copper with rectangular section copper plated joints

.2 Bracing: 10,000 Amperes symmetrical

.3 Neutral: full capacity, solid neutral

.4 Ground Bus: copper

.2 Enclosure:

.1 Prefinished painted sheet steel

.2 Surface mount unless indicated differently on drawings

.3 Trim: Screw-on, concealed hinges and mounting screws, hinged locking door and flush catch.

SERVICE AND DISTRIBUTION

.3 Overcurrent Protective Devices: Bolt-on type breakers

.4 Panel Quantity and Size: as indicated on drawings

2.5 SURGE PROTECTION DEVICE

.1 As shown on drawings.

2.6 VOLTAGE MONITOR

.1 Monitoring of Phase Loss, Phase Reversal, Phase Unbalance, Under/Over Voltage.

.2 Settings to be adjustable.

.3 Relay contact will change state when any of the five monitoring conditions are abnormal.
Relay contact will automatically reset when conditions return to normal.

.4 Acceptable Manufacturers: Eaton D65VML series or approved equivalent.

3. EXECUTION

3.1 SERVICE

.1 Not Applicable.

3.2 PANELBOARDS

.1 Install panelboards securely, plumb and square to adjoining surfaces.

.2 Mount panelboards at 1800mm to top of trim above finished floor.

.3 Connect loads to circuits as indicated on drawings.

.4 Adjust circuits to optimize phase current balance.

.5 Number of breakers and sizes as indicated on panel schedule.

3.3 CONNECTION OF NON-MOTORIZED EQUIPMENT

.1 Connect all equipment with electrical requirements specified in other Divisions

END OF SECTION

TRANSFORMERS

1. GENERAL

1.1 PRODUCT DATA

- .1 All performance and test data to meet with the Owners Representative approval, CEMA and IEEE Standards.

2. PRODUCTS

- .1 Transformers:
 - .1 3 phase, 60 Hz, delta-Y, grounded star, air cooled type, natural circulation in ventilated metal case to CSA and CEMA standards, Class B insulation with temperature rise not exceeding 80°C for rise above 40°C.
 - .2 Voltages and ratings as shown on drawings.
 - .3 Provide four 2.5 per cent full capacity taps, two above and two below normal voltage.

2.1 MOUNTING

- .1 As shown on drawings.

3. EXECUTION

3.1 NAMETAGS

- .1 Provide name tags indicating full electrical data, connection diagrams, etc.

END OF SECTION

MOTOR CONTROL CENTERS

1. GENERAL

1.1 RELATED SECTIONS

- | | | |
|----|--|-----------------|
| .1 | Basic Electrical Requirements: | Section 260500. |
| .2 | Electrical Starting and Testing by Contractor: | Section 260800. |

1.2 PRODUCT DATA

- .1 Comply with requirements of Sections 260500.

1.3 COORDINATION

- .1 Coordinate installation with Section - Mechanical Equipment Controls to provide a complete integrated functional system.

2. PRODUCTS

2.1 MODULAR MOTOR CONTROL CENTERS

- .1 Motor control centers to CSA C22.2 No. 14-95 and as follows:
- .1 Bus Characteristics:
 - .1 Capacity: as shown on drawings.
 - .2 Construction: rectangular section copper, tin plated joints.
 - .3 Bracing: 42,000 Amperes symmetrical (minimum).
 - .4 Neutral bus: as shown on drawings.
 - .5 Ground bus: Copper.
 - .2 General Construction:
 - .1 To EEMAC standards for construction of Class I motor control center with type B wiring.
 - .2 Dead front, multi-unit, modular type with assembly of vertical stacks containing cubicles sized to house equipment required.
 - .3 Minimum height per module: 305 mm.
 - .4 Horizontal bussing across top or center and vertical bussing down each stack.
 - .5 Wiring gutter across top and bottom and vertically down each stack. Wiring gutter shall be barriered from busway compartments.

MOTOR CONTROL CENTERS

- .6 Each module for motor control shall house disconnect breaker, motor control device, relays, and control transformer as shown on drawings. Modules for feeders will house only one or two feeder breakers. All breakers shall have a door mounted operating handle with lock-off facility. Opening of module is restricted by the used of a defeater screw, unless breaker is in the "Off" position.
- .7 Each combination starter or disconnect switch assembly shall be mounted in tub or rack assembly of removable plug-in type with necessary bus connection stabs.
- .8 Blank combination starter spaces shall have hinged cover section provided with full bussing to receive future rack assemblies.

2.2 CONTROL RELAYS

- .1 Rating: 10 amperes, 300 volts AC.
- .2 Coil: 120 Volts AC.
- .3 Poles: as required.

2.3 SURGE PROTECTION DEVICE

- .1 Manufacturer/Model: As shown on drawings.
- .2 Locate within MCC enclosure as indicated on drawings.

2.4 AUTOMATIC TRANSFER EQUIPMENT

- .1 Locate within MCC enclosure as indicated on drawings. Refer to section 263623.

2.5 POWER QUALITY METER

- .1 Metering of Ia, Ib, Ic, In, Va, Vb, Vc, Vab, Vbc, Vca, PF, Hz, W, var, VA, Wh, varh, Vah.
- .2 Harmonic analysis through 63rd with THD and TIF.
- .3 Event Recorder minimum 100 events.
- .4 Waveform capture.
- .5 Data logger minimum 90,000 events.
- .6 Voltage Disturbance Recorder minimum 500 events.
- .7 Digital and analog I/O for control and alarms.
- .8 Ethernet data communications.
- .9 Power to be supplied from customer supplied 120VAC UPS.

MOTOR CONTROL CENTERS

2.6 ACCEPTABLE MANUFACTURERS

- .1 Eaton, Allen-Bradley/Rockwell, Schneider, or approved equivalent.

3. EXECUTION

3.1 INSTALLATION

- .1 Set and secure modular motor control center in place on concrete housekeeping pad.
- .2 Make field power and control connections as indicated.
- .3 Provide heater elements to suit motors installed.
- .4 Provide breakers to suit motors installed.
- .5 Tighten bus connections and mechanical fasteners to assure permanent and effective connection.
- .6 Adjust operating mechanisms for free mechanical movement.
- .7 Touch-up scratched or marred surfaces to match original finish.
- .8 Avoid top cable entry. If top entry is necessary, ensure liquid tight.

3.2 PROTECTION OF COMPLETED WORK

- .1 Protect motor control centers to prevent entry of duct, paint and other foreign matter.

3.3 TESTING

- .1 Comply with requirements of Section 260800.

END OF SECTION

CABINETS AND ENCLOSURES

1. GENERAL

1.1 SOURCE OF SUPPLY

- .1 All cabinets and enclosures larger than 300 mm square and 100 mm deep shall be by a single manufacturer.

1.2 COORDINATION

- .1 Coordinate size and depth of cabinets and enclosures with systems specified in other Sections which require enclosures.
- .2 Coordinate installation and identification of cabinets and enclosures with painting of mechanical and electrical work specified in others Divisions.

2. PRODUCTS

2.1 CABINETS AND ENCLOSURES

- .1 Cabinets and Enclosures: to CSA C22.2 No. 40-M1989 and as follows:
 - .1 Material: sheet steel
 - .2 Finish: pre-painted
 - .3 Covers: hinged
 - .4 Hinges: concealed flush type
 - .5 Latches: flush lock and catch assembly
- .2 Backboards for Mounting of Cabinets and Enclosures: as specified in other Divisions.

3. EXECUTION

3.1 INSTALLATION

- .1 Install surface or flush mounted cabinets at locations and heights indicated on drawings.

END OF SECTION

WIRING DEVICES

1. GENERAL

1.1 SOURCE OF SUPPLY

.1 Each of the following shall be by a single manufacturer:

- .1 Switches.
- .2 Receptacles.
- .3 Cover plates.

1.2 COORDINATION

.1 Coordinate installation of wiring devices and cover plates with site painting and finishing work specified in other Divisions.

2. PRODUCTS

2.1 SWITCHES

.1 Switches to CSA C22.2 No. 111-M1986 and as follows:

- .1 Rating: except where otherwise indicated or specified, 15 A 125/277V, full load rated for fluorescent and 80% for motor load.
- .2 Type: single pole, three-way or four-way as indicated.
- .3 Operation: toggle, quiet action.
- .4 Features:
 - .1 Totally enclosed, 2-piece phenolic case.
 - .2 Large silver cadmium oxide contacts.
 - .3 Rust resistant continuous steel mounting strip.
 - .4 Captive mounting screws.
 - .5 Large head terminal screws.

2.2 RECEPTACLES

.1 Receptacles, plugs and similar wiring devices to CSA C22.2 No. 42-M1984.

.2 General Purpose Receptacles:

- .1 Rating: 15 A, 125 V except where otherwise indicated.
- .2 Configuration: 5-15R, 2 pole, 3 wire grounding.

WIRING DEVICES

.3 Features:

- .1 Ground terminal and poles connected to continuous mounting yoke.
- .2 Wiring terminals: 8 back-wired entrances, 4 side screws.
- .3 Split feed operation.
- .4 Nylon face.
- .5 Triple wipe brass power contacts.

.3 Isolated Ground Receptacles: same as general purpose receptacles, except for the following features:

- .1 Isolated ground.
- .2 Orange face.

.4 Ground Fault Circuit Interrupter Receptacles: same as general purpose receptacles, except for the following features:

- .1 Solid state ground fault sensing and signaling.
- .2 5 milliamperes ground fault trip level.
- .3 Feed-through type.
- .4 Red trip indicator light.

2.3 COVER PLATES

- .1 Stainless Steel: 1.0 mm thick, protective release paper, stainless steel screws.
- .2 Weatherproof: Polycarbonate with reinforcing ribs, single flip lids, resilient rubber or closed cell foam urethane gasket, four mounting screws.

3. EXECUTION

3.1 INSTALLATION, GENERAL

- .1 Install wiring devices as indicated and in accordance with manufacturer's written instructions.
- .2 Install wiring devices only in electrical boxes which are clean.
- .3 Install devices and cover plates flush and level.
- .4 Provide matching male plug for all receptacles other than 15A 5-15R configuration receptacles.

WIRING DEVICES

3.2 REPLACEMENTS

- .1 Replace all wiring devices and cover plates damaged during construction.

END OF SECTION

MOTOR STARTERS

1. GENERAL

1.1 REFERENCE STANDARDS

- .1 Provide motor protection switches of the CEMA size listed. Maximum rating of units not using CEMA rating to be equivalent to CEMA size indicated.

2. PRODUCTS

2.1 COMBINATION STARTERS

- .1 Molded case air circuit breaker style complete with operating handle and lock-off facility. Opening starter enclosure restricted by the use of a defeater screw, unless switch is in the "Off" position.
- .2 Each combination magnetic motor protection switch installed in unit motor control centre to house the following facilities:
 - 1. Molded case automatic air circuit breaker.
 - 2. Contactor with three overload relays.
 - 3. 120 V holding coil.
 - 4. 2 pilot lights in cover.
 - 5. Reset button, HOA switch, ETM in cover.
 - 6. Auxiliary relays as shown on schematics.
 - 7. Control transformer primary and secondary fusing - primary fusing to be HRC type.
 - 8. Control transformer to be sized to operate coil and associated controls.
 - 9. Pilot lights, selector switches and pushbutton switches to be 30mm. Pilot lights to include push to test feature.

2.2 SOFTSTARTS (SOLID STATE REDUCED VOLTAGE STARTERS)

- .1 Molded case air circuit breaker style complete with operating handle and lock-off facility. Opening starter enclosure restricted by the use of a defeater screw, unless switch is in the "Off" position.
- .2 The solid state reduced voltage starter shall be an integrated unit with power SCRs, heat sink, logic board, paralleling bypass contactor and electronic overload relay.
- .3 Unit to have Digital Interface Module (DIM) for configuring device and reading system parameters. DIM to be remotely mounted on MCC cell door.

MOTOR STARTERS

- .4 Integral bypass contactor to directly connect the motor to line power after ramp up.
- .5 Unit to have Ethernet/IP communications.

3. EXECUTION

3.1 INSTALLATION

- .1 Install overload devices to suit the motor requirements.

END OF SECTION

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 RELATED SECTIONS

- .1 Start-up and commissioning.

1.2 CODES AND STANDARDS

- .1 Design and construct the VFD in accordance with the applicable sections of the following standards or as modified in the specification.
 - .1 ANSI C84.1982 -- Voltage Ratings for Electric Power Systems and Equipment.
 - .2 CAN/CSA-C22.2 -- Industrial Control Equipment No. 14-M91.
 - .3 ANSI C37-90.1-1989 -- Guide for Surge Withstand Capability Tests.
 - .4 Equipment shall have CSA approval.
 - .5 Equipment shall comply with the electrical bylaws of the local electrical authority.
 - .6 Equipment shall be designed and manufactured in compliance with ISO-9001 quality standards.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Division 01 – Submittals Section.
- .2 Submit full technical data, service and parts facilities complete with manufacturer's published data.
- .3 Full shop drawings to be submitted for VFD equipment, submit as a minimum.
 - .1 Specification and Data Sheets.
 - .2 Manufacturer's published warranty documents.
 - .3 Shop drawings showing plan and elevation views with certified overall and interconnection point dimensions.
 - .4 Interconnection wiring diagrams showing all external connections required; with all field wiring terminals marked in a consistent manner.
 - .5 Manufacturer's installation instructions.
 - .6 Manufacturer's recommended spare parts.
 - .7 Complete parts list.

1.4 COORDINATION

VARIABLE FREQUENCY DRIVES

- .1 It shall be the responsibility of the Variable Frequency Drive manufacturer to obtain all operating data and operating characteristics of the electric motors and the pump/motor combinations as may be required to ensure that the VFD's will safely and efficiently drive the intended equipment over the full range of intended operating conditions for the expected service life of 25 years.

2. PRODUCTS

2.1 GENERAL

- .1 The Contractor shall ensure full and complete coordination of the drive and motor characteristics which shall include, but not be limited to, the following:
 - .1 A guarantee that the drive and motor meet the load demands and acceleration requirements of the driven equipment throughout the speed range when the input voltage varies over a range of 10%; and,
 - .2 Ensuring complete compatibility of the drive's current limit protection with the motor thermal withstand capability.
- .2 The drive shall be 97% efficient at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
- .3 Controlled acceleration and deceleration times, separately adjustable, shall be provided.
- .4 Separately adjustable minimum and maximum frequency limits shall be provided.
- .5 The drive shall be capable of regulating the frequency to a $\pm 1\%$ of the setpoint over the full input voltage and ambient temperature operating range.
- .6 The vendor data shall indicate the efficiency, power factor, kW output, heat rejection and harmonic distortion of the drive 25%, 50%, 75% and 100% operating points.
- .7 Audible noise levels produced by the drive shall be limited 80 dBA sound pressure at one meter, at any point throughout the operating range of the drive.
- .8 The drive input shall be protected to withstand surges as defined in ANSI Std. (C37.90.1 - 1989, Guide for Surge Withstand Capability (SWC) Tests.
- .9 The drive shall be capable of data communications via Ethernet TCP/IP or Ethernet/IP.

2.2 CONSTRUCTION REQUIREMENTS

- .1 The drive shall be enclosed in the motor control center unless otherwise specified. Hinged, front access doors shall be provided.
- .2 The drive shall be complete with cable compartments for connection of incoming and outgoing cables.

VARIABLE FREQUENCY DRIVES

- .3 When auxiliary cooling is required, the drive shall have fans and the required controls for proper operation.
- .4 Front panel interface module with LCD display and entry keypad to provide the following functions as a minimum:
 - .1 Drive setup parameters
 - .2 Diagnostic information
 - .3 Drive operating values
- .5 The drive shall have, as a minimum, hardwired connections as follows:
 - .1 Hand-Off-Auto (HOA) switch. HOA to be mounted on VFD enclosure door.
 - .2 Manual speed adjust device potentiometer for speed control when HOA is in "Hand". Potentiometer to be mounted on VFD enclosure door.
 - .3 Run Status
 - .4 Fault Status
 - .5 Auto Status
 - .6 Run Command
 - .7 Frequency Command
 - .8 Frequency Feedback
- .6 The drive shall provide the following signals via data communications as a minimum:
 - .1 Fault Reset
 - .2 Active Faults
 - .3 Phase Current
- .7 The diagnostic system shall monitor each alarm and shutdown function and shall display the status of each point on the cubicle front panel.
- .8 Terminal blocks for control, alarms, metering and diagnostics shall each be readily accessible, grouped and shall be segregated from power devices, for personnel safety.
- .9 Each terminal block, fuse, control switch, circuit breaker, auxiliary switch, relay, instrument transformer and other auxiliary component shall be permanently labeled to correspond with the schematics and wiring diagrams.
- .10 The shop drawing shall state what corrosion protection is provided.

2.3 PROTECTION SYSTEMS

- .1 All power connections, cables and buswork shall be braced to withstand the available asymmetric short circuit current.

VARIABLE FREQUENCY DRIVES

- .2 The drive shall be equipped with a minimum of 15 ms power loss ride-through capability.
- .3 The loss of AC input power longer than 15 ms shall cause the drive to shutdown in an orderly fashion, without causing pulsations in the drive or motor systems.
- .4 The drive shall have the capability of being restarted with a remote signal from the PLC control system.
- .5 The drive shall not be affected by radio frequencies emitted by portable radios/transmitters.
- .6 The drive shall protect itself against the following as a minimum:
 - .1 Under/over voltage
 - .2 Overcurrent
 - .3 Over-temperature
 - .4 Output short circuit
 - .5 Output ground fault
 - .6 Stall

2.4 ACCEPTABLE SUPPLIERS

- .1 Qualifications: service and parts facilities in the Province of Alberta with 24 hour service, experienced in installation and operation of VFD's.
- .2 Drives shall be by Rockwell 753 Series, Eaton DG1 Series, Schneider ATV600 Series, Toshiba AS3 Series.

2.5 WARRANTY

- .1 Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment.
- .2 The warranty shall include all parts, labor, travel time and expenses.

END OF SECTION

ENGINE GENERATORS BASIC

1. GENERAL

1.1 SYSTEM DESCRIPTION

- .1 Provide emergency power system for supply of power in the event of failure of normal supply as indicated and in accordance with Canadian Electrical Code Section 46 and local inspection authority. System to be automatic, unattended, emergency power supply consisting of:
 - .1 Diesel fuel powered, electric generating unit with control panel
 - .2 Accessories and equipment as specified in this Specification.

1.2 DESIGN CRITERIA

- .1 System to consist of complete standby power supply unit, self-contained liquid cooled, diesel engine directly coupled to ac alternator complete with fittings, connections, auxiliaries, control panels, safety devices, meters, etc. as indicated for a complete operating system.
- .2 Design equipment suitable to meet the following criteria:
 - .1 Total Rated Load: 500 KW
 - .2 Voltage: 600V; Three Phase, four wire
 - .3 Frequency: 60 Hz
 - .4 Power Factor: 0.8
 - .5 Maximum Rotational Speed: 1800 rpm
 - .6 Duty Rating: Full continuous standby
 - .7 Performance: Automatic
 - .8 Elevation above sea level: 1020 m
 - .9 Ambient temperature: -40°C to 40°C
 - .10 Relative humidity: 60%
 - .11 Mounted on slab on grade outside of building
- .3 Unit must be capable of starting, attaining settled voltage and frequency limits and accepting full rated load with voltage and frequency settling to the specified steady state bands, all within 15 seconds for any temperature between -40 °C. to 40 °C.
- .4 Use engine manufacturer's standard, published continuous (prime) horsepower rating in assessing engine capacity and derate this rating for the specified conditions and engine driven accessories in accordance with latest revisions of ISO 3046/1.

ENGINE GENERATORS BASIC

- .5 Description of generating set operation upon power failure:
 - .1 Automatic starting on contact closure from automatic transfer switch.
 - .2 When the emergency supply has reached settled voltage and frequency preset limits (adjustable) the transfer switch will transfer the load to the emergency supply.
 - .3 The set will continue to supply the load until utility supply returns or the set is shut down manually or under failure conditions.
 - .4 An adjustable time delay relay shall allow the engine to run unloaded to cool down and subsequently to shut down, ready for the next cycle.
 - .5 The engine shall be equipped with a key switch with the following positions: Auto-off-crank-start, key removable in auto positions only.
 - .6 Automatic shut down on:
 - .1 Overcranking
 - .2 Overspeed
 - .3 High engine temperature
 - .4 Low lubricating oil pressure
 - .5 Over and under frequency
- .6 Unit to be equipped with a double wall secondary containment sub-base fuel tank which will contain fuel to support the generator set for a minimum period of 24 hours at 100% rated load. Additional criteria as follows:
 - .1 The above ground steel secondary containment tank for use as a sub base for diesel generators is manufactured and intended to be installed in accordance with the Flammable and Combustible Liquids Code – NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines – NFPA 37 and Emergency and Standby Power Systems – NFPA 110.
 - .2 For normal venting the unit shall be furnished with an appropriate sized vent cap.
 - .3 The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than stipulated in NFPA 30 based on the wetted surface area of the tank. The wetted area of the tank shall be calculated on the basis of 100 percent of the primary tank.
 - .4 Emergency venting shall be provided for the secondary tank.
 - .5 There shall be a 2" NPT opening within the primary tank for fuel fill. The fuel fill shall be furnished with a lockable manual fill cap.

ENGINE GENERATORS BASIC

- .6 A local fuel level indication (0-100%) shall be provided. The indication shall be visible from the fuel fill location.
- .7 A fuel level transmitter capable of providing a 4-20mA DC signal for remote indication shall be provided. The transmitter shall be capable of 0-100% of fuel level.
- .8 A low fuel level switch shall be provided for remote annunciation.
- .9 A leak detection switch shall be provided for remote annunciation of the presence of fuel in the secondary tank.
- .10 A drain shall be provided on the secondary tank.
- .7 The unit shall be housed in an outdoor enclosure as follows:
 - .1 Weatherproof Sound attenuating enclosure (<70 dBA at 7 meters)
 - .2 Winter package rated for – 40 deg C operation
 - .3 Automatic Louvers to modulate enclosure heat.
- .8 Unit to be equipped with a second generator breaker to allow for periodic connection of a load bank for testing.
- .9 Communication
 - .1 The Generator shall be able to communicate via Ethernet for remote monitoring purposes.

1.3 MANUFACTURER

- .1 Generator: Blue Star, Cummins, Caterpillar, MTU, or approved equivalent.

1.4 SUPPLIER QUALIFICATIONS AND QUALITY ASSURANCE

- .1 Qualifications: service and parts facilities in close proximity with 24 hour service, experienced in installation and operation of set of comparable size.
- .2 A minimum of five years experience in the design, manufacture, assembly and testing of diesel fuel generator systems is required.
- .3 All work shall meet requirements of Quality Standard CSA Z299.3.

1.5 SHOP DRAWINGS

- .1 Submit within 2 weeks of contract award an electronic copy (PDF format) of shop drawings for review to Engineer.

ENGINE GENERATORS BASIC

- .2 An electronic copy will be returned to the Contractor within 2 weeks of receipt as reviewed, reviewed as noted, or rejected. Contractor shall incorporate changes identified on the drawings and resubmit the drawings for further review within two weeks.
- .3 Do not proceed with fabrication of equipment until review process is completed.
- .4 Shop drawings and specifications shall include, but not be limited to, the following:
 - .1 Engine: make, model, rating and performance curves.
 - .2 Starter motor, make, model.
 - .3 Generator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.
 - .4 Voltage Regulator: make, model, type.
 - .5 Governor: type, model.
 - .6 Battery: make, type, voltage, capacity.
 - .7 Charger: make, model, input and output rating.
 - .8 Submit a general outline drawing of the complete assembly showing engine and generator mounting , exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings horizontal and vertical dimensions, minimum door opening required for moving the unit, head room required for removal of piston and connecting rod, and weight of engine, generator, baseplate and exhaust silencer.
 - .9 Baseplate construction details and materials.
 - .10 Type and layout of all panels.
 - .11 Schematic and wiring diagrams of engine, generator and control panel.
 - .12 Single line diagram showing all breakers, switches, metering and protective relays.
 - .13 Field wiring diagrams.
 - .14 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.
 - .15 Type of Ethernet interface and protocol used.
- .5 Device Numbering System shall be in accordance with IEEE 200-1975 Reference Designations for Electrical and Electronics Parts and Equipment.

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- .6 Responsibility for errors and omissions in the drawings submittal is not relieved by review of submittals by Owner or the Engineer

1.6 MAINTENANCE DATA AND INSTRUCTION MANUALS

- .1 Provide, but not be limited to, the following in English for incorporation into instruction manuals:
 - .1 Complete set of reviewed shop drawings.
 - .2 Factory test data of engine, generator, exciter, control logic, metering and all other pertinent test data.
 - .3 Maintenance and operation bulletins for:
 - .1 Engine and Accessories.
 - .2 Generator.
 - .3 Voltage Regulator and Accessories.
 - .4 Exciter.
 - .5 Permanent magnet generator if installed.
 - .6 Battery Charger.
 - .7 Speed Governor.
 - .8 Starting Motor.
 - .9 Batteries.
 - .10 Ventilating Equipment.
 - .11 Timers, Relays, Meters.
 - .12 Power Circuit Breakers.
 - .13 Other Accessories.
- .2 If brochures are submitted, these shall be originals; photocopies are not acceptable. Brochures shall contain all technically relevant data.
- .3 Complete sequence of system operation.
- .4 Complete bill of materials including nameplate data of equipment and accessories.
- .5 Forward, two weeks prior to the factory tests, one copy of instruction manual.

ENGINE GENERATORS BASIC

- .6 Forward, within two weeks after the factory tests, three copies of instruction manuals, with updated drawings.

1.7 GUARANTEE

- .1 Provide a written guarantee signed and issued to the Owner stating that the complete assembly consisting of the generator unit and all equipment and accessories is guaranteed against defects and malfunction for a period of two years from the date of installation.

1.8 SPARES

- .1 For panels provide the following:
 - .1 One spare control circuit breaker per rating.
 - .2 One spare control relay and socket per rating and contact arrangement.
- .2 Provide for the generator unit, a standard set of engine manufacturer's spare parts for one year normal operation 1,000 operating hours. Spares to include as a minimum:
 - .1 Two fuel filter elements for each type of fuel filter/water separator.
 - .2 Two lubricating oil filter elements.
 - .3 Three air cleaner elements.
- .3 Provide conclusive evidence that a Canadian distributor has been established and will stock in Canada spare parts likely to be required during the normal life of the engine.

1.9 ACCEPTANCE TESTS

- .1 General: before acceptance, assemble and setup the unit, complete with specified equipment, for tests at the supplier's plant. Tests may be witnessed by the Engineer on a date mutually agreed on. Provide suitable test area with adjustable loading facilities. Supplier shall ensure that the engine has run in sufficiently prior to load test, all test forms filled in, system debugged and recorders connected.
- .2 Examination of product: A complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.
- .3 Non-operational tests and checks: perform following test and checks before starting the unit:
 - .1 Shaft alignment, end float, angular and parallel.
 - .2 Cold resistance of generator windings.
 - .3 Belt tensioning.

ENGINE GENERATORS BASIC

- .4 Equipment grounds.
- .5 Electrical wiring.
- .6 Personnel safety guards.
- .7 Air cleaner.
- .8 Lubricating oil type and level.
- .9 Type of fuel.
- .10 Vibration isolator adjustment.
- .11 Temperature and pressure sensors.
- .12 Engine exhaust system.
- .13 Tools.
- .14 Spares.
- .15 All lubricating points.
- .4 Operation test and check: on completion of paragraph 1.10.3, start the unit cold. Provide multi-channel recorder and record the following:
 - .1 Time for unit to start and reach settled voltage and frequency.
 - .2 Time from initiation of start to full load application, with voltage and frequency settled.
 - .3 Voltage and frequency transient and steady state limits for full load to no load, $\frac{3}{4}$ load to no load, $\frac{1}{2}$ load to no load and $\frac{1}{4}$ load to no load and vice versa.
 - .4 Record battery voltage drop during cranking.
- .5 Protection and control demonstration: on completion of paragraph 1.10.4, demonstrate the following:
 - .1 Overheat protection.
 - .2 Low oil pressure protection.
 - .3 Cranking cut out.
 - .4 Overcrank protection (3 tries).
 - .5 Overspeed protection.
 - .6 Under and over frequency.

ENGINE GENERATORS BASIC

- .7 Under and over voltage.
- .8 All control functions.
- .6 Factory Load Test:
 - .1 Perform torsional analysis test of engine and generator compatibility.
 - .2 Perform a four hour load test using a portable test bank. Perform test for three hours with load applied in 20% steps every 30 minutes until full load is applied and one hour at 110% full load. Record following at 30 minute intervals during the entire test:
 - .1 Kilowatts
 - .2 Amperes
 - .3 Voltage
 - .4 Frequency
 - .5 Oil Pressure
 - .6 Coolant Temperature
 - .3 Test response of governor (droop or isochronous) applying 20% load and 100% load in one step. Use a storage oscilloscope or strip chart recorder to determine response time, voltage and frequency fluctuations during test.
 - .4 Test voltage regulator and compare for conformance to manufacturer's product data.
 - .5 Record noise level measurements in dB at various locations around unit and area surrounding exhaust port.
 - .6 Submit certified tests results for approval by owner representative.
- .7 Field Load Test:
 - .1 Perform a four hour load test using a portable test bank. Perform load test with load applied in 20% steps every 30 minutes until full load is applied. Record following at 30 minute intervals during the entire test:

ENGINE GENERATORS BASIC

- .1 Kilowatts
- .2 Amperes
- .3 Voltage
- .4 Frequency
- .5 Oil Pressure
- .6 Coolant Temperature
- .2 Test all alarm and shutdown circuits by simulating conditions. Closing or opening of appropriate sensor contacts mechanically is not acceptable.
- .3 Record noise level measurements in dB at various locations in generator room and area surrounding exhaust port.
- .8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is the lowest temperature registered out of a group of three thermometers when placed in engine enclosure as follows:
 - .1 One thermometer located on each side of the engine block, approximately two-thirds of the length of the block back from front end of block, 900 mm out from block and at a height equal to height of block. A third thermometer located over end of exciter on the unit centreline, approximately 150mm above top of exciter.
 - .2 Take the thermometer showing the lowest temperature to give true ambient air temperature. Adjust temperature to maintain this thermometer at 40 degree C during the heat test.
- .9 Voltage and frequency regulation tests: on completion of load tests take the hot reading of generator windings. Subject the unit to hot voltage and frequency regulation tests for full load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa.
- .10 Panel performance and functions: check sequence of operation under service conditions. Make provision for supplying and connecting required levels of voltage for primary circuits. Test overcurrent relays by impressing current in secondary circuits.
- .11 Hi-pot tests: perform over potential tests on primary and secondary wiring in accordance with appropriate EEMAC Standard.
- .12 Additional tests: perform any tests, consistent with the contract, to satisfy the Owner of the adequacy and satisfactory operation of the unit.
- .13 Supplier shall record all test data on manufacturer's test forms and be complete with diagrams and description of test results, deficiencies and corrective action. Test data sheets shall be signed by the supplier and Owner's representative.

ENGINE GENERATORS BASIC

1.10 REFERENCES

- .1 Each assembly shall be constructed and tested in accordance with all applicable sections of the latest revision of the following codes.
 - .1 Canadian Standards Association (CSA).
 - .2 Electrical and Electronic Association Manufacturers of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 American National Standards Institute (ANSI).
 - .5 Institute of Electrical and Electronic Engineers (IEEE).
 - .6 American Society of Mechanical Engineers (ASME).
 - .7 American Society for Testing and Materials (ASTM).
 - .8 Society of Automotive Engineers (SAE).
 - .9 Canadian Government Specifications Board (CGSB).
 - .10 International Standards Organization (ISO).
 - .11 Provincial Electrical Protection Act.

2. PRODUCTS

2.1 ASSEMBLY

- .1 Provide the following items plus such other items as necessary to make the unit complete as implied or intended:
 - .1 Engine.
 - .2 Engine Accessories.
 - .3 Baseplate and Drip Pan.
 - .4 Vibration isolators.
 - .5 Governor.
 - .6 Engine Exhaust System.
 - .7 Engine Cooling System.
 - .8 Engine Ventilating System.

ENGINE GENERATORS BASIC

- .9 Starting Motor(s).
- .10 Batteries and Rack.
- .11 Battery Charger.
- .12 Generator and Exciter.
- .13 Voltage Regulator and Accessories.

2.2 GENERAL CONSTRUCTION

- .1 Mount on common steel rail base complete with steel spring vibration isolators between rail base and concrete base pad.
- .2 Provide semi-flexible couplings between generator and engine and protective guards over moving parts.
- .3 Machine enamel finish to be approved by the Engineer.
- .4 Provide fuel shut-off valve.

2.3 WIRING AND CONNECTIONS

- .1 Provide all conduit, wiring and connections required and recommended by unit supplier.
- .2 Install all control and alarm wiring in rigid steel conduit.
- .3 Connect neutral point of generator and generator frame to ground by #1/0 copper conductor.

2.4 TOOLS

- .1 Provide a complete set of specialized tools required for the proper care, adjustment and maintenance of equipment supplied.

2.5 SIGNS

- .1 Provide and attach to the unit in a prominent location a warning sign indicating that generator starts automatically.

2.6 FINISHING AND PAINTING

- .1 Properly clean, finish and paint equipment with a smooth and durable finish. Use grey gloss 501.108 except inside of panel to be painting with white gloss 513-101 in accordance with CGSB 1GP-12c schedule of paint colours.

2.7 WORKMANSHIP

- .1 Manufacture and construct the equipment with new materials, and in the best workmanship manner.

ENGINE GENERATORS BASIC

- .2 Give particular attention to freedom from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

3. EXECUTION

3.1 COORDINATION WITH OTHER SECTIONS OF WORK

- .1 Coordinate to ensure proper execution of work covering ventilation, field supply and products-of-combustion exhaust, to form an efficient and well-coordinated layout.

END OF SECTION

GENERATORS

1. GENERAL

1.1 REGULATORY REQUIREMENTS

- .1 Manufacture unit to CEMA standards.

2. PRODUCTS

2.1 COMPONENTS

- .1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing. Generator to have a full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection, and meet or exceed EEMAC MGI-22 and current IEEE standards.
- .2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.
- .3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 2.4 times rated current.
- .4 Generator winding insulation shall be Class F; winding temperature rise not to exceed 80 degree C as measured by resistance in an ambient temperature of 40 degree C.
- .5 Identify generator windings with metal tags. Bring windings to insulated terminals in a metal junction box mounted on the side or top of generator. Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks. Provide barrier in junction box to separate low and high voltage wiring.
- .6 Provide a voltage regulation system complete with auto/manual control module. Voltage regulator shall be capable of withstanding continuous vibration, 15G shock and temperature up to 50 degrees C while maintaining accuracy to plus/minus 1%.
- .7 Steady-state voltage regulation not to exceed 1%. Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.
- .8 Design equipment to minimize radio frequency interference (RFI) under all operating conditions. Balanced telephone influence factor (TIF) to meet or better requirements of EEMAC Standard MGI-22.43.
- .9 A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed.

GENERATORS

3. EXECUTION

3.1 INSTALLATION

- .1 Provide terminal box for generator and exciter leads.
- .2 Install unit complete and make operational.

3.2 MOUNTING

- .1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter. Mount unit on a common, heavy duty, fabricated steel baseplate. Design and materials of baseplate must be approved by engine manufacturer.
- .2 Baseplate of sufficient rigidity to maintain alignment of engine-generator shafts and frames under all conditions incident to shipping, installation and service.
- .3 Machine engine-generator feet and baseplate sole plates parallel and true. Shimming to be steel type and only permitted underneath the generator feet.
- .4 Support baseplate on spring type isolating fixtures from welded side brackets located in such a manner that bottom of baseplate will be approximately 25mm above supporting floor. Isolators shall have cast iron housings and be complete with leveling bolts, adjustable oil proof snubbers and minimum 6mm sound pads. Isolation efficiency to be not less than 95%.
- .5 Determine quantity and location of isolators in such a manner that each isolator will carry equal proportion of weight and that the pressure exerted on the floor by each isolator does not exceed 345 kPa.
- .6 Isolators shall be shipped loose for installation at project site.
- .7 Unit to be suitable for mounting directly on a concrete floor slab base with suitably sized Hilti anchors.

END OF SECTION

ENGINE

1. GENERAL

- .1 Not Applicable

2. PRODUCTS

2.1 DESIGN/COMPONENTS

- .1 Diesel fuel, heavy duty, cold start, liquid cooled, vertical in line or vee, and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years. Turbocharged engine acceptable providing brake mean effective pressure (BMEP) at rated output does not exceed 1800 kPa. Mechanically driven superchargers not acceptable.
- .2 Capacity: Section – Engine Generators Basic.
- .3 Circulation heater located in cooling jacket complete with immersion thermostat for 208 VAC operation.
- .4 Accessories: Provide all replaceable type oil filters, dry type air cleaners, automatic, lubricating oils and greases, etc.
- .5 Engine shall have a minimum of four (4) cylinders.
- .6 Engine with auxiliary starting aids (e.g., glow plug assist start) not acceptable.
- .7 Equip engine air intakes with dry type heavy duty air cleaners located close to the inlet manifold. Cleaner element to be directly replaceable with elements of Canadian manufacture.
- .8 Provide engine wiring for auto-marine type with plastic shield. Use stranded, minimum No. 14 AWG, TEW 105 °C and coloured coded wires. Terminal wiring with coded, insulating terminals flanged fork. Terminal blocks heavy duty, screw type. Wire markers of slip on oil proof type. Maximum of two wires per terminal block.
- .9 Provide high quality gauges and instruments as specified in Section – Alarms and Instrumentation and provide other standard gauges and instruments. Calibrate and scale gauges and instrument in both metric and imperial units and symbols. Oil temperature sensors to be mounted on engine full flow pressure line. Hoses or tubing for gauges shall be high pressure reinforced type.

ENGINE

- .10 Provide engine control panel complete with:
 - .1 Tachometer.
 - .2 Lubricating oil pressure gauge.
 - .3 Lubricating oil temperature gauge.
 - .4 Low Coolant level gauge.
 - .5 Engine switch auto-off-crank-start selector switch and crank pushbutton.
 - .6 Terminal blocks for connection to D.C. power supply, engine monitoring and shutdown device.
 - .7 Low pressure, high coolant temperature, and overspeed protection to shut down engine on automatic and manual operation.
- .11 Mount unit accessories, including gauges, instruments, and protective sensors, in such a manner that machine vibrations are isolated or dampened.
- .12 Dynamically balance complete engine-flywheel generator arrangement after assembly. Guarantee no torsional or other harmful vibration within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating. Cyclic irregularity to be no greater than 1/250.
- .13 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.
- .14 Provide personnel safety guards for exposed moving parts and exhaust manifolds. Provide platform for servicing upper part of engine where applicable.

2.2 SPEED GOVERNOR

- .1 Provide full electronic governor with speed changer and dry type actuator. Governing System shall be in accordance with ISO 3046/4-1978(E).
- .2 Governor shall provide the following features:
 - .1 Ten turn locking type manual speed adjustment.
 - .2 Speed regulation, steady state, no-load to full load and vice versa: $\pm 0.25\%$, three cycles maximum with two second maximum recovery to steady state.
 - .3 Transient peak, no-load to full-load and vice versa: $\pm 0.10\%$.
 - .4 Recovery time to steady state condition on application of full load from no load not to exceed three seconds.
 - .5 Frequency shall be externally adjustable from zero to 5% while engine is running.
 - .6 Class A accuracy.

ENGINE

2.3 LUBRICATION SYSTEM

- .1 Provide a full pressure lubricating system complete with filter and oil cooler.
- .2 Oil pump shall be engine driven gear type complete with strainer.
- .3 Equip engine oil sump with oil drain pipe, gate valve and pipe cap. Permit complete drainage in a convenient manner.
- .4 All metallic oil hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.
- .5 Provide the initial fill of all required fluids and lubricants for the generator.
- .6 Engine crankcase breather to be equipped with device to minimize emission of oil vapors.

3. EXECUTION

3.1 INSTALLATION

- .1 Install unit complete and make operational.

END OF SECTION

COOLING EQUIPMENT

1. GENERAL

- .1 Not Applicable

2. PRODUCTS

2.1 COMPONENTS

- .1 Engine to include self-contained liquid cooling complete with fan maintaining safe operating temperature for unit under full load conditions.
- .2 Enclosure to be equipped with motorized dampers.

END OF SECTION

EXHAUST EQUIPMENT

1. GENERAL

- .1 Not Applicable.

2. PRODUCTS

2.1 COMPONENTS

- .1 Muffler and piping: hospital type, completely sealed, metal, primed finish.

3. EXECUTION

3.1 INSTALLATION

- .1 Coordinate size and installation of exhaust piping with mechanical section and generator set supplier.
- .2 Install muffler horizontally on spring type compensating hangers as close to unit as practical.
- .3 Provide 12 mm copper drain line from bottom of muffler to drain cock for periodic draining of muffler.
- .4 Provide flexible connection from manifold to muffler.

END OF SECTION

STARTING SYSTEM

1. GENERAL

1.1 SYSTEM

- .1 Unit to be for automatic starting upon power failure.

2. PRODUCTS

2.1 COMPONENTS

- .1 Provide a complete starting system including cranking starting motor, batteries, battery stand, heavy-duty battery cables and wall mounted battery charger.
- .2 Provide positive engaging type cranking motor. Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment not acceptable.
- .3 Provide lead acid battery with sufficient capacity to crank the unit at engine manufacturer's recommended cranking starting speed for a period of 3 minutes. Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, to be not less than 1.75 V per cell. Size battery on the basis of engine and battery manufacturer's published data. Battery termination shall be bolt-on or study type. Terminals and all exposed electrical connections shall be protected from accidental short circuit by falling conductive objects on the battery. Such protection shall be transparent.
- .4 Provide battery stand coated with acid resistant paint and fabricated from angle irons with 20 mm plywood bottom.
- .5 Provide battery charger with 120 volt AC input and output equal to 1.20 of the ampere-hour capacity of the battery based on an 8 h rate. Output voltage ripple shall be 3% or less. Provide an AC input circuit breaker and a 24 h terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals. Provide 5 spare fuses inside charger panel. Charger to be CSA approved.
- .6 Provide necessary heavy duty, maintenance-free battery cables and connectors. Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load. Cable length to be sufficient to allow battery to be located on either side of the engine.

3. EXECUTION

3.1 OPERATION

- .1 Stop/Start Sequence: See Section – Alarms and Instrumentation.
- .2 Battery Charger: adjustable rate of charge, "floating" on batteries at all times with full charging period of 24 hours maximum.

END OF SECTION

ALARMS AND INSTRUMENTATION

1. GENERAL

1.1 SYSTEM

- .1 Provide a digital solid state controller complete with all control and power modules for sensing, timing, logic and instrumentation to control the diesel generator set and automatic transfer system in accordance with Section 46 of the Canadian Electrical Code and the electrical inspection authority.

2. PRODUCTS

2.1 CONTROLLER

- .1 The controller shall include, but not be limited to, the following features:
- .1 Set-mounted controller capable of facing right, left or rear shall be vibration isolated on the generator enclosure. The controller shall be capable of being remote mounted. The microprocessor control board shall be moisture proof and capable of operation from -40°C to 85°C.
 - .2 Fused DC circuit.
 - .3 Complete 2-wire start/stop control, which shall operate on closure of a remote contact.
 - .4 Speed sensing and independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel.
 - .5 The starting system shall be designed for restarting in the event of a false engine start by permitting the engine to completely stop and then re-engage the starter.
 - .6 Cranking cyler with 15 second ON and OFF cranking periods.
 - .7 Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
 - .8 Circuitry to shut down the engine if high coolant temperature, low oil pressure or overspeed. Shutdown to occur in either automatic or test modes.
 - .9 Engine cooldown timer set at 5 minutes to permit unloaded running of the generator after transfer of the load to normal.
 - .10 3-position (Auto-Off-Test) selector switch. In the Test position, the engine shall start and run regardless of the position of the remote starting contacts. In the Auto position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the Off position, the engine shall not start even if the remote start contacts close. The Off 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.

ALARMS AND INSTRUMENTATION

- .11 Ethernet connection for remote monitoring of equipment. Monitoring software, if required, is to be provided with unit.
- .12 Controller enclosure heater where the genset is located outdoors in non-heated enclosure.

2.2 INSTRUMENT PANEL

- .1 The instrument panel shall include, but not be limited to, the following features:
 - .1 Standard indication by means of indicating lights (colours shown) or display screen as follows:
 - .1 Not-in-Auto (flashing red).
 - .2 System Ready (green).
 - .3 Overcrank (red).
 - .4 Emergency Stop (red).
 - .5 Prealarm High Engine Temperature (yellow).
 - .6 High Engine Temperature (red).
 - .7 Prealarm Low Oil Pressure (yellow).
 - .8 Low Oil Pressure (red).
 - .9 Overcrank (red).
 - .10 Battery Charger Malfunction (red).
 - .11 Low Battery Voltage (red).
 - .12 Low Fuel (red).
 - .13 Fuel Tank Leak (red).
 - .2 Test button required for indicating lights where indicating lights used.
 - .3 Voltage indication per phase via gauge or display screen, +/- 2% accuracy.
 - .4 Current indication per phase via gauge or display screen, +/- 2% accuracy.
 - .5 Frequency indication via meter or display screen, +/- 0.5% accuracy, scale 45 Hz to 65 Hz.
 - .6 Battery charging voltage indication via gauge or display screen.
 - .7 Coolant temperature indication via gauge or display screen.

ALARMS AND INSTRUMENTATION

- .8 Oil pressure indication via gauge or display screen.
- .9 Running-time meter via gauge or display screen.
- .10 Voltage-adjustment via control panel or rheostat.

2.3 FUEL LEVEL INDICATION

- .1 Provide local (to generator) fuel level indication (0% to 100%).
- .2 Provide remote fuel level indication (0% to 100%). This is to be a 4-20mADC signal used for station Control System.

2.4 REMOTE CONTROL AND ALARM/STATUS INDICATION

- .1 Provide dry contacts for each of the following alarm/status indications:
 - .1 Run Status.
 - .2 Not-in-Auto.
 - .3 Common Prealarm.
 - .4 Common Fault.
 - .5 Battery Charger Fault.
 - .6 Fuel Tank Leak.
- .2 Run Relay to provide a three-pole, double-throw relay with 10 amps at 250 VAC contacts for indicating that the generator is running.
- .3 Provide data communication interface using Ethernet.

END OF SECTION

AUTOMATIC TRANSFER SWITCH

1. GENERAL

1.1 RELATED SECTIONS

- .1 Basic Electrical Requirements: Section 260500.

1.2 SYSTEM

- .1 Unit to be designed for fully automatic operation upon power failure. Unit to sense utility failure, initiate generator start sequence, and transfer load under correct parameters.

2. PRODUCTS

2.1 COMPONENTS

- .1 Automatic transfer switch: Contactor based, 3 pole, fully automatic electrically operated, mechanically held, for all load classes with normal and emergency supply 3 phase, 3 wire, complete with auxiliary engine starting contacts, to operate on disruption of voltage or frequency (user adjustable settings) on any phase of normal power. Amperage and voltage as shown on drawings.
- .2 Provide time delay relays, adjustable from 10 seconds to 5 minutes to delay transfer from normal to standby until standby power source has obtained 90 per cent of rated voltage.
- .3 Provide time delay relays, adjustable from 1 to 5 minutes, to delay transfer from standby to normal source. Engine rundown period of "No-Load" for 5 minutes.
- .4 Fault level to match level of specified equipment fed from transfer switch.
- .5 In cover of transfer switch provide indication of transfer switch position complete with test switch to simulate a power failure.
- .6 Provide four sets of contacts to indicate supply being used. Two sets of contacts to be closed when normal supply is sourced. Two sets of contacts to be closed when standby supply is sourced.
- .7 Provide a feature which will monitor a remote contact (from station control system). Closure of this contact will initiate a transfer to standby power if the transfer switch is in the utility power position. Opening of this contact will initiate a transfer to utility power if the transfer switch is in the generator power position.
- .8 Capability of Ethernet data communication for remote monitoring of equipment. Communication module to have an embedded webpage which can be viewed with a standard Web browser. Webpage to display all information available on local display.

2.2 ACCEPTABLE MANUFACTURERS

- .1 Asco 7000 Series. No alternates.

AUTOMATIC TRANSFER SWITCH

3. EXECUTION

3.1 OPERATION

- .1 Automatic start-up upon normal power failure.
- .2 Transfer when standby unit reaches 90% of rated voltage.
- .3 Retransfer to normal supply after time delay, when normal power is resumed.
- .4 Engine rundown period at "No "Load".
- .5 Engine shutdown/after rundown.
- .6 Operating sequence automatically reset.

END OF SECTION

LIGHTING

1. GENERAL

1.1 SHOP DRAWINGS

- .1 Provide shop drawings for luminaires. Include all pertinent physical characteristics. Manufacturer's standard catalogue literature, clearly marked, may be used where applicable. Provide photometric data for each fixture and lamp combination.

2. PRODUCTS

2.1 LUMINAIRES

- .1 As shown on luminaire schedule on drawings.

2.2 LIGHTING CONTROLS

- .1 Controls: Provide switches, photoelectric controls, timers and relays for lighting circuits and luminaires as indicated on drawings.

3. EXECUTION

3.1 INSTALLATION

- .1 Provide adequate supports for luminaires. Use chain or rods for suspended luminaires. Do not support luminaires over 5 kg in weight from outlet boxes.
- .2 Coordinate luminaire installation with architectural details, reflected ceiling plans and mechanical equipment. Install accurately in line and level, to present a neat appearance and avoid conflicts.
- .3 Do the following prior to Interim Acceptance of the Work:
 - .1 Clean all luminaires to remove construction dust and debris.
 - .2 Re-lamp with new lamps, all luminaires which have been used for more than two months as temporary lighting during construction.

END OF SECTION

EMERGENCY LIGHTING

1. GENERAL

.1 WORK INCLUDED

- .1 Supply emergency lighting units complete with all accessories.

.2 SPECIAL CODES

- .1 Canadian Electric Code, Part 1, Section 46 "Emergency Systems, Unit Equipment and Exit Signs".
- .2 CSA Standard C22.2 No. 141-M1985 "Unit Equipment for Emergency Lighting"
- .3 CSA Standard C282-05 "Emergency Electrical Power Supply for Buildings"
- .4 National Building Code and Alberta Building Code

2. PRODUCTS

.1 GENERAL

- .1 Supply and install emergency lighting system as shown on the drawings. Lights are to switch "ON" automatically in the event of failure of normal power, and "OFF" on restoration of power.
- .2 System will consist of a central battery/charger with remote lighting heads or self contained units with battery/charger and integral heads or a combination of the two.

.2 INTEGRAL BATTERY/LIGHTING UNITS

- .1 As shown on luminaire schedule on drawings.

.3 CENTRAL BATTERY UNIT

- .1 As shown on luminaire schedule on drawings.

.4 REMOTE LIGHTING HEADS FOR EQUIPMENT SERVICE

- .1 As shown on luminaire schedule on drawings.

.5 REMOTE LIGHTING HEADS FOR EGRESS

- .1 As shown on luminaire schedule on drawings.

.6 EXIT SIGNS REMOTE POWERED

- .1 As shown on luminaire schedule on drawings.

EMERGENCY LIGHTING

.7 EXIT SIGN AND LIGHT HEADS WITH INTEGRAL BATTERY

- .1 As shown on luminaire schedule on drawings.

3. EXECUTION

.1 INSTALLATION

- .1 Mount battery units and remote heads as indicated on the drawings.
- .2 Wiring from units to remote heads and/or exit lights shall be sized to prevent voltage drop of more than 5%.
- .3 Balance loads on battery units.

END OF SECTION

DIVISION 31 – EARTHWORK

AGGREGATES AND GRANULAR MATERIALS

1.0 GENERAL

- 1.1 Section 31 05 16 refers to those portions of the Work that are unique to the supply and processing of aggregates. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

Section 31 05 16 includes specifications for aggregates and granular materials referred to in the following sections:

- | | | |
|-------|---|---------------------|
| 1.2.1 | Excavating, Trenching, and Backfilling | Section 31 23 33.01 |
| 1.2.2 | Roadway Excavation, Embankment and Compaction | Section 31 24 13 |
| 1.2.3 | Granular Subbase | Section 32 11 16.01 |
| 1.2.4 | Granular Base | Section 32 11 23 |
| 1.2.5 | Riprap | Section 31 37 00 |
| 1.2.6 | Horizontal Drilling and Pipe Encasement | Section 33 05 27 |
| 1.2.7 | Waterworks | Section 33 11 01 |

Section 31 05 16 does not include specifications for aggregates to be incorporated into hot-mix asphalt concrete paving, pavement crack filling, ready-mixed concrete or granular materials for landscaping purposes. These specifications are designated as follows:

- | | | |
|--------|-------------------------|---------------------|
| 1.2.8 | Cast-in-Place Concrete | Section 03 30 00 |
| 1.2.9 | Controlled Density Fill | Section 31 23 23 |
| 1.2.10 | Mechanical Seeding | Section 32 92 19.13 |
| 1.2.11 | Hydraulic Seeding | Section 32 92 19.16 |

1.3 References

- 1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 45 00.

1.4 Approvals

- 1.4.1 Inform Consultant of proposed source and provide samples at least 2 weeks prior to commencing production.
- (a) Product Data: Submit manufacturer's instructions, product literature, and data sheets for [aggregate materials]. Include product characteristics, performance criteria, practical size, finishes, and limitations.

AGGREGATES AND GRANULAR MATERIALS

- 1.4.2 If, in opinion of *Consultant*, materials from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate alternative source or demonstrate that materials from source in question can be processed to meet specified requirements.
- 1.4.3 Should a change of material source be proposed during work, advise *Consultant* 2 weeks in advance of proposed change to allow sampling and testing.
- 1.4.4 Acceptance of material does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory
- 1.5 Measurement and Payment
 - 1.5.1 Payment for all work performed as specified in this Section is deemed to be incidental to payment for work specified in other Sections unless specifically noted as payment item in the Tender Form.

2.0 PRODUCTS

- 2.1 Materials – General
 - 2.1.1 Gravel to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over a five year period for particular source of material, soundness to be tested according to ASTM test procedure C-88 or latest revised issue.
 - 2.1.2 All crushed gravel when tested according to ASTM C-136 and ASTM C117, or latest revised issue, to have a generally uniform gradation and conform to following gradation limits and 60% of the material passing each sieve must have one or more fractured faces. The Plasticity Index for crushed gravel to not exceed 6.0.
- 2.2 Native Material
 - 2.2.1 Any workable soil free of organic or foreign matter obtained within limits of project shall be deemed native material. Native material is not acceptable if it is impracticable to control its water content. To be readily compactable to densities specified in Section 31 24 13 – Roadway Excavation, Embankment, and Compaction.
- 2.3 Pit Run Gravel
 - 2.3.1 To be well graded granular material, substantially free from clay lumps, organic matter and other extraneous material, screened to remove all stones in excess of 150 mm. To compact readily to a firm stable course. Conform to following gradations:

Sieve Size (mm)	Percent Passing for Nominal Maximum Size
-----------------	--

AGGREGATES AND GRANULAR MATERIALS

150	100
75	80 - 100
25	50 - 100
4.75	25 - 100
0.075	2 - 8

2.4 Pit Run Sand

2.4.1 To be well graded pit run sand, free from organic materials and conform to following gradations:

Sieve Size (mm)	Percent Passing for Nominal Maximum Size
13.000	100
4.750	35 - 100
2.360	20 - 70
1.180	13 - 50
0.850	8 - 35
0.300	5 - 25
0.150	2 - 15
0.075	0 - 6

2.5 Dain Rocks

2.5.1 To consist of clean round stone or crushed rock conforming to following gradations:

Sieve Size (µm)	Percent Passing for Nominal Maximum Size
25,000	100
5,000	Maximum 10
80	Maximum 2

2.6 Granular Pipe Bedding and Surround Material

2.6.1 Bedding shall be of the type and class specified within the approved construction drawings and shall conform to the details shown and the following requirements:

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- (a) Bedding material shall consist of hard durable particles free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.
- (b) Bedding material shall conform to the embedment materials specified in ASTM D2321.
- (c) Where pipe bedding materials require compaction to meet the density requirements of City of Calgary specifications 504.03.08 and Sheet 39A, it shall be achieved by means of hand compaction in 150mm lifts, with final densities confirmed by geotechnical testing and documentation.
- (d) The following tables must be used in conjunction with City of Calgary Drawing Sheet #39A. The bedding materials listed are divided into Class 1A, 1B, II, and III consistent with ASTM D2321 (Flexible Pipe Installation Specification).
- (e) Minus 20mm bedding material is specified for pipe sizes 375mm and smaller for improved support underneath the haunches of the pipe.

Class 1A - Manufactured Aggregate, open graded, clean

For Pipe 375mm and Smaller	
Sieve Size	Percent Passing by Mass
20mm	100%
4.75mm (#4)	<10%
2.5mm (#8)	<5%
0.075mm (#200)	<5%

For Pipe Larger than 375mm	
Sieve Size	Percent Passing by Mass
40mm	100%
4.75mm (#4)	<10%
2.5mm (#8)	<5%
0.075mm (#200)	<5%

Class 1B - Manufactured, Processed Aggregates; dense graded, clean

For Pipe 375mm and Smaller	
Sieve Size	Percent Passing by Mass
20mm	100%
4.75mm (#4)	10%-50%
2.5mm (#8)	<5%
0.075mm (#200)	<5%

For Pipe Larger than 375mm	
Sieve Size	Percent Passing by Mass
40mm	100%
4.75mm (#4)	10%-50%
2.5mm (#8)	<5%
0.075mm (#200)	<5%

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Class II - Coarse-Grained Soils; clean or borderline clean to w/fines

For Pipe 375mm and Smaller	
Sieve Size	Percent Passing by Mass
20mm	100%
4.75mm (#4)	Varies
0.075mm (#200)	0%-12%

For Pipe Larger than 375mm	
Sieve Size	Percent Passing by Mass
40mm	100%
4.75mm (#4)	Varies
0.075mm (#200)	0%-12%

Class III - Coarse-Grained soils with fines

For Pipe 375mm and Smaller	
Sieve Size	Percent Passing by Mass
20mm	100%
4.75mm (#4)	Varies
0.075mm (#200)	12%-50%

For Pipe Larger than 375mm	
Sieve Size	Percent Passing by Mass
40mm	100%
4.75mm (#4)	Varies
0.075mm (#200)	12%-50%

2.7 Granular Subbase

- 2.7.1 Granular sub-base may be crushed and shall be screened or be a pit run aggregate which shall meet the following gradation requirements when tested according to ASTM C-136. Granular Subbase shall conform to Foothills County Standards.

Sieve Size mm	Percentage Passing For Nominal Maximum Size
75	100
25	50 - 85
4.75	25 - 0
0.300	3 - 20
0.075	0 - 8

- 2.7.2 Any gradation supplied by the Contractor within the above limits will be accepted provided it will not rut when subjected to the loading exerted by the rear axle of a fully loaded tandem truck.

AGGREGATES AND GRANULAR MATERIALS

2.7.3 All aggregates for sub-base shall meet the following requirements:

- (a) The sand equivalent value (ASTM D2419) shall not be less than 20mm.
- (b) Aggregate, when tested in accordance with ASTM C-136 shall have a gradation that defines a curve (% passing versus log sieve size) with a slope between adjacent sieves, equal or intermediate to corresponding slopes of the boundary curves defined by the specification.

2.8 Granular Base

2.8.1 Granular base shall be crushed and shall be screened and shall meet the following gradation requirements when tested according to test ASTM C 136, and shall conform to Foothills County Standards

Sieve Size mm	Percent Passing for Nominal Maximum size
25.0	100
19.0	80 - 100
12.5	70 - 90
9.5	60 - 85
4.75	40 - 70
1.18	20 - 45
0.300	5 - 20
0.075	2 - 8

2.8.2 All aggregates for base shall meet the following requirements:

- (a) The sand equivalent value (ASTM D2419) shall not be less than 40 mm for base course aggregates.
- (b) Aggregate, when tested in accordance with ASTM C-136 shall have a gradation that defines a curve (% passing versus log sieve size) with a slope between adjacent sieves, equal or intermediate to the corresponding slopes of the boundary curves defined by the specification.

2.9 Imported Topsoil

2.9.1 Imported topsoil to be friable loam, neither heavy clay nor of very light sandy nature, containing a minimum of 4% organic matter for clay loams and 2% for sand loams, to a maximum of 20% by volume. To be free from subsoil, roots, noxious grass, weeds, toxic materials, stones over 30mm, foreign objects, and with an

AGGREGATES AND GRANULAR MATERIALS

acidity range (pH) of 5.5 to 7.5. To be free from crabgrass, couchgrass, equisetum or noxious weeds or seeds or parts thereof.

2.9.2 Freedom from rock or debris to be such that 95 - 100% of particles pass a 25mm sieve and 85 - 100% pass a 9.5mm sieve.

2.9.3 Population of any single species of plant pathogenic nematode to not exceed 1000 per litre of growing medium. Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping, and seeding.

3.0 EXECUTION

3.1 Handling

3.1.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.1.2 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Consultant within 48 h of rejection.

END OF SECTION

CLEARING AND GRUBBING

1.0 GENERAL

- 1.1 Section 31 11 00.01 refers to those portions of the *Work* that are unique to clearing and grubbing. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - Rock Removal Section 31 23 16.26
- 1.3 Definitions
 - 1.3.1 Clearing consists of cutting off trees, brush and heavy vegetative growth to not more than a specified height above ground and disposing of felled trees, brush, vegetative growth, including all underbrush, deadwood and surface debris.
 - 1.3.2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing flush with existing grade and disposing of fallen timber and surface debris.
 - 1.3.3 Clearing isolated trees consists of cutting off to not more than a specified height above ground designated trees and disposing of felled trees and debris.
 - 1.3.4 Grubbing consists of excavation and disposal of stumps and roots to not less than a specified depth below existing ground surface.
 - 1.3.5 Underbrush clearing: Consists of removal from treed areas of undergrowth, deadwood, and disposing of fallen timber and surface debris. Trees shall not be removed without the prior approval of the *Consultant*.
- 1.4 Protection of Existing Features
 - 1.4.1 Prevent damage to all existing natural growth, landscaping, buildings, structures, and underground and overhead utilities identified to remain within and adjacent to the *Work* area. Make good all damage to satisfaction of *Consultant*.
 - 1.4.2 Provide environmental protection as required to approval of *Consultant*.
 - 1.4.3 Use appropriate arboricultural practices to repair damage to vegetation designated to remain. Replace or pay compensation for damaged or destroyed trees designated to remain as directed by *Consultant*.
 - 1.4.4 Control spread and dispersal of by parts and seeds of noxious plants and prevent contamination of topsoil by same.

CLEARING AND GRUBBING

2.0 PRODUCTS

Not Applicable

3.0 EXECUTION

3.1 Prior to grubbing, verify limits of grubbing with the *Consultant*, and determine any restrictions regarding preservation of existing trees, shrubs, natural features or improvements within or adjacent to specified limits of grubbing. Install required environmental and vegetation protection works and measures.

3.2 Contractor is responsible for obtaining or coordinating any permits required for clearing and grubbing works.

3.3 Clearing

3.3.1 Clear trees, shrubs, uprooted stumps and surface debris not designated to remain.

3.3.2 Cut off trees, brush, and scrub as indicated or as directed by Consultant, at a height of not more than 300 mm above ground.

3.3.3 Cut off unsound branches of trees designated to be preserved. Upon written authorization from Consultant, fell isolated trees overhanging area to be cleared.

3.3.4 Preserve all shrubs, trees or other cultivated plants specified for replanting.

3.4 Close Cut Clearing

3.4.1 Cut off trees, shrubs, stumps, and other vegetation at ground level.

3.5 Isolated Trees

3.5.1 Cut off isolated trees as shown on *Drawings* or as directed by Consultant at height of not more than 300 mm above existing ground.

3.5.2 Grub out isolated tree stumps.

3.6 Grubbing

3.6.1 Grub out stumps and roots to not less than 200 mm below existing ground surface.

3.7 Removal and Disposal

CLEARING AND GRUBBING

- 3.7.1 Unless specified elsewhere in the *Contract Documents*, all timber becomes property of the *Contractor*.
- 3.7.2 Cleared and grubbed material to be disposed of as *Work* progresses and not left to accumulate.
- 3.7.3 Dispose of cleared and grubbed materials to approved off-site disposal area.
- 3.7.4 Cleared and grubbed vegetative material may be chipped or mulched and spread on site if approved by the *Consultant*.
- 3.8 Finished Surface
 - 3.8.1 Leave ground surface in condition for immediate grading operations or stripping of topsoil if so specified.

END OF SECTION

SOIL STRIPPING AND STOCKPILING

1.0 GENERAL

- 1.1 This section specifies requirements for stripping of topsoil and organic material from the site. The work includes:
 - 1.1.1.1 Stripping and hauling to disposal.
 - 1.1.1.2 Stripping and stockpiling for re-use.
- 1.2 Related Work
 - 1.2.1 Section 31 14 13 includes specifications for soil stripping and stockpiling referred to in the following sections:
 - 1.2.1.1 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.2.1.2 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.2.1.3 Topsoil Placement and Grading Section 32 91 19.13
- 1.3 Regulations
 - 1.3.1 Abide by provincial and municipal regulations with regard to diversions or alterations to drainage patterns.
- 1.4 Limits
 - 1.4.1 Stripping shall not exceed the limits and depths shown on the drawings or as designated by the *Consultant*.
 - 1.4.2 The *Consultant* may waive stripping of wet land areas, at his or her discretion.

2.0 PRODUCTS

- 2.1 Not Applicable

3.0 EXECUTION

- 3.1 Notification
 - 3.1.1 The *Contractor* shall notify the *Consultant* in writing, a minimum of 5 working days prior to commencement of stripping.
 - 3.1.2 The *Consultant* and the *Contractor* shall inspect the area to be stripped to establish specific requirements and to review procedures, which shall be confirmed in writing by the *Contractor*.
 - 3.1.3 Sequencing: Sequence the work of this Section after temporary erosion and sedimentation control measures are installed, as indicated in Section 01 57 00 – Temporary Controls.

SOIL STRIPPING AND STOCKPILING

- 3.1.4 Remove topsoil before other construction procedures commence to avoid compaction of topsoil.
- 3.2 Stripping and Stockpiling
 - 3.2.1 Verify the procedures are conducted in accordance with applicable municipal requirements.
 - 3.2.2 Handle topsoil only when it is dry and warm.
 - 3.2.3 Strip topsoil to depths as indicated on Drawings.
 - 3.2.4 Avoid mixing topsoil with subsoil. Refer to geotechnical report on subsurface soil information.
 - 3.2.5 Load, haul and place in stockpiles as designated by the *Consultant*.
 - 3.2.6 Stockpile in a manner that will not endanger persons, the work or adjacent property.
 - 3.2.7 Keep topsoil stockpiles separate and do not mix with common excavation.
 - 3.2.8 Stockpile wetland material in separate stockpile and do not mix with other soil stripping or common excavation as designated by the *Consultant*.
 - 3.2.9 Maintain a minimum of 1m separation between topsoil and common excavation material when piling.
 - 3.2.10 Leave openings in stockpiles so that fields are accessible to the land owners.
 - 3.2.11 Cover topsoil that has been piled for 30 days, with sterile plants, such as ray florets, or grass to maintain agricultural potential of soil.
 - 3.2.12
- 3.3 Mixing
 - 3.3.1 If the topsoil and subsoil are mixed and the topsoil is adversely affected, the *Contractor* shall, at his own expense, engage a soils specialist to determine the necessary remedial work, and shall perform the required work.
- 3.4 Temporary Erosion And Sedimentation Control
 - 3.4.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.
 - 3.4.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - 3.4.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- 3.5 Cleaning

SOIL STRIPPING AND STOCKPILING

- 3.5.1 On completion of the work, remove surplus materials, excess materials, rubbish, tools, and equipment.
- 3.5.2 Dispose of unused topsoil where acceptable to *Consultant* off site or for later use.

END OF SECTION

LANDSCAPE SUBGRADE

1.0 GENERAL

- 1.1 Section 31 22 01 refers to those portions of the Work that are unique to the preparation of subgrade, by rough grading and filling, to provide a base that will allow placing of growing medium (topsoil) to specified depths. This section does not apply to grading prior to placement of paved or concreted surfaces. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 References
 - 1.2.1 British Columbia Landscape Standard
 - 1.2.2 Canadian System of Soil Classification
- 1.3 Site Conditions
 - 1.3.1 Size, depth and location of existing utilities and structures shown on *Drawings* are for guidance only. Completeness and accuracy not guaranteed.
 - 1.3.2 Prevent damage to all adjacent natural growth, landscaping, buildings, structures and underground and overhead utilities. Make good all damage to satisfaction of *Consultant*.

2.0 PRODUCTS

- 2.1 Fill Material
 - 2.1.1 All additional materials necessary to bring site up to specified grade to comply with material specified in appropriate Section or shown on *Drawings*.
 - 2.1.2 Obtain approval from *Consultant* for excavated or graded material to be used as fill for grading work. Protect approved material from contamination.
 - 2.1.3 Fill material to be placed under areas to be landscaped, i.e. with grass, sod, groundcover, shrubs and trees, to be non-toxic to plant and animal life in part or in concentration (leachate).

3.0 EXECUTION

- 3.1 Stripping of Topsoil
 - 3.1.1 Strip all organic material to specified limits and specified depth or as directed by *Consultant*. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected. Remove all debris. Dispose as specified.
 - 3.1.2 Surface drainage: provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.

LANDSCAPE SUBGRADE

3.2 Subgrade Preparations

- 3.2.1 Rough grade to levels, profiles, and contours allowing for surface treatment as shown on *Drawings*.
- 3.2.2 Compact subgrade to a consistent 90% Modified Proctor Density in compliance with ASTM D1557.
- 3.2.3 Excavate soft and unstable areas below subgrade that cannot be compacted to this standard and fill with approved fill material, except in locations where special environmental conditions have been identified. In such cases, appropriate alternatives solutions to be approved by *Consultant* and carried out.
- 3.2.4 Place fill materials to elevations and sections shown on Drawings.
- 3.2.5 Remove and dispose to approved off-site disposal area, all debris, roots, branches, stones in excess of 50mm diameter, building material, contaminated subsoil, visible weeds and deleterious material that may interfere with proper growth and development of plant material.
- 3.2.6 Rough grade to within ranges shown in Table 1, except where *Drawings* show variation from this standard or as directed otherwise by *Consultant*.
- 3.2.7 Grade transitions of subgrade smooth and even, such that ponding cannot occur on subgrade surface.
- 3.2.8 Coarse cultivate subgrade to minimum depth of 150mm and cross-cultivate at excessively compacted areas. Compact to 90% Modified Proctor Density or as directed otherwise by *Consultant* immediately before placing growing medium (topsoil).

TABLE 1: Landscape Subgrade Gradients		
Location	Minimum	Maximum
Lawn and Grass	50:1 (2%)	3:1
Grass Swales (without additional erosion protection)	50:1 (2%) 6:1 (Preferred)	10:1 (10%) 3:1
i) Slope along inverts		
ii) Side Slopes	50:1 (2%)	2:1
Unmowed Areas	50:1 (2%)	2:1
Planted Areas		

LANDSCAPE SUBGRADE

3.3 Tolerances

3.3.1 Accuracy of subgrade elevations to be within tolerances shown in Table 2.

TABLE 2: TOLERANCE FOR LANDSCAPE SUBGRADE		
Condition	Specified Growing Medium Depth	Tolerance
Within 3 m from fixed elevations (eg. Paving edges, curbs, etc.) Other Areas	0 – 150 mm	±25 mm
	151 – 300 mm	±25 mm
	301 – 600 mm	±50 mm
	0 – 150 mm	±25 mm
	151 – 300 mm	±50 mm
	301 – 600 mm	±50 mm

END OF SECTION

GRADING

1.0 GENERAL

1.1 This section specified requirements for site grading. The *Work* includes:

- (a) The excavation of soil materials, the salvage of select soil materials, the operation of borrow areas and the construction of embankment. This work includes the removal and/or satisfactory placement of all materials necessary for the construction and preparation of embankments, slopes, drainage works and connections to the required alignment, grade and cross-sections. It also includes the excavation for culverts, underdrains, and foundation pits for buildings and other structures.
- (b) Rough Grading
- (c) Fine Grading
- (d) Finish Grading

1.1.2 Related Requirements

- (a) Section 31 22 00 includes specifications for grading referred to in the following sections:
 - (i) Clearing and Grubbing Section 31 11 01
 - (ii) Soil Stripping and Stockpiling Section 31 14 13
 - (iii) Excavating, Trenching, and Backfilling Section 31 23 33.01
 - (iv) Landscape Subgrade Section 31 22 01
 - (v) Rock Removal Section 31 23 16.26

1.2 Price And Payment Procedures

1.2.1 Measurement and Payment

- (a) Payment for all work performed as specified in this Section is deemed to be incidental to payment for work specified in other Sections unless specifically noted as payment item in the Tender Form.

1.3 References

1.3.1 Definitions

- (a) Common Excavation: This means the excavating, hauling, placing and compacting in embankments of materials that are not classified as "topsoil" and/or "rock excavation" within the limits of the Contract.
- (b) Waste Excavation: This means the excavating, hauling, disposing and levelling, within the limits of the Contract and at designated disposal areas,

GRADING

of surplus or unsuitable materials, but not of materials classified as "topsoil" and/or "rock excavation".

1.3.2 Reference Standards

(a) City of Calgary 302.00.00

(b) ASTM D698

(c) ASTM D1557

1.4 Administrative Requirements

1.4.1 Coordination

(a) Verify grading work is coordinated with erosion and sedimentation control efforts.

1.5 Submittals

(a) Site Quality Control Submittals: Submit testing procedure, frequency of tests to *Consultant* for review.

(b) Coordination: Section 01 33 00 - Submittal Procedures.

1.6 QUALITY ASSURANCE

(a) Coordination: Section 01 43 00 - Quality Assurance.

1.6.2 Qualifications

(a) Testing Agencies: Testing laboratory certified by ULC will conduct the soil compaction test.

(i) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 14 Manufacturer Qualifications.

1.7 EXISTING CONDITIONS

(a) Examine subsurface investigation report which is available for inspection as indicated in the geotechnical report.

(b) Known underground and surface utility lines and buried objects are indicated on site plan.

(c) Dewatering requirements as noted in Section 31 23 19.

2.0 PRODUCTS

2.1 Materials

(a) Fill material: Type 1 in accordance with of Section 31 23 33.01 - Excavating, Trenching and Backfilling.

GRADING

- (b) Excavated material existing on site suitable to use as fill for grading work if accepted by Consultant

3.0 EXECUTION

3.1 Examination

- 3.1.1 Verification of Conditions: Verify conditions of substrate previously installed under other Sections or Contracts are acceptable for rough grading in accordance with Section 01 71 00 - Examination and Preparation.
- 3.1.2 Examine soil for unsuitable conditions such as clods, rocks, snow, frost, frozen, muddy, large roots, litter, toxic substances, and unstable material.
- 3.1.3 Proof roll the subgrade areas indicated on Drawings.
- 3.1.4 .1 Verify the subsoil is free of surface water and not frozen.
- 3.1.5 Verify locations of all underground utilities.
- 3.1.6 Inform Consultant of unacceptable conditions immediately upon discovery.
- 3.1.7 Proceed with the Work after unacceptable conditions have been remedied.

3.2 Preparation

- 3.2.1 Remove litter, unsatisfactory and unstable materials.
- 3.2.2 Stake and flag locations of utilities.
- 3.2.3 Protect existing underground and above head utilities.
- 3.2.4 Notify utility companies to remove and relocate utilities as indicated on Drawings.

3.3 Grading

- 3.3.1 Rough grade to levels, profiles, and contours preparing for post grading processes.
- 3.3.2 Rough grade to the
- (a) Grassed areas: [] mm [as indicated on Drawings].
- (b) [Asphalt] [Gravel] paving: [] mm [as indicated on Drawings].
- (c) [Concrete paving] [Concrete walks] [Precast paving units]: [] mm [as indicated on Drawings].
- 3.3.3 Slope rough grade away from building [as specified].
- 3.3.4 Grade ditches to depth [required for maximum runoff as indicated on site drawings] [as indicated on Drawings] [as directed].
- 3.3.5 Remove soil to a minimum depth of 150 mm from the surface before placing fill over existing ground. Maintain fill and existing surface at approximately same

GRADING

moisture content to facilitate bonding, unless otherwise specified by a professional geotechnical engineer.

3.3.6 Remove soil to a minimum depth of 150 mm from the surface before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding, unless otherwise specified by a professional geotechnical engineer.

3.3.7 Compact filled and disturbed areas to [95%] to [ASTM D698] [ASTM D1557], as follows:

3.3.8 Avoid disturbing soil within the areas of existing trees and shrubs indicated to remain, to maintain their stability and health.

4.0 SITE QUALITY CONTROL

4.1 Site Tests and Inspections

4.1.1 Perform tests on compacted soils to determine conformance with specific requirements

(a) One test per [] m² of compacted areas.

(b) Submit test results to Consultant for review.

5.0 CLEANING

5.1 Clean in accordance with Section 01 74 00 - Cleaning.

5.1.1 Upon completion remove surplus materials, rubbish, tools, and equipment.

5.2 Manage waste in accordance with Section 01 74 19 – Waste Management and Disposal and:

5.2.1 Remove and dispose of surplus material and material that is unsuitable for fill, for grading purposes, or for landscaping purposes.

6.0 PROTECTION

6.1 Protect existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines, as directed by Consultant. If damaged, restore to original or better condition, unless directed otherwise.

6.2 Maintain access roads to prevent accumulation of construction related debris on roads.

6.3

END OF SECTION

ROCK REMOVAL

1.0 GENERAL

- 1.1 Section 31 23 16.26 refers to those portions of the *Work* that require rock removal. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 References
 - 1.2.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 43 00.
- 1.3 Definitions
 - 1.3.1 Rock is defined as all solid rock in form of masses, bedrock, layers, or ledges and includes igneous rock of any sort, conglomerate, sandstone or shale that requires breaking by continuous drilling and blasting before excavation and removal and cannot be effectively loosened or broken down by mechanical ripping equipment with a minimum drawbar pull of 360kN. Rock also includes rocks having individual volumes in excess of 1.0 m³ removed by blasting or other means.
 - 1.3.2 Trench rock removal is defined as rock to be removed during excavation of utility trenches generally as shown on the *Drawings*.
 - 1.3.3 Mass rock removal is defined as rock to be removed during roadway excavation, site grading or other excavation work, generally but not necessarily, in larger quantities, and not within the more confining limits of excavation specified for trench excavation.
 - 1.3.4 Dense tills, hardpan, partially cemented material, clay or frozen materials which do not require breaking by continuous drilling and blasting before excavation and removal are not classified as rock.
- 1.4 Qualifications
 - 1.4.1 Retain licensed explosives expert holding a valid Blasters Certificate to supervise and program blasting work, and to determine precautions, preparation and operations techniques.
- 1.5 Blasting Operation Proposal

ROCK REMOVAL

- 1.5.1 Submit to *Consultant* and/or local authorities having jurisdiction for approval, written proposal of operations for removal of rock by blasting.
- 1.5.2 Indicate proposed method of carrying out *Work* in proposal, types and quantities of explosives to be used, loading charts and drill hole patterns, type of caps, blasting techniques, blast protection measures for items such as flying rock, vibration, dust and noise control. Include details on protective measures, time of blasting and other pertinent details.
- 1.5.3 Review of the blasting operation proposal by the *Consultant* or local authorities shall not relieve the *Contractor* of his responsibility for his means and methods, procedures, and safety measures.
- 1.5.4 No blasting to proceed without written approval of *Consultant*.
- 1.6 Seismic Survey and Monitoring
 - 1.6.1 Arrange for assessment of adjacent buildings and structures to determine existing condition and provide building and structure owners with proposed blasting procedures and copies of assessment reports and seismic recording operations.
 - 1.6.2 Visit owners of adjacent buildings to describe blasting and seismic recording operations and obtain permission for setting up seismographs, where required.
- 1.7 Protection
 - 1.7.1 Prevent damage to surroundings and injury to persons. Post guards, sound warnings, and display signs when blasting to take place.

2.0 PRODUCTS

Not used.

3.0 EXECUTION

- 3.1 Blasting and Vibration Control
 - 3.1.1 Complete all blasting before any structural elements are installed within 15m from blast holes.
 - 3.1.2 Minimize ground vibrations which may damage structures or shatter or damage rock mass to remain.

ROCK REMOVAL

- 3.1.3 Blasting not permitted within distance of 30m of concrete or grout less than 24 hours after pouring.
- 3.1.4 Maintain complete and accurate record of all drilling and blasting operations. Submit records to *Consultant* at end of each shift.
- 3.2 Rock Removal
 - 3.2.1 Strip rock of all earth.
 - 3.2.2 Notify *Consultant* within reasonable time to enable *Consultant* to obtain necessary measurements.
 - 3.2.3 Do blasting operations in accordance with local and provincial codes, and requirements of authority having jurisdiction.
 - 3.2.4 Remove rock to alignments, profiles, and cross-sections as shown on *Drawings*.
 - 3.2.5 Locations where explosive blasting is not permitted, if applicable, are shown on *Drawings*.
 - 3.2.6 Use methods, techniques and procedures for control of all factors affecting operations in order to produce smooth and sound peripheral surfaces of all completed excavations, to minimize overbreak, and to avoid damage to adjacent structures.
 - 3.2.7 Excavate trenches in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling and to section shown on Standard Detail Drawings.
 - 3.2.8 Excavate rock for concrete walls, columns and footings to horizontal surfaces not exceeding slope shown on *Drawings*. Scale, pressure wash and broom clean rock surfaces to assist concrete bond.
 - 3.2.9 Except as specified otherwise or as directed by *Consultant* employ pre-shearing, cushion blasting or other smooth wall drilling and blasting techniques to achieve final excavation surfaces.
 - 3.2.10 Remove boulders and fragments which may slide or roll into excavated areas.
 - 3.2.11 Correct unauthorized rock removal at no extra cost, in accordance with backfilling requirements specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling.

ROCK REMOVAL

3.3 Rock Disposal

- 3.3.1 Dispose of surplus removed rock off-site.

END OF SECTION

CONSTRUCTION DEWATERING

PART 1 GENERAL

1.1 Basis of Design:

.1 [REDACTED].

1.2 Description:

.1 Removal and disposal of excessive water during construction operations.

1.3 Performance and Design Requirements:

.1 Delegated Design Responsibility:

.1 Contractor: Design and maintenance of facilities for construction dewatering.

END OF SECTION

CONTROLLED DENSITY FILL

1.0 GENERAL

- 1.1 Section 31 23 23 refers to those portions of the work that are unique to the supply and placement of Controlled Density Fill. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 This specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structure requiring site specific structural or geotechnical engineering design.
- 1.3 Except where stated otherwise, all materials and methods in this Section to conform to requirements of the latest version of CAN/CSA A23.1 & 2.
- 1.4 Other names that Controlled Density Fill (CDF) may be referred to include: Controlled Low Strength Material (CLSM), Unshrinkable Fill (USF), Fillcrete, Low Density CLSM (LD-CLSM), or Fluidized Thermal Backfill.
- 1.5 Related Work
 - 1.5.1 Aggregate and Granular Materials Section 31 05 16
 - 1.5.2 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.5.3 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.5.4 Waterworks Section 33 11 01
- 1.6 References
 - 1.6.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in References - Section 01 45 00.
- 1.7 Samples
 - 1.7.1 Samples may be required.
- 1.8 Measurement for Payment
 - 1.8.1 Payment for all work performed under this Section will be incidental to payment for work described in other sections.

2.0 PRODUCTS

- 2.1 Materials
 - 2.1.1 Portland Cement: CAN/CSA-A300, A3001 - 03 Type HS - High Sulphate Resistant Hydraulic Portland Cement.
 - 2.1.2 Fly Ash: Type F Fly Ash to CAN/CSA A23.5
 - 2.1.3 Water: to CAN/CSA A23.1
 - 2.1.4 Aggregate: to CAN/CSA A23.1
 - 2.1.5 Air entraining admixture: to CAN/CSA A266.1
 - 2.1.6 Chemical admixtures: to CAN/CSA A266.2. *Consultant* to approve accelerating or set retarding admixtures during cold and hot weather placing.

CONTROLLED DENSITY FILL

- 2.2 Mixes
 - 2.2.1 Proportion Controlled Density Fill to specific design criteria specified on Contract Drawings.
 - 2.2.2 Controlled Density Fill that must be excavatable in future to have maximum unconfined compressive strength of 0.5 MPa (500 kPa) at 28 days and maximum cement content of 25 kg per m³.
 - 2.2.3 Controlled Density Fill requiring minimal initial settlement to have fly ash and water reducing admixtures in mix design.
- 2.3 Forms
 - 2.3.1 Where forms or bulkheads are required: conform to CSA S269.3 Formwork.

3.0 EXECUTION

- 3.1 General
 - 3.1.1 Fill excavation with Controlled Density Fill up to underside of pavement or landscaping materials and strike off roughly level.
- 3.2 Formwork
 - 3.2.1 Formwork to conform to shape, lines and dimensions shown on Contract Drawings.
 - 3.2.2 Formwork to be substantial, sufficiently tight to prevent leakage of Controlled Density Fill and braced and tied to maintain position and shape.
 - 3.2.3 Formwork to be unlined unless specified otherwise.
- 3.3 Workmanship
 - 3.3.1 Obtain *Consultant's* approval before placing Controlled Density Fill. Provide minimum 24-hour notice prior to placing of Controlled Density Fill.
- 3.4 Placing
 - 3.4.1 Place material using methods which do not lead to segregation.
 - 3.4.2 Begin spreading material on crown of pipe or on high end of sloped trench.
 - 3.4.3 Place material to full width in uniform layers not exceeding 300mm thickness until material reaches crown of pipe. After that material can be placed full depth. Where formwork or bulkheads are used, 300mm layers not be exceeded except when authorized by *Consultant*.
 - 3.4.4 Pumping of Controlled Density Fill is permitted with approval of *Consultant*.
 - 3.4.5 Internal vibrators or other methods of consolidation may be used to ensure that any undercut areas of pavement are fully supported.
 - 3.4.6 Temporary plating or other means of supporting traffic loads to be used to provide safe driving surface for traffic until pavement material is replaced.

CONTROLLED DENSITY FILL

- 3.4.7 Protect freshly placed Controlled Density Fill from heavy rain to prevent washout.
- 3.4.8 Do not place load upon new Controlled Density Fill until authorized by *Consultant*.
- 3.5 Compaction
 - 3.5.1 No compaction is required
- 3.6 Field Quality Control
 - 3.6.1 Inspection and testing of Controlled Density Fill will be carried out by a CSA certified laboratory designated by *Contractor*.
 - 3.6.2 *Owner* will pay costs for inspection and initial testing.

END OF SECTION

EXCAVATING, TRENCHING AND BACKFILLING

1.0 GENERAL

- 1.1 Section 31 23 33.01 refers to those portions of the Work that are unique to excavating, trenching, and backfilling. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
- | | | |
|-------|-------------------------------|---------------------|
| 1.2.1 | Electrical | Division 26 |
| 1.2.2 | Rock Removal | Section 31 23 16.26 |
| 1.2.3 | Waterworks | Section 33 11 01 |
| 1.2.4 | Pipe Culverts | Section 33 42 13 |
| 1.2.5 | Environmental Procedures | Section 01 35 43 |
| 1.2.6 | Controlled Density Fill | Section 31 23 23 |
| 1.2.7 | Topsoil Placement and Grading | Section 32 91 19.3 |
| 1.2.8 | Manholes and Catchbasins | Section 33 44 01 |
- 1.3 Definitions
- 1.3.1 Rock: Either single boulders, pieces of concrete or masonry with a volume in excess of 1.0 cubic metre, or any material that cannot be removed by an excavator of 50,000 to 62,300 Kg-m with ripper teeth, and which requires for its removal, drilling and blasting or breaking up with a power operated hand tool.
- 1.3.2 Common Excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, partially cemented materials, clay or frozen materials which can be ripped and excavated with heavy construction equipment.
- 1.3.3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping, and seeding.
- 1.3.4 Waste Material: Material unsuitable for use in the Work or surplus to requirements.
- 1.3.5 Borrow Material: Material obtained from borrow areas identified by the *Consultant* and required for construction of embankments or for other portions of the *Work*.
- 1.3.6 Embankment (engineered fill): Material derived from usable excavation and placed above original ground or stripped surface up to subgrade elevation.
- 1.3.7 Import Granular Fill: Approved granular material, supplied by the *Contractor* and obtained from offsite sources to be used for embankment fill up to Subgrade Elevation as determined by the *Consultant*.

EXCAVATING, TRENCHING AND BACKFILLING

- 1.3.8 Import Fill: Approved engineered fill, supplied by the Contractor and obtained from offsite sources to be used for embankment and placed above original ground or stripped surface up to subgrade elevation.
- 1.3.9 Pavement Structure: combination of layers of unbound or stabilized granular subbase, base, and asphalt or concrete surfacing.
- 1.3.10 Prepared Subgrade Surface (Subgrade Elevation): Surface immediately below the finished pavement structure.
- 1.4 Existing Utilities
 - 1.4.1 The existence and location of all utilities and structures, including underground, surface and overhead utilities shown on the *Drawings* is not guaranteed, nor is it guaranteed that all utilities which may be encountered are shown. Notwithstanding any other provisions of this *Contract*, the *Contractor* shall be solely responsible for locating all the utilities and paying for any damage caused by the *Contractor*.
 - 1.4.2 No additional compensation will be made to the *Contractor* for delays in the locating of utility structures or for the tunnelling under or supporting of them during construction. The Contractor may not claim for lost production as a result of delays brought about by unforeseeable alignment conflicts, grade conflicts, or scheduling conflicts with other utilities.
 - 1.4.3 At no extra cost to the *Owner*, the Contractor shall, prior to commencing any installation work, confirm by test excavation, the elevation and location of any utility which may cross the alignment of the proposed work. This work shall be carried out a minimum of seven days in advance of installation in the immediate vicinity of the existing utility. Allow *Consultant* access to exposed utilities to record crowns or inverts.
 - 1.4.4 The *Owner*, shall pay for any relocation of existing underground utilities which, in the opinion of the *Consultant*, are considered to be in direct conflict with the alignment or profile of the new work and require relocating, provided however, that the Contractor cooperates with the provisions found in the preceding section for establishing locations of existing utilities. Authorization for the method of relocating and the arrangements for payment shall be given in writing by the *Consultant*.
 - 1.4.5 All hydrants under pressure, valve box covers, valve boxes, curb stop boxes, fire or police call boxes, and all other utility controls and warning systems, shall be left unobstructed and accessible during the construction period.
 - 1.4.6 Where existing utilities such as water, sewer, electricity, telephone, and gas, are serving the public while construction is in progress, it shall be the responsibility of the *Contractor* to plan and execute his activities such that disruption to existing utilities is held to a minimum. When it is necessary to valve-off a water utility, the *Consultant*, the Fire Department and the individual water consumers affected by

EXCAVATING, TRENCHING AND BACKFILLING

the shut-off, shall be notified by the *Contractor* at least one day prior to shut-off, unless an emergency situation involving life or property necessitates immediate action.

- 1.4.7 The *Contractor* shall protect, and support all underground and surface structures and all utilities, utility services, and appurtenances and all other obstructions, that may be encountered during the construction of the project, at no cost to the *Owner*.

1.5 Existing Buildings and Surface Features

- 1.5.1 Conduct, with *Consultant*, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by Work.
- 1.5.2 Protect existing buildings and surface features which may be affected by Work from damage resulting from Work.
- 1.5.3 Where excavation necessitates root or branch cutting, do so only as approved by *Consultant*.

1.6 Shoring, Bracing, Underpinning

- 1.6.1 Comply with applicable municipal regulations to protect existing features.
- 1.6.2 Trench shoring to be designed and installed in accordance with the regulations of the Workers Compensation Act of Alberta.
- 1.6.3 Sides of trenches or other excavations to be adequately supported. Trench stability and safety procedures to meet or exceed minimum requirements of "Accident Prevention Regulations" current issue of the Workers' Compensation Board of Alberta. All works to be carried out in strict compliance with above mentioned regulations.
- 1.6.4 Prefabricated cages or shields may be used, at the discretion of the *Consultant*, to supplement or replace conventional shoring, provided they conform with all applicable safety requirements and permit the proper placing and tamping of bedding and fill material under and around the pipe.
- 1.6.5 *Contractor* shall have any required shoring, underpinning and bracing designed by a professional engineer that is registered in the Province of Alberta. Provide the *Consultant* with copies of sealed drawings detailing such supports.

1.7 Blasting

- 1.7.1 Refer to Section 31 23 16.26

1.8 Disposal

- 1.8.1 Unless noted otherwise in the *Contract Documents*, *Contractor* to be responsible for off-site disposal of all surplus soil from excavations. Suitability of excavated material

EXCAVATING, TRENCHING AND BACKFILLING

for use as native bedding or trench backfill will be governed by Article 2 within this Section. Dumping of spoil on private property will be permitted only upon written approval from property *Owner* and provided all necessary permits, testing and approvals have been obtained, including that of *Consultant*.

- 1.8.2 Where a specific disposal site owned, operated, or arranged by the *Owner* is designated in the *Contract Documents*, all material destined for the site shall become the property of the *Owner*.

1.9 Measurement and Payment

- 1.9.1 Work performed under this section will be incidental to work involved in other sections of these specifications.
- 1.9.2 Trench rock excavation and imported backfill will be measured and paid for in accordance with Section 01 01 30 - Measurement and Payment.

2.0 PRODUCTS

2.1 General

- 2.1.1 Unless shown otherwise on *Contract Drawings* or Standard Detail Drawings, the materials specified in 2.2 following are approved for their respective uses.

2.2 Use of Specified Material

- 2.2.1 Backfill for over-excavated trench or structure excavations to be:

- 2.2.1.1 Drain Rock (only where approved by the *Consultant*)
- 2.2.1.2 Granular Pipe Bedding and surround material
- 2.2.1.3 Pit Run Sand
- 2.2.1.4 Concrete
- 2.2.1.5 Controlled Density Fill

- 2.2.2 Pipe bedding and surround: See applicable Sections:

- 2.2.2.1 Electrical Division 26
- 2.2.2.2 Waterworks Section 33 11 01

- 2.2.3 Trench and excavation backfill to be:

- 2.2.3.1 Approved Native Material
- 2.2.3.2 Pit Run Gravel

- 2.2.4 Surface treatment to be:

- 2.2.4.1 Restoration to match existing conditions
- 2.2.4.2 Subgrade, subbase and base for works described in other Sections

EXCAVATING, TRENCHING AND BACKFILLING

2.2.4.3 Topsoil, grass, sod, or requirements for landscaping works described in other Sections

2.3 Materials

- 2.3.1 Refer to Section 31 05 16 - Aggregates and Granular Materials for specifications for approved granular materials.
- 2.3.2 Concrete: to be minimum 30 Mpa or as indicated on the Structural drawings and Division 03 Concrete.
- 2.3.3 Other granular materials: granular materials approved for roadwork (subbase, base) also acceptable for trench backfill subject to approval of *Consultant*.
- 2.3.4 Anchor blocks: where specified or required by *Consultant* provide anchor blocks as shown on Standard Detailed Drawings. All concrete anchor blocks to be carried at least 150 mm into undisturbed ground on bottom and sides of trench. Concrete to be of type indicated in these specifications.

3.0 EXECUTION

3.1 Site Preparation

- 3.1.1 Remove all brush, weeds, grasses, stumps, and accumulated debris from site.
- 3.1.2 Cut pavement or sidewalk neatly along limits of proposed excavation as shown on Standard Detail Drawings in order that surface may break evenly and cleanly. Cut beyond limits shown only if approved by *Consultant*.
- 3.1.3 Where trench passes through a lawn, neatly cut and remove sod before trench excavation. Save sod for replacement upon backfilling trench. Keep sod in moist condition in preparation for reinstallation.
- 3.1.4 Strip topsoil after area has been cleared and stockpile in locations as directed by *Consultant*. Stockpile height not to exceed 2 m. Avoid mixing topsoil with subsoil. Dispose of unused topsoil as directed by *Consultant*. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

3.2 Stockpiling

- 3.2.1 Stockpile fill materials in areas designated by *Consultant*. Stockpile granular materials in manner to prevent segregation.
- 3.2.2 All excavated material shall be piled in a manner that will not endanger persons, the work or adjacent properties and will avoid obstructing roads, surface drainage ditches, sidewalks, driveways, hydrants and control devices. Gutters, ditches, and culverts shall be kept clear or other satisfactory provisions shall be made by the Contractor for drainage.

3.3 Excavation

EXCAVATING, TRENCHING AND BACKFILLING

- 3.3.1 Connection to existing mains:
 - 3.3.1.1 Prior to or at commencement of construction, check existing main for line and elevation at point of connection. If found different from *Contract Drawings* report such difference to *Consultant* immediately, and cease construction pending instructions from *Consultant*.
 - 3.3.1.2 Connections to existing system to be made by *Contractor* under direct supervision of utility. Make all necessary arrangements with utility to schedule work to prevent construction delays.
 - 3.3.1.3 To prevent damage to existing utilities, excavate last 300 mm over utility by hand.
- 3.3.2 Surface drainage: provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.
- 3.3.3 Excavation to grade: excavate trenches to allow pipe to be laid to alignment and grades required with allowance for specified pipe bedding.
- 3.3.4 Excavation below grade: when bottom of excavated trench at subgrade is unstable and in opinion of *Consultant*, cannot adequately support pipe, install pipe using bedding as shown on *Contract Drawings* or over-excavate trench to suitable subgrade or as directed by *Consultant*. Backfill over-excavation with specified materials and compact to minimum 98% Standard Proctor Density in compliance with ASTM D698.
- 3.3.5 Trench width: excavate trench to section and dimensions shown on Standard Detail Drawings. If width exceeds maximum allowable, *Contractor* may be required to demonstrate that specified pipe is still adequate or provide pipe with approved higher strength class or provide approved higher class of bedding. All additional requirements as a result of excessive trench width to be to *Contractor's* cost.
- 3.3.6 Hand excavation: excavate by hand if necessary to preserve or minimize damage to existing trees, shrubs, buildings and all similar existing features or facilities
- 3.3.7 Trench bottom conditions: remove disturbed or softened material and protruding or loose rocks from trench bottom before placing bedding material. Maintain trench free from water and soft materials during placement of pipe bedding, pipe installation and trench backfill to ensure proper compaction of granular materials.
- 3.3.8 Trench drainage:
 - 3.3.8.1 During pipe laying, jointing, bedding, and backfilling, keep trench free of water by pumping or other appropriate means. Pumps and dewatering equipment to be provided and precautions taken to prevent any damage to adjoining buildings, structures, roads or land from prolonged or excessive

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pumping by installing shoring, sheeting, or other supportive measures. Water to be discharged from excavations in such a manner as not to cause nuisance, injury, loss or damage. *Contractor* to be responsible for any claims or actions arising from such discharge of water.

3.3.8.2 Keep bell holes free from water during jointing. Diverting trench water through newly laid system not allowed, unless authorized by *Consultant*.

3.3.8.3 In wet conditions, where the *Contractor* desires to use drain rock bedding in place of the bedding specified he may do so only with the written permission of the *Consultant* and the incremental cost of such drain rock bedding shall be solely at the *Contractor's* expense. The *Consultant* will review the *Contractor's* request after the *Consultant* has assured himself that the *Contractor* has made every reasonable effort within the requirements of this Contract to keep the trench free of water.

3.3.9 Disposal of surplus soil: Side-casting not allowed in restricted areas where, in opinion of the *Consultant*, side-casting would create interference with flow of traffic. In such case, materials to be temporarily stored or disposed of on approved site.

3.3.10 Roads used for transporting materials and equipment to be maintained in clean condition. Clean, flush and/or sweep on daily basis and more frequently if directed by *Consultant*.

3.3.11 Unless otherwise authorized by *Consultant* 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.

3.4 Pipe Installation

3.4.1 Related work: Pipe installation, including bedding, pipe laying, and granular surround to be in accordance with the following sections:

3.4.1.1 Electrical Division 26

3.4.1.2 Waterworks Section 33 11 01

3.4.2 Concrete encasement: where specified or required by *Consultant* provide concrete encasement of pipe as shown on Standard Detail Drawings. Do not place backfill materials until concrete has taken its initial set and in no case less than 1 h.

3.4.3 Rock excavation in trenches shall provide a minimum clearance of 150 mm below the pipe, including the pipe bell.

3.5 Backfill and Compaction

3.5.1 General

3.5.1.1 Do not proceed with trench backfilling operations until *Consultant* has inspected and approved installations.

EXCAVATING, TRENCHING AND BACKFILLING

- 3.5.1.2 Ensure trenches are free from debris, snow, ice, and water.
- 3.5.1.3 Do not use backfill material which is frozen or contains ice, snow, or debris.
- 3.5.1.4 Do not backfill around or over cast-in-place concrete within 24 h after placing.
- 3.5.1.5 Place layers simultaneously on both sides of installed work to equalize loading.
- 3.5.1.6 During backfill and compaction of trench, remove shoring or cages in such a manner as to allow proper compaction and to prevent trench walls from collapsing. Remove all bracing and/or shoring from trench.
- 3.5.1.7 Place backfill by rolling down a slope or lowering by machine. Prevent backfill from dropping vertically on to the pipeline installation.
- 3.5.2 Backfill Materials above pipe zone
 - 3.5.2.1 Boulevards and easements: for trenches in boulevards, easements, or other areas not subject to vehicle loading and outside of ditchlines, backfill to be native material, except as shown otherwise on *Contract Drawings* or directed by the *Consultant*.
 - 3.5.2.2 Roads, driveways and shoulders: for trenches in paved or gravelled roads, driveways, shoulders or other areas subjected to vehicle loading, backfill to be approved native material, or imported material as specified on the *Contract Drawings* or directed by the *Consultant*.
 - 3.5.2.3 Ditches: backfill to be approved native material or imported material as specified on the *Contract Drawings* or directed by the *Consultant*.
 - 3.5.2.4 *Consultant* may permit native material for all above uses subject to suitability of native material for said use.
- 3.5.3 Compaction
 - 3.5.3.1 Place backfill and compact to following Standard Proctor densities in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).
 - 3.5.3.1.1 To a minimum 98% Standard Proctor Density for depths greater than 1.5 from subgrade elevation and or as otherwise specified on the *Contract Drawings*.
 - 3.5.3.1.2 To a minimum 98% Standard Proctor Density for depths within the top 1.5m from the subgrade elevation or as otherwise specified on the *Contract Drawings*.
 - 3.5.3.1.3 Use caution in pipe zone to ensure no damage to pipe.

EXCAVATING, TRENCHING AND BACKFILLING

3.5.3.1.4 Maximum thickness of lift not to exceed 200mm in compacted state for granular soils, 150mm for non-granular soils.

3.5.3.1.5 Where additional water is required to obtain the specified density, it shall be applied in such a manner to maintain uniform moisture content. Cost of additional water supply and application shall not be in considered for separate payment.

3.5.3.1.6 Motorized compaction equipment shall be used with extreme caution to prevent damage to public or private property or to the new installation.

3.6 Inspection and Testing

3.6.1 Testing of materials and compaction to be carried out by testing laboratory designated by *Consultant*. Frequency of tests to be determined by *Consultant*.

3.6.2 *Owner* to pay costs for inspection and initial testing.

3.6.3 If initial test determine materials or compaction not as specified, *Contractor* to take all steps necessary to correct deficiencies. Subsequent testing to *Contractor's* cost.

3.7 Surface Restoration

3.7.1 General:

3.7.1.1 Restore all disturbed surfaces to condition at least equal to that which existed prior to construction.

3.7.1.2 Make good any damage to adjacent lands or improvements.

3.7.1.3 Resolve all reasonable claims arising from *Contractor's* actions and obtain written releases from landowners following restoration.

3.7.2 Boulevards and easements:

3.7.2.1 Surface restoration to be minimum 150mm depth.

3.7.2.2 Restore unimproved surfaces with material equal to that removed at surface.

3.7.2.3 Restore gardens with topsoil.

3.7.2.4 Restore lawns with topsoil and sod to match existing lawn.

3.7.2.5 Restore gravel surfaces with granular base material.

3.7.2.6 Complete final restoration immediately upon completion of trench backfilling.

3.7.3 Gravelled roads and driveways:

3.7.3.1 Restore surface with minimum 100mm granular road base material.

3.7.3.2 Compact to minimum 100% Standard Proctor Density.

EXCAVATING, TRENCHING AND BACKFILLING

- 3.7.3.3 Complete final restoration immediately upon completion of trench backfilling.
- 3.7.4 Ditches:
 - 3.7.4.1 Shape ditch to specified lines, grades, and sections and restore surface with minimum 300mm of native material to ensure stability of ditch slopes and bottom.
 - 3.7.4.2 Compact to minimum 98% Standard Proctor Density.
 - 3.7.4.3 Complete final restoration immediately upon completion of trench backfilling.
- 3.7.5 Sub-base and base preparation for paved surfaces:
 - 3.7.5.1 Paved surfaces to include all paved roads, driveways, sidewalks, and parking areas.
 - 3.7.5.2 If native material used for backfill, minimum 300mm granular road subbase materials and additional as required to match existing depth of sub-base in excess of 300mm or provide specified depth of sub-base as shown on *Contract Drawings* in accordance with Section 32 11 16.01, (Granular Sub-base).
 - 3.7.5.3 Place granular base material to specified depth as shown on *Contract Drawing* and in accordance with Section 32 11 23 (Granular Base) once sub-base layer has been inspected and approved by *Consultant*.
- 3.7.6 Permanent pavement restoration:
 - 3.7.6.1 Install permanent pavement within 14 days of placement of pipe installation.
 - 3.7.6.2 Sawcut original pavement minimum of 300mm from edge of broken or cracked pavement as well as any paved areas showing settlement.
 - 3.7.6.3 Remove pavement from within limits of sawcut and dispose off-site.
 - 3.7.6.4 Remove underlying granular road base materials as required to permit placement of specified thickness of permanent pavement. Ensure remaining base meets specified thickness of road base to Granular Base - Section 31 11 23.
 - 3.7.6.5 Compact base to minimum 100% Standard Proctor Density.
 - 3.7.6.6 Clean edges of cut pavement to remove all loose material. If thickness of existing pavement permits, mill 25mm depth along saw cut edge of pavement. Dry if necessary and paint clean, dry edge with asphalt emulsion (tack coat).

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- 3.7.6.7 Place and compact hot-mix pavement material to minimum thickness as shown on *Contract Drawings*.
- 3.7.6.8 Material and placement of hot-mix pavement to Hot-Mix Asphalt Concrete Paving - Section 32 12 16.
- 3.7.6.9 Restored surface to be smooth and matching with grade of adjacent pavement.
- 3.7.6.10 Maintain restored pavements in complete repair during the Contract Maintenance Period. Effect repairs within 14 days from receipt of written notice from City or immediately if so directed by *Consultant* if dangerous situation exists.
- 3.7.7 Landscape restoration
 - 3.7.7.1 Restoration of planted areas, either in private or public places, to consist of restoration to original condition by replacement of original depth of topsoil (minimum of 100mm of imported topsoil), sodding of grassed areas and replacement of any killed or removed plants or shrubs by ones of equal quality, type, and maturity to originals. Should restored item fail to grow successfully either throughout work area, or in patches, it is to be redone so that a successful regrowth is established over entire area.
 - 3.7.7.2 Replacement trees and shrubs to be planted at a suitable time of year in accordance with good horticulture practice, to provide maximum assurance of plant survival. Trees or shrubs close to, but not actually within excavated area, which show signs of dying during maintenance period to be replaced by new trees of a similar variety, age and size, up to limits of maximum available size, if tree has died as a result of environmental disturbance, cutting of roots, or other cause directly attributable to *Contractor's* work.
- 3.7.8 Restoration acceptance: no restoration work to be considered satisfactory until acceptance by *Consultant* and in case of properties not owned by the *Owner*, until a written and signed statement of release from property *Owner* has been obtained by *Contractor* and provided to *Consultant*.
- 3.7.9 Settlement of the constructed areas occurring prior to the end of the maintenance period as a result of error or negligence on the part of the *Contractor*, shall be corrected by the *Contractor* at no extra cost to the *Owner*. Any damages to the works as a result of settlement shall be restored or repaired by the *Contractor* to the *Owner's* approval and at no additional cost to the *Owner*. Any deficiency in the quantity of material for backfilling or filling depressions caused by settlement shall be supplied and placed by the *Contractor*.

END OF SECTION

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

1.0 GENERAL

- 1.1 Section 31 24 13 refers to those portions of the Work that are unique to roadway excavation, embankment construction and compaction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Aggregate Granular Materials Section 31 05 16
 - 1.2.2 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.2.3 Grading Section 31 22 13
 - 1.2.4 Roads and Site Improvements Division 32
 - 1.2.5 Subgrade Preparation
 - 1.2.6 Geotextile soil stabilization Section 31 32 19.16
- 1.3 References
 - 1.3.1 The abbreviated standard specification for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance – Section 01 43 00.
- 1.4 Definitions
 - 1.4.1 Excavation classes: only two classes of excavation will be recognized, rock excavation and common excavation.
 - 1.4.1.1 Rock excavation: rock is either single boulders, pieces of concrete or masonry with a volume in excess of 1.0 cubic metre, or any material that cannot be removed by an excavator of 50,000 to 62,300 Kg-m with ripper teeth, and which requires for its removal drilling and blasting or breaking up with a power operated hand tool.
 - 1.4.1.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation, including dense tills, hardpan, clay or frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.
 - 1.4.1.3 Topsoil: materials capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - 1.4.1.4 Waste material: material unsuitable for use in work or surplus to requirements.

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

- 1.4.1.5 Borrow material: material obtained from borrow areas identified by the *Consultant* and required for construction of embankments or for other portions of work.
- 1.4.1.6 Embankment (engineered fill): material derived from usable excavation and placed above original ground or stripped surface up to subgrade elevation.
- 1.4.1.7 Imported Granular Fill: approved granular material, supplied by *Contractor* and obtained from off-site sources, to be used for embankment fill up to subgrade elevation.
- 1.4.1.8 Import Fill: Approved engineered fill, supplied by the Contractor and obtained from offsite sources to be used for embankment and placed above original ground or stripped surface up to subgrade elevation.
- 1.4.1.9 Pavement structure: combination of layers of unbound or stabilized granular subbase, base, and asphalt or concrete surfacing.
- 1.4.1.10 Prepared Subgrade Surface (subgrade elevation): Surface immediately below pavement structure.
- 1.5 Protection of Existing Facilities
 - 1.5.1 Existing buried utilities and structures:
 - 1.5.1.1 Size, depth and location of existing utilities and structures as shown on *Contract Drawings* are for guidance only. Completeness and accuracy not guaranteed.
 - 1.5.1.2 Prior to commencing any excavation work, notify applicable owner of authorities, establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during work.
 - 1.5.1.3 Confirm locations of buried utilities by careful test excavations and advise *Consultant*.
 - 1.5.1.4 Owner will pay for costs to relocate utilities in conflict as authorized by *Consultant*.
 - 1.5.1.5 Maintain and protect from damage, water, sewer, gas, electric, telephone, signage and pots, and other utilities and structures encountered or shown on *Contract Drawings*. Obtain direction of *Consultant* before moving or otherwise disturbing utilities or structures.
 - 1.5.1.6 Record location of maintained, re-routed and abandoned underground lines.
 - 1.5.2 Existing buildings and surface features:

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

1.5.2.1 Conduct, with *Consultant*, condition survey of existing buildings, trees, and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

1.5.2.2 Protect existing buildings and surface features which may be affected by work from damage while work is in progress and repair damage resulting from work.

1.5.2.3 Where excavation necessitates root or branch cutting, do so only as approved by *Consultant*.

1.6 Blasting

1.6.1 When blasting is required during excavation, exercise care and limit use of explosives to such charges that do not cause damage to existing pipelines, other utilities or private property. Blasting to be done by qualified personnel. Compliance with all regulations regarding use and storage of explosives to be responsibility of Contractor. Contractor to be responsible for any accidents, injury, loss or damage which occur through his blasting. Blasting bylaw of relevant jurisdiction to be adhered to.

1.7 Disposal

1.7.1 Unless noted otherwise in the *Contract Documents*, Contractor to be responsible for off-site disposal of all surplus spoil from excavations. Suitability of excavated material for use as native bedding or trench backfill will be governed by article 2 within this Section. Dumping of spoil on private property will be permitted only upon written request from property owner and provided all necessary permits, testing and approvals have been obtained, including that of the *Consultant*.

1.7.2 Where a specific disposal site owned, operated, or arranged by the *Owner* is designated in the *Contract Documents*, all material destined for the site shall be the property of the *Owner*.

1.8 Permits and Approvals

1.8.1 Obtain all required permits and approvals from regulatory authorities before commencing any excavation.

2.0 PRODUCTS

2.1 General

2.1.1 Unless shown otherwise on *Contract Drawings* or Standard Detail Drawings materials specified in 2.2 following are approved for their respective uses.

2.2 Specified Materials

2.2.1 Backfill for embankment fill (subgrade fill) to be:

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

2.2.1.1 Approved native material.

2.2.1.2 Pit run gravel.

2.2.1.3 Pit run sand.

2.3 Materials

2.3.1 Refer to Section 31 05 16 - Aggregates and Granular Materials for specifications for approved granular materials.

3.0 EXECUTION

3.1 General

3.1.1 Clear and grub limits of excavation and/or embankment fill in accordance with Section 31 11 00 - Clearing and Grubbing.

3.1.2 Strip all organic material to specified limits and specified depth or as directed by Consultant. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected. Remove all debris. Dispose as specified.

3.1.3 Surface drainage: provide suitable temporary ditches or other approved means of handling-drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.

3.2 Excavation

3.2.1 Advise *Consultant* sufficiently in advance of excavation operations for initial cross-sections to be taken.

3.2.2 Notify *Consultant* whenever unsuitable materials are encountered and remove unsuitable materials to depth and extent as directed by *Consultant*.

3.2.3 If, during excavation, material appearing to conform to classification for rock is encountered, notify *Consultant* in sufficient time to enable measurements to be made to determine volume of rock.

3.2.4 Rock excavation:

3.2.4.1 Rock excavation to Section 31 23 16.26 - Rock Removal.

3.2.4.2 When blasting is required during excavation, exercise care and limit use of explosives to such charges that do not cause damage to existing pipelines, other utilities or private property. Blasting to be done by qualified personnel. Compliance with all regulations regarding use and storage of explosives to be responsibility of *Contractor*. *Contractor* to be responsible for any accidents, injury, loss or damage which occur through his blasting. Blasting bylaw of Municipality to be adhered to.

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

3.2.4.3 Shatter rock to 300 mm below subgrade elevation as indicated. Provide effective drainage to ditches, leaving no undrained pockets in foundation.

3.2.4.4 Where excavation to design limits results in unstable subgrade or side slopes, remove unstable soils as directed by *Consultant* and backfill with pit run gravel or materials approved by *Consultant*. Such work necessitated by *Contractor's* procedures to *Contractor's* cost.

3.3 Inspection of Prepared Surface

3.3.1 Prior to placing embankment fill, compact prepared native surface to minimum 98% Standard Proctor Density in areas where the surface is more than 1.5m below subgrade elevation or 98% Standard Proctor Maximum Dry Density (SPMDD) in areas where the surface is within 1.5m of the subgrade elevation in compliance with ASTM D698 (All following references to density imply compliance with ASTM D698). Engineered fill should be moisture conditions to within Optimum Moisture Content (OMC) to 2% above OMC.

3.3.2 Do not place embankment fill until finished native surface is inspected and approved by *Consultant*.

3.4 Suitable Fill Import

3.4.1 Where designated on the *Contract Drawings* or by the *Consultant*, the *Contractor* shall place and compact approved fill material to replace the unsuitable material

3.5 Placing

3.5.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.

3.5.2 Begin spreading material on crown line or high side of one-way slope.

3.5.3 Place granular materials using methods which do not lead to segregation or degradation.

3.5.4 Place material to full width in uniform layers and compact to specified densities. Layers not to exceed 200mm compacted depth for granular and 150mm for non-granular soils.

3.5.5 As a minimum, the required depth of subgrade preparation is 300 mm in all areas. Subgrade preparation should consist of scarification of the surface using appropriate equipment in such a way as to achieve thorough mixing of surface materials.

3.5.6 Where 300 mm subgrade preparation is deemed insufficient, and where the underlying soil is soft or wet, the use of geosynthetic reinforcement (such as geotextiles, geogrids, or combi-grid) may be required. Selection of an appropriate geosynthetic product should be made by qualified personnel.

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

- 3.5.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- 3.5.8 Remove and replace that portion of any layer in which material becomes segregated during spreading.
- 3.5.9 Where shown on *Contract Drawings* or as directed by *Consultant*, scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces. Obtain prior approval from *Consultant* of method to be used.
- 3.5.10 Where fill material consists principally of rock:
 - 3.5.10.1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1m.
 - 3.5.10.2 Individual rock fragments not exceeding 1.5m in vertical dimension permitted provided their vertical dimension does not exceed one third of fill section depth.
 - 3.5.10.3 Carefully distribute rock material to fill voids with smaller fragments to form compact mass.
 - 3.5.10.4 Fill surface voids at subgrade level with rock spalls or selected material to form an earth-tight surface.
 - 3.5.10.5 Do not place boulders and rock fragments with dimensions exceeding 150mm within 600mm of pavement subgrade elevation.
- 3.5.11 Where subgrade is on transition from excavation to embankment, the natural slope (excepting solid rock) shall be excavated to a depth of 1m and replaced with suitable material for a distance of 15 metres in order to prevent abrupt future differential grade changes.
- 3.6 Compaction
 - 3.6.1 Compaction equipment to be capable of obtaining required densities in materials on project.
 - 3.6.2 Compact to density of not less than 95% Standard Proctor Density for depths greater than 1.5m from the subgrade elevation and 98% for depths within the top 1.5m from the subgrade elevation or as otherwise specified on the *Contract Drawings*. All engineered fill should be moisture conditioned to within Optimum Moisture Content (MOC) to 2% above OMC.
 - 3.6.3 Shape and roll alternately to obtain smooth, even and uniformly compacted subbase.

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

- 3.6.4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- 3.6.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Consultant.
- 3.7 Inspection and Testing
 - 3.7.1 Testing of materials and compaction to be carried out by testing laboratory designated by *Consultant*. Frequency of tests to be determined by *Consultant*.
 - 3.7.2 If initial tests determine materials or compaction not as specified, *Contractor* to take all steps necessary to correct deficiencies. Subsequent testing to *Contractor's* cost.
- 3.8 Prepared Subgrade
 - 3.8.1 Remove soft or other unstable material that will not compact properly. Replace with specified material and compact to specified density.
 - 3.8.2 Shape, compact and scarify top 150mm layer of entire subgrade surface to 98% Standard Proctor Density, moisture adjusted to +/- 2% of Optimum Moisture Content in compliance with ASTM D698.
 - 3.8.3 Do scarifying, blading, compacting, or other methods of work as necessary to provide thoroughly compacted roadbed shaped to grades and cross-sections as shown on *Contract Drawings* or as directed by *Consultant*.
 - 3.8.4 Finish back and side slopes of common material to neat condition, suitable for seeding, true to line and grade.
 - 3.8.4.1 Remove boulders encountered in cut slopes and fill resulting cavities.
 - 3.8.4.2 Hand finish slopes that cannot be finished satisfactorily by machine.
- 3.9 Inspection of Prepared Subgrade
 - 3.9.1 Prior to placing granular base, compact prepared subgrade surface to minimum 98% Standard Proctor Density at +/- 2% Optimum Moisture Content in compliance with ASTM D698 (all following references to density imply compliance with ASTM D698).
 - 3.9.2 Prepared subgrade surface shall be shaped to the proper grade, crown and super elevation as shown on the *Contract Drawings* or as directed by the *Consultant*.
 - 3.9.3 Do not place embankment fill until prepared subgrade surface is inspected and approved by *Consultant*.

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

- 3.9.4 The *Contractor* shall advise the *Consultant* at least 48 hours prior to commencement of gravel surfacing operations to allow inspection of the prepared subgrade surface.
- 3.10 Finish Tolerances
- 3.10.1 Finished subgrade surface to be within plus or minus 15mm of specified grade and cross-section but not uniformly high or low.
- 3.10.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- 3.11 Proof Rolling
- 3.11.1 For proof rolling, use roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 915mm maximum.
- 3.11.2 *Consultant* may authorize use of other acceptable proof rolling equipment.
- 3.11.3 Proof roll top of embankment fill upon completion of fine grading and compaction.
- 3.11.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- 3.11.5 Where proof rolling reveals areas of defective subgrade fill:
- 3.11.5.1 Remove embankment material to depth and extent directed by *Consultant* and replace with embankment fill in accordance with this section or,.
- 3.11.5.2 Cement stabilize the subgrade surface to the application rate, depth and extent directed by the *Consultant*

3.12 Summary of Compaction Requirements

	Standard Proctor Maximum Dry Density Compaction Requirement (SPMDD)	Optimum Moisture Content (OMC)
Engineered Fill	98%	2% above OMC
Prepared Subgrade	98%	2% above OMC
Granular Base Material	100%	2% above OMC

3.13 Maintenance

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

- 3.13.1 The *Contractor* shall maintain and protect the subgrade and be responsible at no cost to the Owner for its protection from vehicular traffic, rain or other damaging causes throughout the term of the Contract. Damaged subgrades shall be scarified to a depth of 150mm and reshaped and compacted to 100% Standard Proctor Density at no cost to the Owner.

END OF SECTION

EROSION AND SEDIMENT CONTROLS

PART 1 GENERAL

1.1 Basis of Design:

.1 [REDACTED].

1.2 Description:

.1 Erosion and sediment controls during construction operations.

1.3 Performance and Design Requirements:

.1 Delegated Design Responsibility:

.1 Contractor: Design and maintenance of facilities for erosion and sediment control.

END OF SECTION

GEOTEXTILE SOIL STABILIZATION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section []
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .3 Section 31 24 13 - Roadway Embankments
- .4 Section 33 41 16 - Subdrainage Piping
- .5 Section 35 31 19 - Revetments

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A123/A123M-[17], Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM D3787-[16], Standard Test Method for Bursting Strength of Textiles—Constant-Rate-of-Travel (CRT) Ball Burst Test
 - .3 ASTM D4491/D4491M-[22], Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - .4 ASTM D4595-[23], Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Method
 - .5 ASTM D4716/D4716M-[22], Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
 - .6 ASTM D4751-[21a], Standard Test Method for Determining Apparent Opening Size of a Geotextile
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-4.2 No. 11.2-M89, Textile Test Methods - Bursting Strength - Ball Burst Test
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes
 - .1 No. 2-M85, Methods of Testing Geosynthetics - Mass per Unit Area
 - .2 No. 3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles
 - .3 No. 6.1-93, Methods of Testing Geotextiles and Geomembranes Bursting Strength of Geotextiles Under No Compressive Load
 - .4 No. 7.3-92, Methods of Testing Geotextiles and Geomembranes Grab Tensile Test for Geotextiles

GEOTEXTILE SOIL STABILIZATION

- .5 No. 10-94, Methods of Testing Geosynthetics: Geotextiles - Filtration Opening Size
- .3 CSA Group (CSA):
 - .1 CSA G40.20-[13]/G40.21-[13], General requirements for rolled or welded structural quality steel/Structural quality steel
- .4 Ontario Provincial Standard Specifications (OPSS):
 - .1 OPSS 1860-[2019], Material Specification for Geotextiles

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit the following action submittals minimum [4] weeks before starting work of this Section:
 - .1 Product data: Product literature and data sheets for geotextiles, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .2 Samples:
 - .1 Minimum length of [2] m of roll width of geotextile.
 - .2 Methods of joining.
 - .3 Source Quality Control Submittals:
 - .1 Mill test data.
 - .2 Certificates: Certifying materials that comply with specified performance characteristics and physical properties, and signed by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and:
 - .1 Inspect geotextiles, upon delivery, to confirm materials have good appearance qualities and are free from defects that might affect their specific properties.
 - .2 Store and protect geotextiles from direct sunlight and UV rays.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Geotextiles: Woven synthetic fibre fabric, supplied in rolls.
 - .1 Composed of [minimum 85%, by mass, of] [polypropylene] [polyester] [with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure [for 60 days]].

GEOTEXTILE SOIL STABILIZATION

- .2 Width: [] m minimum.
- .3 Length: [] m minimum.
- .4 Physical properties:
 - .1 Thickness: To [CAN/CGSB-148.1, No. 3], minimum [] mm.
 - .2 Mass per unit area: To [CAN/CGSB-148.1, No. 2], minimum [] g/m².
 - .3 Tensile strength and elongation (in any principal direction): To [ASTM D4595].
 - .4 Grab tensile strength and elongation: To [CAN/CGSB-148.1, No. 7.3].
 - .5 Ball burst strength: To [CAN/CGSB-4.2, No. 11.2] [ASTM D3787], minimum [] N, wet condition.
 - .6 Bursting strength: To [CAN/CGSB-148.1, No.6.1], minimum [] kPa, wet condition.
- .5 Hydraulic Properties:
 - .1 Apparent opening size (AOS): To [ASTM D4751], [] µm.
 - .2 Filtration opening size (FOS): To [CAN/CGSB-148.1 No.10] [OPSS 1860], [] µm.
 - .3 Transmissivity: To [ASTM D4716/D4716M], minimum [] m²/s under test conditions of [].
 - .4 Permittivity: To [ASTM D4491/D4491M], [] per s.
- .6 Factory seams: Sewn in accordance with manufacturer's recommendations.
- .7 Thread for sewn seams: Equal or higher resistance to chemical and biological degradation than geotextile.
- .2 Securing Pins and Washers: To [CSA G40.20/G40.21], Grade 300W, hot-dip galvanized with minimum zinc coating of 600 g/m² to [ASTM A123/A123M].
 - .1 Pin Size: [].

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner, and locations indicated on Drawings. Secure in position with [weights] [securing pins and washers] spaced at [0.6] m on-centre.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles, and creases.

GEOTEXTILE SOIL STABILIZATION

- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .4 Overlap each successive strips of geotextile [600] mm over previously laid strip.
- .5 Join successive strips of geotextile by sewing.
- .6 Pin successive strips of geotextile [with securing pins and washers at [] m interval at midpoint of lap] [as indicated on Drawings].
- .7 Place and compact soil layers in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.2 PROTECTION

- .1 Protect installed geotextile material from displacement, damage, or deterioration before, during, and after placement of material layers.
- .2 Cover installed geotextiles with overlying layer within [4] hours of placement.
- .3 Vehicular traffic is not permitted directly on geotextile.
- .4 Avoid overloading soil or aggregate on geotextile.
- .5 Replace damaged or deteriorated geotextile to acceptance of the Consultant.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

SUBGRADE PREPARATION

1.0 GENERAL

1.1 Description

1.1.1 This section specifies requirements for working and compacting subgrade soil.

1.2 Definition

1.2.1 Prepared subgrade: soil immediately below the granular sub-base, base course, pavement structure or concrete slab, pad or curb & gutter, and boulevards, compacted to a minimum depth of 300 mm or as specified on the drawings.

1.3 Quality Assurance

1.3.1 Refer to Section 01 43 00 – Quality Assurance.

1.4 Quality Control

1.4.1 Maximum Density: the dry unit mass of a sample of soil at optimum moisture content as determined according to ASTM-D698 method A.

1.4.2 Required Densities:

1.4.2.1 Minimum of 100% of SPMDD for each 150 mm lift of subgrade under pavement structures, concrete; curb & gutter, curb ramps, alley and access crossings

1.4.2.2 Minimum of 97.98% of the maximum density for each 150 mm lift of subgrade under concrete sidewalks, asphalt trails.

1.4.2.3 Minimum of 95% of the maximum density for each 150 mm lift of subgrade under turf areas, planting beds and disturbed areas.

1.4.3 Testing Frequency to ASTM-D2169 or to ASTM-D2922:

1.4.3.1 Subgrade – one for each 1,000 m² of compacted lift.

1.4.3.2 Fill – one for each 2,000 m² of compacted lift.

1.4.4 Proof Rolling: a proof roll of the finished subgrade will be required to confirm adequate bearing capacity of the subgrade soil. Proof rolling will be done using a single axle dual wheel truck loaded to a minimum 9,100 kg on the rear axle. Tires to be inflated to a minimum 275 KPa.

1.4.5 The *Contractor* shall perform as many tests as are necessary to ensure that the work conforms to the requirements of the Contract regardless of the minimum number specified.

2.0 PRODUCTS

2.1 Materials

SUBGRADE PREPARATION

- 2.1.1 Use only compacted subgrade soil with no deleterious material approved by the *Consultant*.
- 2.2 Equipment
 - 2.2.1 Use various pieces of equipment designed for disking, scarifying, spreading, spraying water, compacting and trimming material to specified depth and cross section and proof rolling.

3.0 EXECUTION

- 3.1 Subgrade Preparation
 - 3.1.1 Loosen subgrade material to a minimum of 150 mm. Work subgrade material with cultivating and mixing equipment until it is pulverized into pieces no larger than 25 mm maximum, exclusive of all rock.
 - 3.1.2 The required compaction can generally best be achieved if the subgrade material is dried or moistened at + 3% to - 3% of the optimum moisture content prior to compacting.
 - 3.1.3 Leave the surface of the compacted subgrade slightly higher than required elevation; then trim to the required elevation.
 - 3.1.4 Leave the finished surface even and free of depressions, humps, loose debris and foreign material.
 - 3.1.5 Finished subgrade shall be within 6 mm above the specified elevation or within 25 mm below the specified elevation.
- 3.2 Tolerances
 - 3.2.1 Trim high spots and refinish surface to within tolerance.
 - 3.2.2 Add approved material to low areas, scarify and blend to full subgrade depth re-compact to required density and refinish surface at the *Contractor's* expense. Fill low areas with extra thickness of subsequent granular sub-base or base course at the *Contractor's* expense
 - 3.2.3 If a density test result is less than the required density, the test result is discarded and 3 retests shall be performed on the area represented by the failed test. The average of the 3 tests shall represent the density of that area. If this average is less than the required density, the area shall be reworked to the full depth of the lift, the soil moisture altered as necessary and re-compacted to the required density. If the area is not retested but is reworked and re-compacted the area shall be tested at the normal testing frequencies.
 - 3.2.4 The *Contractor* shall assume the risk of uncovering and reworking the subgrade if it is covered before the *Consultant* has accepted the test result.

SUBGRADE PREPARATION

3.3 Protection of finished *Work*

- 3.3.1 Do not permit vehicle traffic over prepared subgrade.
- 3.3.2 If the subgrade floods, drain immediately by natural flow or by pumping into catch basins, manholes or ditches. This *Work* shall be done at the *Contractor's* expense.
- 3.3.3 Maintain protection of the prepared subgrade until subsequent granular sub-base or base course is placed. Repair and retest as required by the *Consultant* if damaged.

END OF SECTION

GRANULAR SUB-BASE

1.0 GENERAL

- 1.1 Section 32 11 16.01 refers to those portions of the Work that are unique to the supply and placement of granular subbase materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Aggregates and Granular Materials Section 31 05 16
 - 1.2.2 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.2.3 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.2.4 Granular Base Section 32 11 23
- 1.3 The abbreviated standard specifications for testing materials, fabrication, and supply referred to herein, are fully described in Quality Assurance - Section 01 45 00.

2.0 PRODUCTS

- 2.1 Granular Sub-base

Material for granular road sub-base to be in conformance with Section 31 05 16 - Aggregates and Granular Materials, for Materials Specification.

3.0 EXECUTION

- 3.1 Inspection of Existing Subgrade Surface
 - 3.1.1 Place granular sub-base after sub-grade is inspected and approved by the *Consultant*.
- 3.2 Placing
 - 3.2.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
 - 3.2.2 Place granular sub-base materials using methods which do not lead to segregation or degradation.
 - 3.2.3 Place material to full width in uniform layers not exceeding 150mm compacted thickness. *Consultant* may authorize thicker lifts if specified compaction can be achieved.
 - 3.2.4 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - 3.2.5 Remove and replace portion of layer in which material has become segregated during spreading.
- 3.3 Compaction Equipment
 - 3.3.1 Compaction equipment must be capable of obtaining required densities in materials on project.
- 3.4 Compacting

GRANULAR SUB-BASE

- 3.4.1 Compact to density of not less than 100% Standard Proctor Maximum Dry Density in accordance with ASTM D698.
- 3.4.2 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- 3.4.3 Apply water as necessary during compaction to obtain specified density. If sub-base is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- 3.4.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by *Consultant*.
- 3.5 Finish Tolerances
 - 3.5.1 Finish compacted surface to within plus or minus 10mm of established grade and cross section but not uniformly high or low.
 - 3.5.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- 3.6 Proof Rolling
 - 3.6.1 For proof rolling use roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 915mm maximum.
 - 3.6.2 *Consultant* may authorize use of other acceptable proof rolling equipment.
 - 3.6.3 Proof roll at level in sub-base as indicated. If alternative proof rolling equipment is authorized, *Consultant* will determine level of proof rolling.
 - 3.6.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - 3.6.5 Where proof rolling reveals areas of defective subgrade:
 - (a) Remove sub-base and subgrade material to depth and extent as directed by *Consultant*.
 - (b) Backfill excavated subgrade with approved common material and compact in accordance with Section 31 24 13 - Roadway Excavation, Embankment and Compaction.
 - (c) Replace sub-base material and compact.
 - 3.6.6 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.
- 3.7 Maintenance

GRANULAR SUB-BASE

- 3.7.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by *Consultant*.

END OF SECTION

RESHAPING GRANULAR ROADBED

1.0 GENERAL

- .1 Section 32 11 17 refers to those portions of the work that are unique to the requirements for scarifying and reshaping existing granular roadbeds, and where required, the supply and placement of additional granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Related Work
 - .1 Aggregates and Granular Material Section 31 05 16
- .3 References

The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 45 00.
- .4 Samples
 - .1 Samples are not required.
- .5 Definitions
 - .1 Reshaping granular roadbed: scarifying, blading, reshaping, and recompact existing granular road surface.

2.0 PRODUCTS

- .1 Materials
 - .1 Additional granular base material to be in accordance with Section 32 11 23 - Granular Base and Section 31 05 16 - Aggregates and Granular Materials.

3.0 EXECUTION

- .1 Scarifying and Reshaping
 - .1 Scarify roadbed in accordance with width shown on *Contract Drawings* or as directed by *Consultant* and to depth as directed by *Consultant*.
 - .2 Pulverize and break down scarified material to 19mm maximum particle size.
 - .3 Blade and trim pulverized material to elevation and cross section dimensions as shown on *Contract Drawings* or as directed by *Consultant*.
 - .4 Where deficiency of material exists, add and blend in specified new granular base material as directed by *Consultant*.
 - .5 Dispose excess material off-site.
- .2 Compaction

RESHAPING GRANULAR ROADBED

- .1 Compaction equipment to be capable of obtaining required densities in materials on project. Compact to density not less than 100% Standard Proctor Density in compliance with ASTM D698.
- .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .3 Apply water as necessary during compaction. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by *Consultant*.
- .3 Repair of Soft Areas
 - .1 Correct soft areas by removing material to depth and extent as directed by *Consultant*. Replace with specified material and compact to specified density.
- .4 Finish Tolerances
 - .1 Reshaped compacted surface to be within plus or minus 10mm of elevation as shown on *Contract Drawings* but not uniformly high or low.
 - .2 Finished surface not to have irregularities exceeding 10mm when checked with a 3 m straight edge placed in any direction.
 - .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Inspection and Testing
 - .1 Testing of materials and compaction to be carried out by testing laboratory designated by *Consultant*. Frequency of tests to be determined by *Consultant*.
 - .2 *Owner* to pay costs for inspection and initial testing.
 - .3 If initial tests determine materials or compaction not as specified. *Contractor* to take all steps necessary to correct deficiencies. Subsequent testing to *Contractor's* cost.
- .6 Maintenance
 - .1 Maintain reshaped surface in condition conforming to this section until succeeding material is applied or until reshaped roadbed is accepted by *Consultant*.

END OF SECTION

GRANULAR BASE

1.0 GENERAL

- 1.1 Section 32 11 23 refers to those portions of the Work that are unique to the supply and placement of granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Aggregates and Granular Materials Section 31 05 16
 - 1.2.2 Roadway Excavation, Embankment and Compaction Section 31 24 13
- 1.3 References
 - 1.3.1 The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance - Section 01 43 00.

2.0 PRODUCTS

- 2.1 Granular Base
 - 2.1.1 Material for granular road base to be in conformance with Section 31 05 16 - Aggregates and Granular Materials, for material specifications.

3.0 EXECUTION

- 3.1 Inspection of Subgrade Surface
 - 3.1.1 Do not place granular base until subgrade surface is inspected and approved by *Consultant* as outlined in Section 31 24 13 – Roadway Excavation, Embankment and Compaction.
 - 3.1.2 Road surface shall be shaped to the proper grade, crown and super elevation as shown on the *Contract Drawings* or as directed by the *Consultant*.
 - 3.1.3 The *Contractor* shall advise the *Consultant* at least 48 hours prior to commencement of gravel surfacing operations to allow inspection of the prepared subgrade surface.
- 3.2 Placing
 - 3.2.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice.

GRANULAR BASE

- 3.2.2 Place material to full width in uniform layers not exceeding 200mm compacted thickness. *Consultant* may authorize thicker lifts if specified compaction can be achieved.
- 3.2.3 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- 3.2.4 Remove and replace that portion of layer in which material becomes segregated during spreading.
- 3.3 Compaction Equipment
 - 3.3.1 Compaction equipment must be capable of obtaining required densities in materials on project.
- 3.4 Compacting
 - 3.4.1 Compact to density not less than 100% Standard Proctor Density in accordance with ASTM D698.
 - 3.4.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - 3.4.3 Apply water as necessary during compacting to obtain specified density. If materials is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
 - 3.4.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by *Consultant*.
- 3.5 Finish Tolerance
 - 3.5.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.
 - 3.5.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- 3.6 Maintenance
 - 3.6.1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by *Consultant*.
- 3.7 Acceptance
 - 3.7.1 The *Contractor* shall notify the *Consultant* upon completion of the granular base course prior to paving work.
 - 3.7.2 The *Consultant* will review the granular base course for acceptance prior to paving work.

END OF SECTION

CHAIN LINK FENCING

1.0 GENERAL

1.1 Description

- .1 This section specifies requirements for chain link fencing.

1.2 Related Work

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

1.3 Location

- .1 The location of the fence terminal posts, and gates is shown on the *Drawings*.

1.4 Quality Assurance

- .1 Fence layout details to be approved on site by the Consultant prior to installation.
- .2 Fence erection shall be carried out by experienced fence construction personnel.
- .3 Supply materials to CGSB-138.1.

2.0 PRODUCTS

2.1 Fabric

- .1 Fabric height as indicated on *Drawings*.
- .2 Chain Link 50 mm x 9 gauge wire finished as indicated on *Drawings*; knuckled selvage top and bottom
 - .1 Galvanized to CAN/CGSB-138.1
 - .2 Vinyl coated to 0.045 mm dry film thickness minimum

2.2 Wire

- .1 Tension wire – single strand 4.5 mm galvanized steel.
- .2 Wire Ties - 5 mm aluminum or 3 mm galvanized steel
- .3 Barbed wire – 2 mm diameter galvanized steel with 4-point barbs at 150 mm spacing to ASTM-A121

2.3 Posts and Rails

- .1 Schedule 40 galvanized steel pipe to CAN/CGSB-138.2
- .2 Line Posts - 60 mm O.D. c/w tops.
 - .1 Terminal Posts - for ends, gates and corners - 90 mm with gate posts as

CHAIN LINK FENCING

specified in Article 2.5.

.2 Top Rail - 42 mm O.D.

.3 Bracing - 42 mm O.D.

.3 Posts heights to be suitable for hole depths, specified height of posts to match the height indicated on the *Drawings*, and barbed wire overhang, if indicated.

2.4 Fittings

.1 Top rail ends, brace bands, tension bars, arms, tops, sleeves, hinges and latches in accordance with *Drawings*.

.2 All fittings to be hot dipped galvanized steel or cast aluminum.

.3 Terminal and gate posts to have dome tops.

.4 Stretcher Bars - min 5 x 20 steel.

2.5 Gates

.1 Gates to be framed with steel pipe ASTM-A120 standard weight galvanized after welding. Use 42 mm O.D. pipe for outside frame and 35 mm O.D. pipe for bracing.

.2 Gate fabric to be the same as fence fabric.

.3 Gate posts to conform to the following:

<u>Opening</u>	<u>Gate Post O.D.</u>
Single to 3.0 m and Double to 6.0 m	90 mm

Single from 3.0 to 4.2 m Double to 8.5 m	114 mm
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Single from 4.3 m to 7.6 m Double from 8.5 m to 12 m	170 mm
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.4 Gate hardware to include galvanized malleable iron hinges, lockable latch and latch catch accessible from both sides of gate.

.5 Double gates to have centre rest with drop bolt for closed position and chain hook to hold gate in open position.

.6 Gate braces to be 45 mm O.D. galvanized steel.

2.6 Concrete

.1 Compressive strength 20 MPa at 28 days.

.2 Use type 50 sulphate resistant cement.

CHAIN LINK FENCING

3.0 EXECUTION

3.1 General

- .1 Install fence to CGSB-138.3.

3.2 Grading

- .1 Remove debris and grade between posts to provide ground clearance between 40 mm and 70 mm.

3.3 Post Setting

- .1 Line post holes to be 1060 mm deep, 250 mm diameter.
- .2 Terminal post holes to be 1220 mm deep, 300 mm diameter.
- .3 Line posts to be spaced maximum 3.0 m.
- .4 Set posts in line and plumb so that the fence forms a straight line between corner posts.
- .5 Set posts in concrete and extend concrete 40 mm above grade for drainage.
- .6 Install straining posts at equal intervals not exceeding 150 m spacing, and at top and bottom of sharp grade changes.
- .7 Install corner post where change in alignment exceeds 10°.
- .8 Install end posts at end of fence runs, at buildings and at changes in fence height.
- .9 Install gate posts at both sides of gate.

3.4 Fence Erection

- .1 Allow concrete to cure sufficiently before erecting fence - minimum 5 days.
- .2 Set braces between end posts, gate posts and line posts.
- .3 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .4 Lay out fabric, stretch tightly to tension recommended by manufacturer and secure to end, corner, gate and straining posts with tension bar secured to posts with tension bar bands at 375 mm spacing.
- .5 Install top rail and fasten to posts with caps.
- .6 Secure fabric with tie wires at 450 mm intervals to top and line posts and to tension wire.

CHAIN LINK FENCING

3.5 Gate Installation

- .1 Locations and sizes of gates are shown on the *Drawings*.
- .2 Level grade between gateposts and set gate bottom 40 mm above ground surface.
- .3 Determine location for centre gate rest for double gate and cast concrete gate rest with domed top and cast-in pipe to take drop bolt.

3.6 Cleanup

- .1 Touch up damaged galvanized by cleaning with a wire brush and applying two (2) coats of organic zinc-rich paint for galvanized metal.
- .2 Clean up debris and earth removed from posts holes and trim areas disturbed.

END OF SECTION

TOPSOIL AND FINISH GRADING

1.0 GENERAL

- 1.1 Section 32 91 19.13 refers to those portions of the *Work* that are unique to the supply and placement of growing medium for planting and landscape areas and to subsequent finish grading. In this Section, the term "growing medium" is used in place of the generic and commonly used term "topsoil". The term "topsoil" in this Section is specific to natural organic soil conforming to the definition of "topsoil" in this specification. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Source Quality Control
 - 1.2.1 Advise the *Consultant* of sources of growing medium to be utilized at least seven days in advance of starting work.
- 1.3 Soil Testing
 - 1.3.1 Imported or on-site topsoil shall be tested and modified as necessary by admixture of other specified products to bring its properties within ranges specified for growing medium.
 - 1.3.2 Employ services of recognized horticultural soil testing laboratory and provide representative samples of proposed growing media for each distinct application for testing. Submit soil test results to the *Consultant* verifying compliance of proposed growing media to specification prior to commencing placement of growing media in landscape areas. *Contractor* shall be responsible for soil testing and for amendments and requirements to supply growing medium as specified and shall guarantee that soil test results are representative of growing media incorporated in the work.
- 1.4 Product Handling
 - 1.4.1 Topsoil and growing medium shall not be prepared, worked, placed or travelled upon when in a wet or frozen condition and shall not be handled in any manner that adversely affects the soil structure.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 In this Section, a range of measurable physical and chemical properties are set out as being acceptable in a growing medium. Compliance with this Section is to be determined by testing for those properties. When imported or on-site soil is used, it is to be tested and modified as necessary by admixture of other components to bring its properties within ranges set in 2.10 of this Section for growing medium.
- 2.2 Applications

TOPSOIL AND FINISH GRADING

- 2.2.1 The growing medium in this Section is for different applications including low traffic and high traffic lawn areas.
- 2.3 On-Site Soil
 - 2.3.1 On-site native topsoil may be used on approval by the Consultant, provided it meets standards set for imported topsoil and can be modified to meet requirements set out for specified growing media.
 - 2.3.2 If testing shows on-site soil to be suitable for landscaping, a sufficient quantity of stripped topsoil shall be stockpiled where shown on drawings or in areas designated for stockpiling.
- 2.4 Imported Topsoil
 - 2.4.1 Topsoil parameters for planted areas: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended application.
 - (a) Class B Clay Loam Textural Class with constituents of:
 - Sand: 40% (+/-5%) by dry mass
 - Clay: 25% (+/-5%) by dry mass
 - Silt: 35% (+/-5%) by dry mass
 - (b) Organic Matter: 10% by dry mass
 - (c) Toxic Chemicals: None
 - (d) Electrical Conductivity: Maximum 4.0 mhos/cm²
 - (e) pH Value: 6.0 – 7.5
 - (f) Sodium Absorption less than 6
 - (g) Contain no toxic elements or growth inhibiting materials.
 - (h) Finished surface free from:
 - (i) Debris and stones over 25mm diameter.
 - (ii) Course vegetative material, 10mm diameter and 100mm length, occupying more than 2% of soil volume.
 - (i) Consistence: friable when moist.
 - 2.4.2 Topsoil shall be free from weeds and weed seeds, and shall be in a reasonably moist condition.
 - 2.4.3 Free from rock or debris such that 95 - 100% of particles pass a 25 mm sieve and 85-100% pass a 9.5 mm sieve.

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- 2.4.4 Population of any single species of plant pathogenic nematode to not exceed 1000 per litre of topsoil.
- 2.4.5 Topsoil shall be capable of sustaining vigorous plant growth.
- 2.4.6 Soil analysis shall include the source location, soil deficiencies, amendments and recommendations. Topsoil shall be tested for particle size, organic matter (volume), Nitrogen, Phosphorus, Potassium, electrical conductivity (salinity) and pH value.
- 2.5 Peat Moss
 - 2.5.1 Shall be horticultural grade, partially decomposed fibrous or cellular stems and leaves of Sphagnum Mosses with texture varying from porous to spongy fibrous, fairly elastic and substantially homogenous with pH value not less than 4.5 and not greater than 6.0, free of decomposed colloidal residue, wood, sulphur, and iron, brown in colour and medium to coarse shredded, suitable for horticultural purposes.
 - 2.5.2 Salinity: saturation extract conductivity to not exceed 2.0 millimhos/cm at 25 °C.
 - 2.5.3 Organic content: to be no less than 90% based on dry weight as determined by ash analysis.
 - 2.5.4 Nitrogen: to be no less than 0.8% based on dry weight.
 - 2.5.5 Particle size:
 - (a) 95 – 100% to pass a 9.5 mm sieve.
 - (b) 0 – 15% to pass a 0.50 mm sieve.
- 2.6 Sand
 - 2.6.1 Shall be hard, granular sharp sand to CSA A82.50, well washed and free of impurities, chemical or organic matter.
 - 2.6.2 Particle size:
 - (a) 95 - 100% to pass a 4.75 mm sieve
 - (b) 0 - 40% to pass a 0.50 mm sieve
 - (c) 0 - 5% passing a 0.05 mm sieve.
- 2.7 Manure and Compost
 - 2.7.1 Manure shall be well-rotted farm animal or mushroom manure, rotted to extent that liquids have been eliminated, and material is crumbly; free from weed seeds, rocks, sticks, rubble and containing not more than 40% sawdust, straw or shavings by dry weight.

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- (a) Salinity: saturation extract conductivity to not exceed 0.5 mmho/cm at 25 °C.
 - (b) Particle size: 100% to pass a 6.35 mm sieve.
 - (c) Total Nitrogen: not less than 1.0% by dry weight.
- 2.7.2 Compost shall be commercially prepared from rotted vegetative material free from all weed seeds, municipal sewage sludge, coliform, pathogen and chemical or toxic contaminants.
 - (a) Organic Content: 30-65% dry weight basis.
 - (b) Particle Size: 100% to pass a 19 mm sieve.
- 2.8 Wood Residuals
 - 2.8.1 Rotted wood residuals such as sawdust, except cedar and redwood residuals, may be present in manure, compost or growing medium provided that the total Carbon to total Nitrogen ratio for the growing medium shall be a maximum of 40:1.
- 2.9 Fertilizers
 - 2.9.1 To be standard commercial brands, meeting requirements of Canada Fertilizer Act with guaranteed nutrient analysis.
 - 2.9.2 Type, formulation and application rate to be as recommended by soil test.
 - 2.9.3 To be in granular, pelleted or prill form, and to be dry, free-flowing and free from lumps; packed in standard waterproof containers, clearly marked with name of manufacturer, weight and analysis.
 - 2.9.4 Store in weatherproof storage place and keep dry prior to application.
 - 2.9.5 Fertilizers to have a guaranteed N-P-K analysis.
 - 2.9.6 Fertilizers to include, but not be limited to, those shown in Table 1.

TABLE 1: FERTILIZERS		
NAME	Minimum Proportion by Weight	Main Element
Ammonium Nitrate	33.5%	N
Ammonium Sulfate	21.0%	N
Superphosphate (0-20-0)	8.5%	P (20% P2O5)
Superphosphate (0-45-0)	19.5%	P (45% P2O5)

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Potassium Sulfate	41.5%	K (50% K ₂ O)
Potassium Nitrate	13.0% 36.5%	N K (44% K ₂ O)
Iron Sulfate	20.0%	Fe, as metallic
Gypsum	23.0%	Ca
Rock or oyster shell lime, limestone flour	40.0%	Ca
Dolomite Lime	20.0% 13.0%	Ca M
Bonemeal	20.0% 3.0%	Phosphoric Acid N

(Bonemeal, Gypsum and limes to be finely ground to 12 mesh or finer.)

2.10 Growing Medium

- 2.10.1 Shall be any approved soil, soil substitute, or mixture with chemical and physical properties within ranges required by this Section for a particular application.
- 2.10.2 Shall be free of plants or their roots, weed seeds, sticks, building materials, wood chips (in excess of 10 mm maximum dimensions), chemical pollutants, and other extraneous materials not contributing to generally desirable physical and chemical properties for horticultural purposes.
- 2.10.3 Shall require not more than 0.5 kg/m³ of dolomite lime to reach required pH.
- 2.10.4 Salinity: saturation extract conductivity to not exceed 3.0 millimhos/cm at 25°C.
- 2.10.5 Boron: concentration in saturation extract to not exceed 1.0 ppm.
- 2.10.6 Sodium: sodium adsorption ratio (SAR) as calculated from analysis of saturation extract to not exceed 8.0.
- 2.10.7 Total Nitrogen: to be 0.2% to 0.6% by weight.
- 2.10.8 Available Phosphorous: to be 50 to 70 ppm.
- 2.10.9 Available Potassium: to be 50 to 100 ppm.
- 2.10.10 Cation Exchange Capacity: to be 30 to 50 meq.
- 2.10.11 Carbon to Nitrogen Ratio: to be not more than 40:1.
- 2.10.12 Acidity: to be within range specified in Table 2 for intended application.

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- 2.10.13 Texture: particle sizes and proportions to be within ranges shown in Table 2 for intended application.
- 2.10.14 Organic Content: to be within range shown in Table 2 for intended application.
- 2.10.15 Drainage of growing medium can be measured only after growing medium in place. Mixing and handling of growing medium to be done in such a manner that minimum saturated hydraulic conductivity: to be as specified in Table 2 for intended application.
- 2.10.16 Tolerances: samples of growing medium taken just before planting to have above properties to within tolerances of $\pm 20\%$, except for salinity, which is to be less than stated limit.

TABLE 2: MINIMUM LEVELS FOR PROPERTIES OF GROWING MEDIUM	
TEXTURE: - Gravel (2 mm – 75 mm) - Sand (0.05 mm – 2 mm) - Silt (0.002 mm - 0.05 mm) - Clay (less than 0.002 mm)	0 – 5% 40% 35% 25%
ACIDITY	pH 6.0 – 7.5
DRAINAGE: Minimum Saturated Hydraulic Conductivity (cm/hr)	2.0 cm/hr
ORGANIC CONTENT: Percentage of Dry Weight (%)	10

3.0 EXECUTION

3.1 Preparation of Subgrade

- 3.1.1 Prepare subgrade in accordance with the following section and Section 32 01 00 – Subgrade Preparation and in compliance with the Drawings.
- 3.1.2 Verify that grades are correct. If discrepancies occur, notify the Consultant and do not commence work until instructed by the Consultant.
- 3.1.3 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- 3.1.4 Remove debris, roots, branches, stones in excess of 25 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic

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materials and petroleum products. Remove debris which protrudes more than 50 mm above surface. Dispose of removed material to approved off-site disposal area.

3.1.5 Coarse cultivate entire area which is to receive growing medium to minimum depth of 150 mm immediately before placing growing medium. Cross cultivate area where equipment used for hauling and spreading has compacted soil.

3.1.6 Obtain approval of subgrade prior to placing growing medium.

3.2 Processing Growing Medium

3.2.1 Commercial processing and mixing of growing medium components to be done thoroughly by mechanized screening process. No hand mixing to occur. Resulting product to be homogeneous mixture having specified properties throughout.

3.2.2 Moisture content of peat moss at time of mixing to be not less than 50% to 75%. Peat moss to form a ball when squeezed and retain shape upon release of pressure. Insufficient moisture will result in peat moss not holding together, while excessive moisture is evident when ball formed is pliable with a clear water sheen on surface.

3.2.3 Add lime and potassium fertilizer, as required, at time of processing.

3.2.4 Do not prepare or handle growing medium in a wet or frozen condition.

3.3 Placing Growing Medium

3.3.1 Ensure growing medium moisture content is in range between wilting (25% to 75% of field capacity) but not wet when placed. Do not handle if frozen or so wet that its structure will be altered.

3.3.2 Finish depth of growing medium to be as specified in Table 3 unless otherwise indicated on drawing or directed by the Consultant.

3.3.3 Place growing medium to depths indicated over prepared subgrade and allow to settle or compact by light rolling such that it is firm against deep footprints. Do not compact growing medium more than necessary to meet this requirement.

3.3.4 Manually spread growing medium around existing trees, shrubs, and structures.

3.3.5 Minimum depths of growing medium after settlement shall be 100 mm for sodded areas and 150 mm for seeded areas.

3.4 Applying Fertilizers

3.4.1 Apply nitrogen and phosphorous fertilizers as required by soil test after growing medium is in place.

3.4.2 Spread fertilizers evenly over growing medium with suitable mechanical spreader.

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- 3.4.3 Incorporate fertilizers fully and evenly to minimum depth of 150 mm, except in lawn area, where they are to be incorporated to a depth of 50 mm.
- 3.4.4 Allow minimum one week separation between application of lime and fertilizers other than lime
- 3.4.5 Add lime (if required) to growing medium at time of screening. Add all other fertilizers (such as nitrogen, phosphorus and micronutrients) to growing medium by thorough cultivation after medium is in place (if required).
- 3.5 Finish Grading
 - 3.5.1 Fine grade growing medium after placing to finish elevations and contours required. Re-grade rough spots and low areas to ensure positive surface drainage.
 - 3.5.2 Finish surface smooth, uniform, firm against deep footprinting with a fine loose surface texture.
- 3.6 Acceptance
 - 3.6.1 The *Consultant* will inspect and test growing medium as placed and determine acceptance of material, depth of growing medium and finish grading. Approval of growing medium will be subject to soil testing and analysis.
 - 3.6.2 Testing of growing medium for acceptance will be carried out by testing laboratory designated by the *Consultant*. *Owner* will pay for costs of initial test. Costs of tests to check work to correct deficiencies shall be paid by *Contractor*.
- 3.7 Restoration of Stockpile Sites
 - 3.7.1 Restore stockpile sites to satisfaction of the *Consultant*.
- 3.8 Clean-up
 - 3.8.1 Dispose of surplus materials and all construction debris off-site.

END OF SECTION

HYDRAULIC SEEDING

1.0 GENERAL

Section 32 92 19.16 refers to those portions of the *Work* that are unique to the supply and application of grass seed by hydraulic seeding. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 References

- 1.1.1 Canada Seed Act
- 1.1.2 Canadian System of Soil Classification

1.2 Scheduling

- 1.2.1 Schedule all operations to ensure optimum environmental protection, grading, growing medium or topsoil placement, planting and seeding operations as outlined in these Specifications. Organize scheduling to ensure minimum movement and compaction of topsoil or growing medium and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.
- 1.2.2 Schedule seeding after frost has left ground and before July 1st, or between August 15th and September 15th.
- 1.2.3 Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet requirements of living plant material.
- 1.2.4 Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants.

1.3 Handling and Storage

- 1.3.1 All seed, mulch, fertilizers and related materials, where required, to be stored in dry, weatherproof storage place and to be protected from damage by heat, moisture, rodents or other causes until time of seeding. Labels or other identification to not be removed or defaced.

1.4 Drainage Control

- 1.4.1 Provision to be made for proper water management and drainage of site during construction. To include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period.

1.5 Quality Control

- 1.5.1 All products and materials used in work to be subject to testing when *Consultant* determines that testing is necessary to ensure specified standards are met.

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- 1.5.2 Provide *Consultant* with tag or label printed by seed supplier for original container of each different seed mix delivered.
- 1.6 Site Examination
 - 1.6.1 No seeding to be carried out in areas or over surfaces that are not properly prepared. *Contractor* to examine site before starting work to verify all surfaces are properly prepared.

2.0 PRODUCTS

- 2.1 Grass and Legume Seed
 - 2.1.1 Grass seed to meet requirements of Canada Seed Act for Canada No. 1 seed. Where specified, all nurse crop seed to meet requirements of Canada Seed Act for Canada No. 1 seed.
 - 2.1.2 Seed mixtures or indicated on the drawings to be approved by *Consultant* and to be suited to climate, terrain, establishment and maintenance conditions under which they are to be grown. Mixture to be mixed and supplied by recognized seed house.
 - 2.1.3 Legume seed to be supplied with appropriate type and quantity of *Rhizobium* inoculant. Add inoculant to seed mixture immediately before seeding.
 - 2.1.4 Seed to be packed and delivered in original containers clearly showing:
 - (a) Name of supplier.
 - (b) Analysis of seed mixture
 - (c) Percentage of pure seed
 - (d) Year of production
 - (e) Net weight (mass)
 - (f) Date and location of bagging
 - 2.1.5 Seed to have a minimum germination rate of 75% and minimum purity of 97% except where otherwise required by professional selecting seed mixture.
- 2.2 Mulch Material
 - 2.2.1 Specially prepared wood cellulose and/or textile fabric of a type commonly used and approved for hydraulic mulching.
 - 2.2.2 Capable of dispersing in water to form a homogenous slurry and remaining in such state when agitated or mixed with other specified materials. When applied, hydraulic mulch to be capable of forming absorptive mat, which will allow moisture to percolate into underlying soil and to contain no growth or germination inhibiting factors. Mulch to be dry free of weeds and all other foreign material and to be

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- supplied in packages bearing manufacturer's label clearly indicating weight and product name.
- 2.2.3 Capable of forming an absorptive mat ground cover allowing water percolation but not inhibiting seed germination and growth.
- 2.2.4 Material to be clean, weed free and contain a non-toxic green dye to aid in visual inspection after application.
- 2.3 Tackifier
 - 2.3.1 Mulch may contain a colloidal polythacuride (or equivalent) tackifier, which is to be adhered to mulch to prevent separation during shipment and to avoid chemical agglomeration during mixing in hydraulic mulching equipment.
- 2.4 Water
 - 2.4.1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
- 2.5 Erosion Control Blanket
 - 2.5.1 Nilex C125 or approved equal.

3.0 EXECUTION

- 3.1 Workmanship
 - 3.1.1 Take care to prevent spraying items such as structures, utilities and plant materials.
- 3.2 Preparation
 - 3.2.1 Verify that grades are correct and prepared in accordance with Section 31 24 13 – Roadway Excavation, Embankment and Compaction and do not commence work until instructed by Consultant.
 - 3.2.2 Do not perform work under adverse field conditions such as winds greater than 10 km per hour, frozen soil, hot and arid conditions, excessively wet or dry soil or soil covered with snow, ice or standing water.
 - 3.2.3 Remove and dispose of weeds; debris; soil contaminated by oil, gasoline and other deleterious material; to approved off-site disposal area.
 - 3.2.4 Scarify or rake the soil surface perpendicular to the slope to provide a surface that will enhance the germination of seed.
 - 3.2.5 Finish grade smooth to extent required for class of seeding to be carried out, firm against footprints, loose textured, and free of all stones, roots, branches, etc. larger than diameter required for removal for class of seeding to be carried out.
- 3.3 Seeding – General

HYDRAULIC SEEDING

- 3.3.1 Scheduling: carry out seeding during periods that are most favourable for establishment of healthy stand of grass. Seed only during calm weather and on soil that is free of frost, snow and standing water, when seasonal conditions are likely to ensure successful germination and continued growth of all varieties of seed in grass mix.
- 3.3.2 Rates of Application: rates of application of fertilizers, seed mixtures, mulch and other components to be based on analysis of season, climate, terrain, soil and establishment and maintenance conditions affecting project.
- 3.4 Equipment
 - 3.4.1 All hydraulic seeding/mulching equipment to equipment and not to be removed or altered.
 - 3.4.2 Hydraulic seeder/mulching to be capable of sufficient agitation to mix materials into homogeneous slurry and to maintain slurry in homogeneous state until application. Discharge pumps and gun nozzles to be capable of applying material uniformly over designated areas.
- 3.5 Protection
 - 3.5.1 Carry out hydraulic seeding with care to ensure fertilizer in solution does not come in contact with foliage of any trees, shrubs or other susceptible vegetation. Do not spray seed or mulch on objects not expected to grow grass.
 - 3.5.2 Protect existing site equipment, roadways, landscaping, reference points, monuments, markers and structures from damage.
 - 3.5.3 Promptly rectify any overspray or damage that occurs during hydraulic seeding.
- 3.6 Slurry Application
 - 3.6.1 Combine seed mixture, mulch material, tackifier and fertilizer at rate as specified on drawing or in specification. Add water and thoroughly mix to form a homogenous slurry.
 - 3.6.2 Use sufficient water to suspend the components in the slurry and provide a uniform coverage of the soil surface at the specified rates.
 - 3.6.3 Measure quantities of each material to be charged into hydraulic seeder/mulcher tank accurately either by mass or by commonly accepted system of mass-calibrated volume measurements. Add material to tank while it is being filled with water and in following sequence: seed, fertilizer, and where applicable, mulch. Thoroughly mix materials into homogeneous water slurry and distribute uniform over surface area with hydraulic seeder/mulcher. Uniformly apply slurry mixture over areas requiring hydroseeding in a minimum of two passes and a maximum of three passes.
 - 3.6.4 Keep seeds for grass and legumes in separate containers prior to seeding.

HYDRAULIC SEEDING

- 3.6.5 If required, add legume seed to grass mixture at time of seeding. Inoculate legume seed with standard product humus culture before mixing with grass seed. Protect inoculated seed from exposure to sunlight for periods of over one-half hour. Use seed within eight hours from inoculation or to be re-inoculated.
- 3.6.6 After charging, do not add water or other material to mixture in hydraulic mulcher.
- 3.6.7 Do not leave seed, fertilizer, mulch and water slurry in tank for more than 4 h. Slurry left in tank of maximum time to not be used for seeding, dispose off-site.
- 3.6.8 If required, apply wild flower seed following grass hydroseeding.
- 3.6.9 Blend applications into adjacent grass to form uniform surfaces. Clean sprayed slurry mixture from hard surfaces, utilities, site furniture, signs and other structures.
- 3.7 Erosion Control Blanket
 - 3.7.1 Apply blanket over designated areas in accordance with manufacturer's instructions.
 - 3.7.2 Anchor blanket in accordance with manufacturer's recommendations which are to be used as minimum standard and ensure that blanket is held down to maintain firm contact with soil.
- 3.8 Clean-up
 - 3.8.1 Remove all materials and other debris resulting from seeding operations from job site.
- 3.9 Maintenance and Protection
 - 3.9.1 Begin maintenance for seeded areas immediately after seeding has been completed, and continue until issuance of *Total Performance of the Work*.
 - 3.9.2 Include all measure necessary to establish and maintain grass in a vigorous growing condition, including, but not limited to, following:
 - (a) Mow at regular intervals as required, to maintain grass at maximum height of 100 mm. Do not cut more than 1/3 of blade during any time of mowing. Neatly trim edges of seeded areas. Remove heavy clippings immediately after mowing and trimming.
 - (b) Water when required and with sufficient quantities to prevent grass and underlying soil from drying out.
 - (c) Roll when required and with sufficient quantities to prevent grass and underlying soil from drying out.
 - (d) Undertake weed control when density of weeds reaches 10 broadleaf weeds or 50 annual weeds or weedy grasses per 40 m² and reduce density of weeds to zero.

HYDRAULIC SEEDING

- (e) Immediately repair seeded area that show deterioration or bare spots. Top-dress all areas showing shrinkage due to lack of watering and seed with seed mix that matches original seed mix.
- (f) Protect all seeded areas with warning signs, temporary wire or twine fences, or other necessary means.

3.10 Conditions for *Total Performance of the Work*

3.10.1 *Consultant* will issue Notice of *Total Performance of the Work* only when the following conditions exist:

- (a) Growing medium quality, fertility levels, depths and surface condition are as specified in the *Contract Documents*.
- (b) Grasses are required varieties, free of varieties other than those specified.
- (c) Grass areas are relatively free of weeds, containing no more than two broadleaf weeds or ten annual weeds or weedy grasses per m².
- (d) Grass is sufficiently established that its roots are growing into underlying growing medium.
- (e) Seeded areas have been mown at least three times, last mowing being within 48 h of inspection for acceptance.
- (f) Grasses established in sufficient density that no surface soil visible when mown to height of 38 mm.
- (g) Specified maintenance procedures have been carried out.

3.11 Guarantee / Maintenance

3.11.1 *Customary one year guarantee period for construction industry will apply as standard for landscape work. Contractor to guarantee all materials and workmanship for a period of one full year from date of Total Performance of the Work unless specified otherwise in the Contract Documents.*

3.11.2 Guarantee includes replacing all seeded areas determined by *Consultant* to be dead or failing at end of guarantee period. Replacements to be made at next appropriate season, and conditions of guarantee will apply to all replacement seeding for one full growing season.

3.11.3 Guarantee will not apply to seeded areas damaged after date of *Total Performance of the Work* by causes beyond *Contractor's* control, such as vandalism, "acts of God", 'excessive wear and tear', or abuse. *Contractor* is responsible for *Work* until *Total Performance of the Work*.

END OF SECTION

DIVISION 33 – UTILITIES

CCTV INSPECTION OF PIPELINES

1.0 GENERAL

1.1 Section 33 01 30.1 refers to those portion of the *Work* that are unique to the requirements for inspecting new and existing sanitary sewers, storm and combined sewers and pipe culverts by closed circuit television.

1.2 Related Work

1.2.1 Cleaning of Sewers Section 33 01 30.02

1.3 References

1.3.1 These specifications must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.3.2 Reference standards, specification or publications.

1.3.2.1 Water Research Centre (WRC) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.

1.3.3 Nomenclature

1.3.3.1 NAAPI – North American Association of Pipeline Inspectors)

1.3.3.2 CCTV – Closed Circuit Television

1.3.3.3 JPEG – Joint Photographic Experts Group

1.3.3.4 MPEG – Movie Photographic Experts Group

1.3.3.5 S-VHS – Super VHS format

1.3.4 Submission of Certification

1.3.4.1 Cleaning of Sewers Section 33 01 30.02

1.3.5 Submission of Certification

1.3.5.1 Submit copy of the CCTV operator's training certification to the *Prime Consultant* at least one week prior to the start of the CCTV inspection operations.

1.3.5.2 Submit copy of certificate for each CCTV operator working on the contract.

1.3.6 Work Regulations

CCTV INSPECTION OF PIPELINES

1.3.6.1.1 Work to conform to all applicable regulations of the Alberta Government and OH&S Standards. Confirm training compliance in the following:

1.3.6.1.2 Confined space entry

1.3.6.1.3 Ventilation

1.3.6.1.4 Atmospheric monitoring

1.3.6.1.5 Personal protective equipment

1.3.6.2 .2 Provide written confirmation to the *Prime Consultant* that workers have knowledge of confined space entry practices and of equipment required for confined space entry.

1.3.7 Scheduling of Work

1.3.7.1 Schedule work to minimize interruptions to existing services.

1.3.7.2 Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11).

2.0 PRODUCTS

2.1 Equipment

2.1.1 Survey Vehicle to contain a separate area for viewing, recording and controlling the CCTV operation.

2.1.1.1 Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation to be provided to enable one person in addition to the operator to clearly view the monitor screen.

2.1.1.2 All equipment utilized within the pipeline to be stored outside the viewing, recording and control area.

2.1.1.3 Vehicle to be equipped with a telephone for communication with the *Prime Consultant* for the duration of the work.

2.1.1.4 Electrical power for the system to be self-contained. External power sources from public or private sources not permitted.

2.1.2 Survey Equipment to have sufficient cables to view the lengths of pipe as specified.

CCTV INSPECTION OF PIPELINES

- 2.1.2.1 Survey unit to be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
- 2.1.2.2 Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
- 2.1.2.3 Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.
- 2.1.3 Camera to be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - 2.1.3.1 Camera to be "Pan & Tilt" and have the capability of panning the pipe at 360° with tilt capability of 270°.
 - 2.1.3.2 Live picture to be visible with no interference and capable of registering a minimum number of 400 lines of resolution at the periphery.
 - 2.1.3.3 Focus and iris adjustment to allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150 mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - 2.1.3.4 Camera to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.
- 2.1.4 Digital video files shall be MPEG2 and conform to the following requirements:
 - 2.1.4.1 Picture Size: NTSC 704 x 480 at 29.97 frames per second
 - 2.1.4.2 Digital video files to be stored on new, unused DVD media.
- 2.1.5 Photographs to be colour, minimum image size 90 mm x 70 mm and reproduced on premium glossy ink jet paper when required, as specified in the Agreement.

3.0 EXECUTION

3.1 CCTV Inspection

- 3.1.1 CCTV operator to have received training by NAAPI or NASSCO.

CCTV INSPECTION OF PIPELINES

- 3.1.2 Submit sample of inspection reports, video in DVD format together with corresponding digital data file for review within one week of receipt of notice to proceed with contract. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent inspection report submissions.
- 3.1.3 No inspection surveys to be carried out under this contract until an acceptable sample inspection report has been approved by the *Prime Consultant*.
- 3.1.4 Flow in the pipeline not to exceed approximately 20% of the pipe diameter. Notify *Prime Consultant* of excessive flows, inspect using flow reduction method (See Clause 3.11).
- 3.1.5 Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.
- 3.1.6 Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.
- 3.1.7 Inspection video image to be produced in MPEG2 format:
 - 3.1.7.1 Create separate digital file for each individual Manhole to manhole inspection report.
- 3.1.8 Set zero chainage at face of every manhole or on entrance into pipe or start or pipe culvert.
- 3.1.9 Report and record on full length of pipeline from inside face to inside face between manhole or outlet end of pipes and from one end of pipe culvert to the other.
- 3.1.10 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- 3.1.11 Data generator to electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information prior to the start of each run:
 - 3.1.11.1 Manhole (from-to) / pipe length reference numbers.
 - 3.1.11.2 Pipeline dimensions
 - 3.1.11.3 Pipe material (i.e. vitrified clay, concrete, PVC etc.)
 - 3.1.11.4 Type or use of pipe (i.e. sanitary, storm or combined sewer)

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- 3.1.11.5 Date of survey (yyyy.mm.dd)
 - 3.1.11.6 Road name/location
 - 3.1.11.7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
 - 3.1.11.8 Inspection (report) number
 - 3.1.11.9 Verbal description of all the above on screen information.
 - 3.1.12 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
 - 3.1.13 Data generator to continuously electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following information during each run:
 - 3.1.13.1 Automatic update of the camera's metre reading position from adjusted zero.
 - 3.1.13.2 Manhole/pipe length reference numbers.
 - 3.1.13.3 Type or use of pipe (i.e. sanitary, storm or combined sewer)
 - 3.1.13.4 The unique inspection/report number of the run.
 - 3.1.13.5 Display digital information such that it will not interfere with the video image on the screen.
 - 3.1.14 Stop camera at each defect, change of condition of pipe and service connection to record defect in accordance with WRC codes.
 - 3.1.15 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
 - 3.1.16 Immediately notify the *Prime Consultant* of any blockage or obstruction that will not allow passage of survey equipment.
 - 3.1.17 Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by the *Prime Consultant*.
- 3.2 Recording Resolution
- 3.2.1 At the beginning of each video tape, day of inspection or when a substitute camera is introduced perform necessary checks to ensure recording resolution satisfies these specifications.

CCTV INSPECTION OF PIPELINES

3.3 Site Coding Sheets

- 3.3.1 Each pipeline length to be recorded according to the MSCC. Any variation from the manual to be noted in the survey report.
- 3.3.2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - 3.3.2.1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day)
 - 3.3.2.2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds)
 - 3.3.2.3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC

3.4 Camera Position

- 3.4.1 Position camera lens centrally in the pipeline with a positioning tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned $\frac{2}{3}$ the height of the pipe measured from the invert.
- 3.4.2 Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

3.5 Camera Travel Speed

- 3.5.1 Travelling speed of the camera in the pipeline to be as follows:
 - 3.5.1.1 6 m/min for pipeline of diameter less than 200 mm.
 - 3.5.1.2 9 m/min for diameters 200 mm and larger but not exceeding 310 mm:
and
 - 3.5.1.3 12 m/min for diameters exceeding 310 mm.

3.6 Camera Position Chainage Device

- 3.6.1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera
 - 3.6.1.1 Chainage information to be transmitted electronically to control area and displayed on the monitor.
 - 3.6.1.2 Chainage device to be accurate to within 0.3 m up to the first 50 m and within $\pm 1\%$ for lengths exceeding 50 m.

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- 3.6.1.3 Chainage tolerance to be checked at the start of contract and a minimum of once every two weeks thereafter or every 5,000 m of pipeline inspected, whichever is greater.
 - 3.6.1.4 Provide audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.
- 3.7 Photographs and/or Digital Images
 - 3.7.1 Photograph all major defects as defined by condition codes: B, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X
 - 3.7.2 Overlay on photographs the following data in alpha-numeric form such that it will not interfere with the defect condition reported:
 - 3.7.2.1 Report/job number
 - 3.7.2.2 .2 Metre reading position (chainage)
 - 3.7.2.3 .3 Manhole/pipe length reference numbers (from - to)
 - 3.7.2.4 .4 Photograph number
 - 3.7.2.5 .5 WRC. condition defect code
 - 3.7.2.6 .6 Date of survey (yyyy.mm.dd)
 - 3.7.3 Capture photograph and alpha-numeric data as a digital image in a JPEG file format if required, as specified in the Agreement.
 - 3.7.4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.
- 3.8 Inspection Reporting Hard copies & Digital Format
 - 3.8.1 Submit reports to the *Prime Consultant* within ten (10) working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
 - 3.8.2 Present machine printed (hard copy) and computer generated data base reports according to the MSCC format.
 - 3.8.2.1 Each binder to commence with an index of all survey inspection reports contained within.

CCTV INSPECTION OF PIPELINES

- 3.8.2.2 Hard copy reports to be presented in tabular form in accordance with WRc MSCC
- 3.8.2.3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the *Agreement*.
- 3.8.2.4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
- 3.8.2.5 Digital information to be presented in tabular configuration in accordance with the Municipality's standard file format in Microsoft ACCESS (.MDB)
- 3.8.2.6 Provide CD ROM of digital photographs. Disk to be labelled with photo and contract numbers.
- 3.8.2.7 .7 Include Municipality supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
- 3.8.3 Present report in 215 mm x 280 mm three ring (D type) binder. DVD's containing relevant CCTV inspections surveys to be included in the binder.
- 3.8.4 Attach computer disks in three hole plastic diskette sheet holder in back of binder.
- 3.8.5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
- 3.8.6 All dimensions and chainages in the reports to be metric.
- 3.9 Cleaning
 - 3.9.1 Clean pipelines to Section 33 01 30.2 immediately prior to CCTV inspection survey, unless otherwise specified in the *Agreement*.
- 3.10 Root Cutting & Removal
 - 3.10.1 Remove roots to Section 33 01 30.2 for condition codes RT and RM where required, to allow for CCTV equipment to pass.
- 3.11 Flow Reduction
 - 3.11.1 Reduce flow in pipeline to approximately 20% of pipe diameter to allow CCTV inspection by combination of the following:
 - 3.11.2 Schedule work for off peak flow times.

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3.11.3 Plug or block flow at upstream manhole.

3.11.3.1 Plug designed to either plug all flow or impede flow ("flow through" plug) to the approximate 20% of pipe diameter.

3.11.3.2 Obtain the *Prime Consultant's* approval prior to plugging or impeding any flow.

3.11.3.3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.

3.11.4 Temporary bypass pump flow around inspection section when *Contractor* demonstrates that off peak inspection, plugging and /or the use of sewer cleaning equipment cannot effectively reduce flow levels to specified levels. Bypass pump plugs to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain the *Prime Consultant's* approval prior to setting up temporary bypass pump system.

3.12 Coding Accuracy

3.12.1 Coding accuracy to be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:

3.12.1.1 header accuracy - 95%

3.12.1.2 detail accuracy - 85%

3.12.2 *Contractor* to implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the *Contractor* on a random basis on a minimum of 10% of the inspection reports. The *Prime Consultant* to be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.

3.12.3 A minimum of two accuracy verifications to be performed for each operator for each working week. Coding not satisfying the accuracy requirements to be re-coded and the accuracy of the inspection report immediately preceding and following the non-compliant inspection to be verified. Process to be repeated until the proceeding and subsequent inspections meet accuracy requirements.

END OF SECTION

WATERWORKS

1.0 GENERAL

- 1.1 Section 33 11 01 refers to those portions of the Work that are unique to the supply and installation of watermains, hydrants, valves and valve boxes, service connections and related appurtenances. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the works described herein.
- 1.2 All details of waterworks facilities not specifically covered in this Section to comply with appropriate AWWA and National Sanitation Foundation (NSF) standards and/or manuals of practice as specified in the Contract Documents.
- 1.3 Related Work:
 - 1.3.1 Concrete Reinforcement Section 03 20 00
 - 1.3.2 Cast-in-Place Concrete Section 03 30 00
 - 1.3.3 Aggregates and Granular Materials Section 31 05 16
 - 1.3.4 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.3.5 Water Utility Tracer Wire Section 33 11 01.01
- 1.4 References
 - 1.4.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 43 00.
 - 1.4.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - 1.4.2.1 ANSI/AWWA B300- [10], Standard for Hypochlorites.
 - 1.4.2.2 ANSI/AWWA B301- [10], Standard for Liquid Chlorine.
 - 1.4.2.3 ANSI/AWWA B303- [10], Standard for Sodium Chlorite.
 - 1.4.2.4 ANSI/AWWA C104/A21.4- [08], Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - 1.4.2.5 ANSI/AWWA C105/A21.5- [10], Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 1.4.2.6 ANSI/AWWA C111/A21.11- [07], American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 - 1.4.2.7 ANSI/AWWA C110/A21.10- [08], American National Standard for Ductile-Iron and Grey Iron Fittings for Water.
 - 1.4.2.8 ANSI/AWWA C150/A21.50- [08], Standard for Thickness Design of Ductile-Iron Pipe.

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- 1.4.2.9 ANSI/AWWA C151/A21.51- [09], Standard for Ductile-Iron Pipe, Centrifugally Cast.
- 1.4.2.10 ANSI/AWWA C153/A21.53- [11], Standard for Ductile-Iron Compact Fittings.
- 1.4.2.11 ANSI/AWWA C200- [05], Standard for Steel Water Pipe - 6 Inch (150 mm) and Larger.
- 1.4.2.12 ANSI/AWWA C203- [08], Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
- 1.4.2.13 ANSI/AWWA C205- [07], Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
- 1.4.2.14 ANSI/AWWA C206- [11], Standard for Field Welding of Steel Water Pipe.
- 1.4.2.15 ANSI/AWWA C207- [07], Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
- 1.4.2.16 ANSI/AWWA C208- [07], Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- 1.4.2.17 ANSI/AWWA C300- [11], Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
- 1.4.2.18 ANSI/AWWA C301- [07], Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
- 1.4.2.19 ANSI/AWWA C303- [08], Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- 1.4.2.20 ANSI/AWWA C500- [09], Standard for Metal-Seated Gate Valves for Water Supply Service.
- 1.4.2.21 ANSI/AWWA C504- [10], Standard for Rubber-Seated Butterfly Valves.
- 1.4.2.22 ANSI/AWWA C600- [10], Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- 1.4.2.23 ANSI/AWWA C602- [11], Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
- 1.4.2.24 ANSI/AWWA C651- [05], Standard for Disinfecting Water Mains.

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- 1.4.2.25 ANSI/AWWA C800- [05], Standard for Underground Service Line Valves and Fittings.
- 1.4.2.26 ANSI/AWWA C900- [07], Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- 1.4.3 ASTM International (ASTM)
 - 1.4.3.1 ASTM A53/A53M- [10], Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - 1.4.3.2 ASTM A123/A123M- [09], Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 1.4.3.3 ASTM A307- [10], Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - 1.4.3.4 ASTM B88M- [05(2011)], Standard Specification for Seamless Copper Water Tube [Metric].
 - 1.4.3.5 ASTM C117- [04], Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - 1.4.3.6 ASTM C136- [06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 1.4.3.7 ASTM C478M- [11], Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
 - 1.4.3.8 ASTM D698- [07e1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 1.4.3.9 ASTM D2310- [06], Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - 1.4.3.10 ASTM D2657- [07], Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - 1.4.3.11 ASTM D2992- [06], Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
 - 1.4.3.12 ASTM D2996- [01(2007)e1], Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - 1.4.3.13 ASTM F714- [10], Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

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- 1.4.3.14 ASTM C618- [08a], Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- 1.4.4 Canadian General Standards Board (CGSB)
 - 1.4.4.1 CAN/CGSB-8.1- [88], Sieves, Testing, Woven Wire, Inch Series.
 - 1.4.4.2 CAN/CGSB-8.2- [M88], Sieves, Testing, Woven Wire, Metric.
 - 1.4.4.3 CAN/CGSB-34.1- [94], Pipe, Asbestos Cement, Pressure.
 - 1.4.4.4 CGSB 41-GP-25M- [77], Pipe, Polyethylene, for the Transport of Liquids.
- 1.4.5 CSA Group (CSA)
 - 1.4.5.1 CAN/CSA-A257 Series- [09], Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - 1.4.5.2 CAN/CSA-A3000- [08], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - 1.4.5.3 CAN/CSA-B137 Series- [09], Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - 1.4.5.4 CAN/CSA-B137.1- [09], Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - 1.4.5.5 CAN/CSA-B137.3- [09], Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
- 1.4.6 CSA G30.18- [09], Carbon and Steel Bars for Concrete Reinforcement.
- 1.4.7 The Master Painters Institute (MPI)
 - 1.4.7.1 Architectural Painting Specification Manual - [current edition].
- 1.4.8 Underwriters' Laboratories of Canada (ULC)
 - 1.4.8.1 CAN/ULC-S520- [07], Standard for Fire Hydrants.
 - 1.4.8.2 CAN/ULC-S543- [09], Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.
- 1.5 Samples
 - 1.5.1 Submit adequate samples of materials for testing purposes.
 - 1.5.2 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- 1.6 Material Certification

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- 1.6.1 Products having CSA certification to be used where readily available. Products to be certified to CSA standard(s) by an approved independent third body accredited by the Standards Council of Canada and that is acceptable to the *Consultant*. Products to be marked with certification body logo and CSA standard markings.
- 1.6.2 At least two weeks prior to commencing work, submit manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this section. Include manufacturer's drawings where pertinent.
- 1.7 Shop Drawings and Technical Data
 - 1.7.1 *Contractor* to submit shop drawings and technical data for all waterworks products, and associated components.
 - 1.7.2 Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.
 - 1.7.3 Submit complete drawings and construction schedule for water mains. Include method for installation of water main.
 - 1.7.4 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - 1.7.5 Pipe certification to be on pipe.
- 1.8 Record Drawings
 - 1.8.1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions.
 - 1.8.1.1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers, and pig launch & retrieval stations.
 - 1.8.2 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers, pig launch & retrieval stations for incorporation into manual.
- 1.9 Scheduling of Work
 - 1.9.1 Schedule Work to minimize interruptions to existing services.
 - 1.9.2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Consultant.
 - 1.9.3 Notify Consultant minimum of 24 hours in advance of interruption in service.

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- 1.9.4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.
- 1.9.5 Notify fire department of planned or accidental interruption of water supply to hydrants.
- 1.9.6 Provide and post "Out of Service" sign on hydrant not in use.
- 1.9.7 Advise local police department of anticipated interference with movement of traffic.
- 1.10 Commissioning Plan
 - 1.10.1 Prior to starting construction on the water mains, submit a commissioning plan that describes how the watermain will be pressure tested, flushed, and disinfected.

2.0 PRODUCTS

2.1 General

- 2.1.1 Pipe material as shown on *Contract Drawings*.
- 2.1.2 All products are specified by reference to approved specifications and/or standards. Refer to *Contract Drawings* for specified or approved manufacturers or trade names.
- 2.1.3 All waterworks products shall have a minimum operating pressure of 1380 kPa (200 psi) and be capable of withstanding a hydrostatic test pressure of 2068 kPa (300 psi) for a minimum of 5 hours.
- 2.1.4 All waterworks products shall be approved for potable water use to NSF 61.
- 2.1.5 Metallic fittings to be coated with fusion bonded epoxy to AWWA C213.

2.2 Mainline Pipe, Joints, and Fittings

2.2.1 Ductile Iron Pipe

- 2.2.1.1 Not applicable.

2.2.2 Polyvinyl Chloride (PVC) Pressure Pipe

2.2.2.1 Pipe:

- 2.2.2.1.1 Pipe to be manufactured to specifications for pipe size ranges as follows:
 - 2.2.2.1.1.1 Pipes 100 to 300mm dia. – AWWA C900
- 2.2.2.1.2 Pipes 350 to 1200mm dia. – AWWA C905
- 2.2.2.1.3 AWWA C900 pipe to Pressure Class or AWWA C905 pipe to pressure rating specified in *Contract Documents*.

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- 2.2.2.1.4 Pipes to be certified by Canadian Standards Association for pipe size ranges 100 to 1200mm dia. – CSA B137.3
- 2.2.2.2 ULC approved.
- 2.2.2.3 Cast iron pipe equivalent outside diameter.
- 2.2.2.4 To be compatible with specified mechanical joint and push-on joint fittings and valves without use of special adapters.
- 2.2.2.5 Pipe to be blue in colour.
- 2.2.2.6 Joints: Push-on integrally thickened bell and spigot type to ASTM D3139 Clause 6.2 with single elastomeric gasket to ASTM F477.
- 2.2.3 High Density Polyethylene Pipe:
 - 2.2.3.1 HDPE pipe and fittings must confirm to AWWA C906.
 - 2.2.3.2 Shall be 4710.
 - 2.2.3.3 DR as indicated on drawings.
 - 2.2.3.4 The pipe Manufacturer, Distributor, and Installer shall ensure that the ends of each pipe length remain sealed in a manner acceptable to the Consultant during the transportation and storage of the pipe. The purpose of the end-seals is to prevent contaminants from entering the interior of the pipe from the time of manufacture to the time of installation.
- 2.2.4 Steel Pipe:
 - 2.2.4.1 Refer to Section 40 05 23.24
- 2.2.5 Pre-Stressed Concrete Pressure Pipe:
 - 2.2.5.1 Not applicable.
- 2.2.6 Fittings
 - 2.2.6.1 Gray-iron (cast iron) fittings to AWWA C110/A21.10-93 suitable for 1,035 kPa minimum pressure rating or higher as specified in *Contract Documents*. Where specified in *Contract Documents*, to be cement mortar lined and externally seal coated, both to AWWA C104/A21.4.
 - 2.2.6.2 Ductile iron fittings to AWWA C110 suitable for pressure rating of 1,720 kPa, cement mortar lined to AWWA C104/A21.4.
 - 2.2.6.3 Compact ductile iron fittings to AWWAC153/A21.53.94 suitable for pressure rating of 2,415 kPa, cement mortar lined to AWWA C104/A21.4.
 - 2.2.6.4 PVC Injection-moulded fittings shall be DR18 conforming to AWWA C907 and certified to CSA B137.3. PVC compound is 1245B according to ASTM

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D1784. PVC fittings shall only be used when specified as acceptable or where specifically indicated in *Contract Documents*.

2.2.6.5 PVC Fabricated fittings shall conform to AWWA C900 and be certified to CSA B137.3. Fabricated fittings to be made from CSA certified PVC pipe of the same pressure class or pressure rating as the pipe.

2.2.6.6 Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints: to AWWA C111. All push-on joint hubs to be equipped with tie-rod lugs.

2.2.6.7 Fabricated HDPE mitred fittings to AWWA C906 suitable for pressure rating specified in *Contract Documents*. Fittings to be butt fused, thermofused fitting/couplings or equipped with flanged adapters.

2.2.6.8 Flanged Joints:

2.2.6.8.1 Flat faced conforming to the face dimension and drilling of ANSI B16.1, Class 125.

2.2.6.8.2 On AWWA C119 fittings to AWWA C110 with minimum pressure rating of 1,035 kPa or higher as specified in *Contract Documents*.

2.2.6.8.3 On AWWA C153 fitting to AWWA C153 with minimum pressure rating of 1,723 kPa or higher as specified in *Contract Documents*.

2.2.6.9 Flange Gaskets:

2.2.6.9.1 Flange gaskets to be manufactured from black natural rubber 3.175 mm thick with layer of cotton both sides.

2.2.6.9.2 Gaskets to be natural or SBR type rubber.

2.2.6.10 Bolts and Nuts:

2.2.6.10.1 Bolts to be carbon steel, Grade B to ASTM 307, heavy hex style, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.

2.2.6.10.2 Nuts and washers: Nuts to be carbon steel, Grade A to ASTM A563. Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.

2.2.6.11 Tie Rods and Nuts:

2.2.6.11.1 Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Tie rod

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sizes to be minimum 19mm diameter or greater as shown on Contract Drawings.

2.2.6.11.2 Nuts and internally threaded couplings to be heavy hex finish to ASTM A563. Washers to be flat hardened steel to ASTM F436. Zinc plated to ASTM B633 or cadmium plated to ASTM B766.

2.2.6.12 Fabricated steel pipe fittings: to AWWA C200 and AWWA C208, and AWWA C207 if flanged, interior and exterior protected with hot applied coal tar enamel to AWWA C203 or liquid epoxy coating to AWWA C210.

2.2.6.13 Couplings and Flanged Coupling Adapters:

2.2.6.13.1 General Requirements:

2.2.6.13.1.1 Suitable for pressure rating specified in *Contract Documents*.

2.2.6.13.1.2 Flanges and full face flange gaskets where applicable to 2.2.6 (h) and (i) of this Section.

2.2.6.13.1.3 To AWWA C219.

2.2.6.13.1.4 Anti-corrosion coating of interior and exterior centre sleeve and rings to AWWA C210, C219, C213 or AWWA C550 as specified in *Contract Documents*.

2.2.6.13.1.5 Compression gaskets to AWWA C219.

2.2.6.13.1.6 Bolts and nuts high strength low alloy steel AWWA C111, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts, as specified in *Contract Documents*. Rolled threads, fit and dimensions to AWWA C111.

2.2.6.13.1.7 Ductile iron castings to ASTM A536, Grade 65-45-12.

2.2.6.13.2 Plain end or transition coupling as specified in *Contract Documents*.

2.2.6.13.3 Flanged coupling adapters as specified in *Contract Documents*.

2.2.6.14 Joint Resistant Devices: General Requirements

2.2.6.14.1 Ductile iron castings to ASTM A536.

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- 2.2.6.14.2 Anti-corrosion coating of ductile iron castings to AWWA C219, AWWA C210, AWWA C213 or AWWA C550 as specified in *Contract Documents*.
- 2.2.6.14.3 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in *Contract Documents*, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
- 2.2.6.14.4 Tie rods to 2.2.6 (k) of this Section.
- 2.2.6.14.5 Restrainers for ductile iron pipe with mechanical joint fittings as specified in *Contract Documents*.
- 2.2.6.14.6 Restrainers for PVC pipe conforming to 2.2.2 of this Section with mechanical joint fittings as specified in *Contract Documents*.
- 2.2.6.14.7 Restrainers for ductile iron pipe with push-on joint fittings with tie rod lugs as specified in *Contract Documents*.
- 2.2.6.14.8 Restrainers for PVC conforming to 2.2.2 of this Section with push-on joint fittings with tie rod lugs as specified in *Contract Documents*.
- 2.2.6.14.9 Restrained harnesses or integral restraint systems manufactured as part of the pipe joint as specified in *Contract Documents*.
- 2.2.6.14.10 Restrainers for bell joints in PVC pipe conforming to 2.2.2 of this Section.
- 2.2.6.14.11 All joint restraint systems for PVC pipe shall be approved by the PVC pipe manufacturer confirming that they are to be used on PVC pipe and that they do not reduce the pipe manufacturer's recommended working pressures.
- 2.2.6.15 Tapping Sleeves for Branch Connections 75mm and Larger:
 - 2.2.6.15.1 Not applicable.
- 2.2.6.16 Repair clamps shall be constructed of 18-8 stainless steel passivated for corrosion resistance. Stainless steel components shall be Type 304 or 304L. All surfaces including weld areas shall be thoroughly cleaned of scale, grease or other contaminants. Welding must be performed in a controlled environment to prevent sensitization.

2.3 Lubricants

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- 2.3.1 Joint lubricants must be certified for potable water use in accordance with NSF Standard 61 and must:
 - 2.3.1.1 Impart no taste or odour to potable water containing free or combined chlorine disinfectants;
 - 2.3.1.2 Create no turbidity in potable water;
 - 2.3.1.3 Promote no bacterial growth; and
 - 2.3.1.4 be compatible with rubber and neoprene gasket materials.
- 2.4 Insulation and Water Proofing
 - 2.4.1 As shown on *Contract Drawings*.
- 2.5 Valves and Valve Boxes
 - 2.5.1 Mainline Valves - General Requirements:
 - 2.5.1.1 Valves to open clockwise.
 - 2.5.1.2 All valves to have manufacturer's name, year of manufacturer, size and working pressure on the bonnet or body.
 - 2.5.1.3 Gate valves larger than 400 mm to have gear operating operators.
 - 2.5.1.4 Provide extension where depth to top of operating nut is greater than 1.5 m.
 - 2.5.1.5 Install resilient wedge gate valves unless specified otherwise.
 - 2.5.1.6 All valves must incorporate an independent packing retaining plate or recessed packing retaining device to accommodate the actuator removal under fully system pressure.
 - 2.5.1.7 The actuator must not be used to retain the valve packing on any valve size.
 - 2.5.1.8 The coating requirements will be per the valve exterior coating specification.
 - 2.5.1.9 All valves shall be zero leakage at rated pressures for bi-directional flow conditions and satisfactory for applications involving operation after long periods of inactivity.
 - 2.5.1.10 All materials shall be in compliance with ANSI/NSF Standard 61.
 - 2.5.2 Mainline Gate Valves:
 - 2.5.2.1 Locations of solid wedge or double disc valves and resilient-seated valves as shown in *Contract Documents*.

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- 2.5.2.2 To AWWA C500: 75 to 300 mm to working pressure 1,380 kPa; 400 mm and larger to working pressure 1,035 kPa, gray cast iron or cast ductile iron body, bronze mounted solid wedge, or double disc, non-rising stem, hub or flanged ends.
- 2.5.2.3 To AWWA C509: 75 to 300 mm to working pressure 1,380 kPa; gray cast iron or cast ductile iron body, resilient seated, non-rising stem, hub or flanged ends.
- 2.5.2.4 Stem seal to be O-ring type.
- 2.5.2.5 Hydrant Valves – to be as specified for mainline gate valves.
- 2.5.2.6 Valves to be complete with 50 mm square operating nut for underground service.
- 2.5.3 Mainline butterfly valves to AWWA C504 Class 150B, as specified in *Contract Documents*.
- 2.5.4 Blowdown or Blowoff Valves: 50 mm to AWWA C800 for working pressure 1,380 kPa threaded ends, 75 mm to 300 mm as specified for mainline gate valves.
- 2.5.5 Air Release, Air/Vacuum and Combination Air Valves : heavy duty combination air release valves employing direct acting kinetic principle.
 - 2.5.5.1 As per AWAA 512
 - 2.5.5.2 Double acting (Air Release and Vacuum Break functions)
 - 2.5.5.3 To be supplied with a written Lifetime Warranty for all internal parts.
 - 2.5.5.4 Shall come with provisions for draining.
 - 2.5.5.5 Shall have a non-slam or three stage design to reduce transients.
- 2.5.6 Air and Vacuum Release Valves: To NSF 61. Valves to expel air at high rate during filling, low rate during operation, and to admit air while line being drained. Valves to be suitable for 1724kPa working pressure. Valves to be “direct bury” ARI D-090-P complete with insulation and internal frost protection
- 2.5.7 Mainline Valve Boxes:
 - 2.5.7.1 To be as specified in *Contract Documents*: telescoping, cast iron, top flange type service box:
 - 2.5.7.1.1 Rectangular type to be as specified in *Contract Documents*.
 - 2.5.7.1.2 Circular type to be as specified in *Contract Documents*.
 - 2.5.7.2 Valve box riser pipe to be 150 mm diameter PVC DR35 or better.
- 2.5.8 Service Valve Boxes:

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- 2.5.8.1 Not required.
 - 2.5.8.2
 - 2.5.9 Check Valves
 - 2.5.9.1 Not applicable.
- 2.6 Valve and Meter Chambers
 - 2.6.1 Materials and installation for Cast-in-place chambers to Section 33 44 01 - Manholes and Catchbasins.
 - 2.6.2 Concrete and reinforcing steel: to Section 03 20 00 - Concrete Reinforcement and Section 03 30 00 - Cast-in-Place Concrete.
 - 2.6.3 Precast concrete sections to ASTM C478. Ladder rungs be cast integral with unit; field installation not permitted. Precast concrete lids to H20 loading conditions.
 - 2.6.4 Joining materials:
 - 2.6.4.1 Manufacturer's rubber ring gaskets,
 - 2.6.4.2 Mastic joint filler,
 - 2.6.4.3 Cement mortar or,
 - 2.6.4.4 Combination of above types.
 - 2.6.5 Mortar: aggregate to CAN/CSA A82.56, masonry cement to CSA A3002.
 - 2.6.6 Ladder rungs for valve chambers: minimum 20 mm diameter, for 76 mm minimum embedment in precast or cast-in-place concrete, minimum rung length 250 mm, minimum projection 100 mm, maximum vertical spacing 300 mm, minimum design liveload 1,334 N, cold rolled steel to CAN/CSA-G40.20, hot-dip galvanized after fabrication to CAN/CSA G164 or aluminium alloy #6061-T6 to CAN3-S157 and NBC 1990. Rungs to be safety pattern. Hand holds at top entry to conform to minimum design liveload and dimensions.
 - 2.6.7 Valve chamber frames and covers: as specified in *Contract Documents*.
- 2.7 Service Connections, Pipe, Joints, and Fittings
 - 2.7.1 Pipe diameter 19 mm to 75 mm to be Polyethylene to AWWA C901, Pressure Class 200 tubing certified to CSA B137.1, or Type K annealed copper, to ASTM B88M, or Polyethylene/Aluminium/Polyethylene composite pipe certified to CSA B137.9 or CSA B137.10, as shown on the *Contract Drawings*.
 - 2.7.2 Pipe diameter 100 mm and larger to be of material specified for mainline pipe.
 - 2.7.3 Service saddles:
 - 2.7.3.1 Tapping threads to be tapered to AWWA C800.

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2.7.3.2 Saddles for ductile iron pipe:

2.7.3.2.1 Not applicable.

2.7.3.3 Saddles for PVC Pipe to AWWA C900 PVC Pipe:

2.7.3.3.1 Not applicable.

2.7.3.4 Saddles for HDPE pipe:

2.7.3.4.1 As shown on *Contract Drawings*.

2.7.3.5 Copper tubing joints to be suitable for 1,380 kPa working pressure.

2.8 Hydrants

2.8.1 Approved Products: CLOW, M-67 Brigadier 150mm, AWWA C502 or as specified on *Contract Drawings*.

2.8.2 Dry Hydrant: Per NFPA 1142 and *Contract Drawings*.

2.8.3 Hydrants to: AWWA C502, standard specifications for dry barrel Fire Hydrants for ordinary waterworks service; typical fire hydrant detail drawing and National Fire Code with following supplementary details:

2.8.3.1 Shut-Off: compression type as per *Contract Documents*.

2.8.3.2 Inlet Connection: to be 150 mm nominal diameter, bell type with harness lugs.

2.8.3.3 Bury Length: 2.7m nominal bury length or as shown on *Contract Drawings*.

2.8.3.4 Self draining hydrants or as specified on *Contract Drawings*.

2.8.3.5 Delivery Classification: two hose nozzles and one pump nozzle. Each outlet nozzle to be locked or screwed in place to safeguard against blowing out, turning or backing out.

2.8.3.6 Hose and Pump Nozzle:

2.8.3.6.1 Hose nozzles to be 65 mm (2.5") nominal diameter with threads on nozzle ends to suit Alberta Mutual Thread

2.8.3.6.2 Pump nozzles to be 114 mm (4.5") nominal diameter and fastened by a thread connection with 100mm Storz connection

2.8.3.7 Nozzle Cap Gasket: to be provided with each nozzle cap.

2.8.3.8 Opening Direction: counter-clockwise.

2.8.3.9 Operating Nut and Cap Nuts: to AWWA C502 Standard for fire hydrants.

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- 2.8.3.10 Working parts to be removable without disturbing barrel or base of hydrant and without excavation. Main operating stem to be non-rising. Hydrants to be so designed that its top section may, without excavation, be rotated at any angle relative to the inlet pipe if desired and bolted or locked in place without decreasing its strength or causing it to leak when under pressure.
- 2.8.3.11 Hydrants to be subjected to hydrostatic pressure test of 2,068 kPa in compliance with AWWA C502. Provide "Affidavit of Compliance" if requested by *Consultant*.
- 2.8.4 Colour: Hydrants to be painted as specified below:
 - 2.8.4.1 Draining hydrants: yellow body with blue caps and blue top
- 2.8.5 Approved standard 150 mm Fire Hydrants are as specified in *Contract Documents*.
- 2.9 Underground Service Line Valves and Fittings
 - 2.9.1 Underground service line valves and fittings 19 mm to 50 mm to AWWA C800 suitable for 1,380 kPa working pressure.
 - 2.9.2 Corporation Stops:
 - 2.9.2.1 19 mm to 50 mm: bronze to ASTM B62, AWWA thread inlet, compression type outlet.
 - 2.9.3 Curb Stops:
 - 2.9.3.1 Not required.
- 2.10 Tracer Wire
 - 2.10.1 Refer to Section 33 11 01.01 – Water Utility Tracer Wire for specifications.
- 2.11 Granular Pipe Bedding and Surround Material
 - 2.11.1 As shown on *Contract Drawings*.
 - 2.11.2 Granular material to: Section 31 05 16 - Aggregates for Earthwork and following requirements:
 - 2.11.2.1 Crushed or screened stone, gravel or sand.
 - 2.11.2.2 Suitable material for bedding shall consist of material free from large rocks, boulders and frozen lumps.
 - 2.11.2.3 The suitability of this material shall be determined at the sole discretion of the Consultant.
 - 2.11.2.4 Suitable granular bedding material shall be well rounded pea gravel conforming to the following gradation, unless otherwise specified:
- 2.12 Table

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Sieve Designation	% Passing
20mm	100
12mm	60-100
10mm	20-80
4.75mm	0-10
2.36mm	0-3

- 2.13 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00.09 - Cast-in-Place Concrete.
- 2.14 Backfill Material
 - 2.14.1 As shown on *Contract Drawings*.
 - 2.14.2 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 2.15 Pipe Disinfection
 - 2.15.1 Calcium hypochlorite or Liquid chlorine to AWWA B300 and AWWA B301, respectively to disinfect water mains.
 - 2.15.2 Disinfect water mains in accordance with AWWA C651.

3.0 EXECUTION

- 3.1 General
 - 3.1.1 Pipe bedding details, including granular surround (pipe cushion) and material specifications to be shown on *Contract Drawings*.
- 3.2 Preparation
 - 3.2.1 Clean pipe, fittings, valves, hydrants, and appurtenances of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.
- 3.3 Trenching
 - 3.3.1 Do trenching in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - 3.3.2 Trench alignment and depth as shown on *Contract Drawings* or as otherwise approved by *Consultant*.

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- 3.3.3 Trench alignment and depth require Consultant's approval prior to placing bedding material and pipe.
- 3.4 Horizontal Directional Drilling
 - 3.4.1 Not required.
- 3.5 Concrete Bedding and Encasement
 - 3.5.1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete. Place concrete to details as shown on *Contract Drawings*.
 - 3.5.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
 - 3.5.3 Do not backfill over concrete within 24 hours after placing.
- 3.6 Granular Bedding
 - 3.6.1 Fill over-excavation below design elevation of bottom of specified bedding with granular bedding placed and compacted in accordance with Section 31 23 33.01 Excavating, Trenching, and Backfilling . Drain rock may be used for backfill of over-excavation only with *Consultant's* approval.
 - 3.6.2 Do not place material in frozen condition.
 - 3.6.3 Place granular bedding material across full width of trench bottom in uniform layers not exceeding 150mm compacted thickness to depth as indicated on *Contract Drawings*.
 - 3.6.4 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.
 - 3.6.5 Shape transverse depressions in bedding as required to suit joints.
 - 3.6.6 Compact each layer full width of bed to minimum 98% Standard Proctor Density in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).
 - 3.6.7 Place water main pipe and water service tubing on prepared flat bottomed trench free of rock in excess of 50 mm without bedding and backfill with approved native or imported material and compact as specified. Use hand tools to compact material under 'haunch' area of pipe and around fittings and other materials.
 - 3.6.8 Use imported bedding when proposed work is installed through paved areas, when native material is deemed unsuitable for backfill by *Consultant* or when trench has been excavated in rock.
- 3.7 Pipe Installation

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- 3.7.1 Handle pipe in accordance with pipe manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- 3.7.2 Pipe to be shipped from supplier with both ends capped or bagged.
- 3.7.3 Cap for bags to remain on ends of pipe until lowered into trench and is about to be installed.
- 3.7.4 Each pipe is to be visually inspected internally. If dusty or dirty, pull foam pig through pipe.
- 3.7.5 In the trench wipe clean pipe ends before joining.
- 3.7.6 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. PE/HDPE pipe to Plastics Pipe Institute Handbook of Polyethylene Pipe and AWWA Manual M55.
- 3.7.7 Horizontal Tolerance for pipe installed by open cut: plus or minus 50 mm from specified alignment.

Vertical Tolerance: plus or minus 25 mm from specified grade.
- 3.7.8 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - 3.7.8.1 Take up and replace defective pipe.
 - 3.7.8.2 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

Face socket ends of pipe in direction of laying. For mains on grade of [2] % or greater, face socket ends up-grade.
- 3.7.9 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- 3.7.10 Keep jointing materials and installed pipe free of dirt, water, and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.
- 3.7.11 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe or its coating and leave smooth end at right angles to axis of pipe. Bevel or taper ends of PVC pipe to match fittings.
- 3.7.12 Joints:
 - 3.7.12.1 Install gaskets as recommended by manufacturer.
 - 3.7.12.2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

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- 3.7.12.3 Align pipes carefully before joining.
- 3.7.12.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
- 3.7.12.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
- 3.7.12.6 Complete each joint before laying next length of pipe.
- 3.7.12.7 Minimize each joint deflection before laying next length of pipe.
- 3.7.12.8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- 3.7.12.9 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- 3.7.12.10 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- 3.7.12.11 Do not lay pipe on frozen bedding.
- 3.7.12.12 Do hydrostatic and leakage test and have results approved by Consultant before surrounding and covering joints and fittings with granular material.
- 3.7.12.13 Backfill remainder of trench.
- 3.7.12.14
- 3.7.13 Fused joints
 - 3.7.13.1 Fusing of pipe shall be undertaken by a factory qualified technician with a current fusion ticket (obtained or renewed within the last 12 months). Documentation shall be provided to the *Consultant* prior to project commencement.
 - 3.7.13.2 Two fusions under field conditions shall be performed by the technician prior to construction commencement. A minimum of two successful fusions shall be witnessed by the *Consultant*.
 - 3.7.13.3 Fusion equipment must be serviced and maintained to the manufacturer's specifications.
 - 3.7.13.4 Butt and sidewall fusion machines shall be A H McElroy or approved equal.
 - 3.7.13.5 Electrofusion fittings and equipment shall be by Friatec or Central Plastics.

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- 3.7.13.6 For HDPE pipe, the pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and the manufacturer's recommendations. Perform all heat fusion joints in the presence of the *Consultant* as requested.
- 3.7.13.7 Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine.
- 3.7.13.8 Pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipe so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 16 m and no shorter than 6 m.
- 3.7.13.9 For HDPE, polyethylene flange adapters at pipe material transitions or valve connections shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel to ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation apply a bitumastic coating to bolts and nuts.
- 3.7.13.10 Only appropriately sized and outfitted fusion machines that have been approved by the manufacturer shall be used for fusion processes. Fusion machines must, at minimum, incorporate the following:
- 3.7.13.10.1 Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition.
- 3.7.13.10.2 The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines. Dedicated heat plates should be used for various types of pipe.
- 3.7.13.10.3 The carriage shall travel smoothly with no binding at less than 350 kPa. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
- 3.7.13.10.4 Machine body shall show no obvious defects, missing parts, or potential safety issues during fusion.
- 3.7.13.10.5 Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion

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machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of thermoplastic pipe. The software shall register and/or record the required parameters and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.7.13.10.6 The most current version of the pipe supplier's recommended and compatible software shall be used. Data logging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110 V power source shall be available to extend battery life.

3.7.13.10.7 Pipe rollers shall be used for support of pipe to either side of the machine and for the full length of the fused pipe.

3.7.13.10.8 A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, wet and/or windy weather, or as directed by the *Consultant*.

3.7.13.10.9 Facing blades specifically designed for cutting the pipe shall be used.

3.7.14 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as specified otherwise.

3.7.15 When any stoppage of work occurs, restrain pipes in an approved manner to prevent 'creep' during down time.

3.7.16 Recheck components assembled above ground after placing in trench to ensure that no movement of joints has taken place.

3.8 Valve Installation

3.8.1 Install valves to manufacturer's recommendations at locations shown on *Contract Drawings*.

3.8.2 Support valves located in valve boxes or valve chambers by means of concrete blocks, located between valve and solid ground. Valves not to be supported by pipe.

3.8.3 Valves to be installed in vertical position with actuating stem plumb.

3.9 Valve Chambers

3.9.1 Use cast-in-place or precast units as shown on Contract Drawings. Precast units to be in accordance with Section 33 44 01 - Manholes and Catchbasins. Cast-in-

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- Place units to be in accordance with Section 03 20 00 - Concrete Reinforcement and Section 03 30 00 - Cast-in-Place Concrete.
- 3.9.2 Construct units as shown on *Contract Drawings* plumb and centred over valve nut, true to alignment and grade. Valve chambers not to rest on pipe.
 - 3.9.3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details shown in *Contract Drawings* and in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - 3.9.4 Cast bottom slabs for precast units directly on undisturbed ground or when permitted by *Consultant*, set precast concrete slab on 150mm minimum of compacted granular material.
 - 3.9.5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab. Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
 - 3.9.6 Clean surplus mortar and joint compounds from interior surface of valve chambers as work progresses.
 - 3.9.7 Plug lifting holes with precast concrete plugs set in non-shrink non-staining grout or non-shrink, non-staining mortar.
 - 3.9.8 Set frame and cover to required elevation on at least two and not more than four courses of brick or precast concrete riser rings. Make brick or riser ring joints and join brick or riser rings to frame with cement mortar, parge and trowel smooth.
 - 3.9.9 Cover to be marked "WATER"/"EAU".
 - 3.9.10 Clean valve chambers of debris and foreign materials, remove fins and sharp projections.
 - 3.9.11 Set valve boxes centrally over valve nut. Set valve boxes and any other boxes around appurtenances and complete backfill within 24 hours of setting appurtenance.
 - 3.9.12 Install sump drainer assemblies to manufacturer's instructions and to AWWA C510 and AWWA C511.
- 3.10 Under-crossing
 - 3.10.1 Not applicable.
 - 3.11 Service Connection Installation
 - 3.11.1 Install service connections to 3.7 of this Section and as shown on *Contract Drawings* or as directed by *Consultant*.
 - 3.11.2 Construct service connections at right angles to watermain unless otherwise directed. Locate curb stops as shown in *Contract Documents*.

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- 3.11.3 Complete service connections before pressure testing of watermains
- 3.11.4 Tap main as shown on *Contract Drawings*, not closer to a joint or closer to adjacent service connections than recommended by manufacturer, or 1m, whichever is greater. No two adjacent connections on same pipe length to be on same plane of pipe.
- 3.11.5 Leave corporation stop valves fully open.
- 3.11.6 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- 3.11.7 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- 3.11.8 Install curb stop with corporation box on services 50mm or less in diameter. Equip larger services with a gate valve and cast iron box. Set box plumb over stop or valve and adjust top flush with final grade elevation. Leave curb stop valves fully closed.
- 3.11.9 Place temporary location marker at ends of plugged or capped unconnected water lines. Each marker to consist of 40 x 90mm stake extending from pipe end at pipe level to 600mm above grade. Paint and mark exposed section of stake with blue waterproof paint, with designation "WATER".
- 3.12 Tapping Sleeve Installation
 - 3.12.1 Thoroughly clean the exterior of the main to be tapped. Grind or file any protrusions or irregularities in the pipe exterior which may interface with uniform seating of gaskets or clamping bands. In accordance with Section 10 of AWWA C651, dust interior surface of the tapping sleeve annulus with calcium hypochlorite powder before attaching to main.
- 3.13 Hydrants
 - 3.13.1 Install hydrant assemblies at locations shown on *Contract Drawings*.
 - 3.13.2 Install hydrant assemblies in accordance with AWWA Manual of Practice No. M17 and in accordance with *Contract Drawings*.
 - 3.13.3 Set hydrants plumb, with hose nozzles parallel with edge of pavement or curb line, with pumper nozzle facing roadway at right angles to road centreline and with body flange set at elevation of 150mm above final grade or as shown on *Contract Drawings*.
 - 3.13.4 Place concrete thrust blocks as shown and specified ensuring that drain holes are unobstructed.
 - 3.13.5 To provide proper draining for each hydrant, excavate a pit as shown and backfill with coarse gravel or crushed stone to a level 150mm above drain holes.

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- 3.13.6 For hydrants not in service, place an orange painted sign, 30 x 30cm, lettered 'Not in Service' on the main port. Remove when water main is accepted by *Consultant*.
- 3.14 Thrust Blocks
 - 3.14.1 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as shown on *Contract Drawings* or as directed by the *Consultant*.
 - 3.14.2 Place 6 mil polyethylene between interface of concrete and fitting.
 - 3.14.3 Where shown on *Contract Drawings*, install joint restraint devices to 2.2.6 (n) of this Section.
 - 3.14.4 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - 3.14.5 Alternative restraints may be used in place of thrust blocks at the discretion of the *Consultant*.
 - 3.14.6 Concrete shall be CSA Type HS with Fly Ash or Silica Fume for Sulphate and Chloride resistance, as well as 20 MPa at 28 days strength.
 - 3.14.7 Keep joints and couplings free of concrete.
 - 3.14.8 Do not backfill over concrete within 24 h of placing.
- 3.15 Corrosion Protection:
 - 3.15.1 Where specified, provide corrosion protection measures as shown on *Contract Drawings*.
- 3.16 Pipe Surround
 - 3.16.1 Upon completion of pipe laying and after the *Consultant* has inspected work in place, surround and cover pipes as shown on *Contract Drawings*.
 - 3.16.2 Hand place surround material in uniform layers not exceeding 150mm depth simultaneously on both sides of pipe. Do not dump material within 1m of exposed pipe.
 - 3.16.3 Compact each layer from pipe invert to underside of backfill to minimum 98% Standard Proctor Density.
- 3.17 Backfill
 - 3.17.1 Place and compact backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - 3.17.2 Backfill requirements, including type of material and compaction requirements, as shown in *Contract Drawings*.
 - 3.17.3 Do not place backfill in frozen condition.

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- 3.17.4 Approved warning tape must be installed above all watermain installations at the discretion of the Consultant.
- 3.17.5 Inspection of Sacrificial Anodes and Test Points prior to Backfilling
- 3.17.6 All installations of sacrificial anodes, test points, and related wiring shall be inspected by the Contractor prior to backfilling.
- 3.17.7 It is the Contractor's responsibility to notify the Consultant and request inspection of each cathodic protection installation.
- 3.17.8 If backfilling over anodes and test wires has been carried out prior to inspection, the Contractor shall, when requested by the Consultant, re-excavate and expose all anodes and test wires, at no cost, for the purpose of inspection.
- 3.17.9 All engineered fills shall be compacted to 98% of Standard Proctor Maximum Dry Density.
- 3.18 General Procedure Flushing, Testing and Disinfection
 - 3.18.1 Do tests in accordance with the manufacturer's specifications, AWWA M55 for HDPE pipe, and AWWA M23/AWWA C605 for PVC pipe.
 - 3.18.2 Provide labour, equipment and materials required to perform hydrostatic tests hereinafter described.
 - 3.18.3 All cleaning, flushing, pressure and leakage testing, disinfection and final flushing to be done by *Contractor*. All testing to be done by *Contractor* at his cost. Testing costs deemed to be included in Contract Price.
 - 3.18.4 Perform all testing, disinfection, flushing and water sampling in presence of *Consultant*. Notify *Consultant* 24 h in advance of proposed test.
 - 3.18.5 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 5 days after placing concrete or 2 days if high early strength concrete is used.
 - 3.18.6 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Consultant.
 - 3.18.7 When testing is done during freezing weather, protect valves, joints and fittings from freezing.
 - 3.18.8 Open valves.
 - 3.18.9 Expel air from main by slowly filling main with potable water.
 - 3.18.9.1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - 3.18.9.2 Remove stops after satisfactory completion of test and seal holes with plugs.

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- 3.18.10 Apply hydrostatic test pressure of 1,380 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- 3.18.11 Repeat hydrostatic test until defects have been corrected.
- 3.18.12 Define leakage as amount of water supplied from water metre in order to maintain test pressure for 2 hours.
- 3.18.13 Do not exceed allowable leakage as per the appropriate AWWA manual including lateral connections.
- 3.18.14 Locate and repair defects if leakage is greater than amount specified.
- 3.18.15 Repeat test until leakage is within specified allowance for full length of water main.

- 3.18.16 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.
- 3.18.17 Comply with *Contract Documents* regarding environmental requirements relative to discharge of flushing water.
- 3.18.18 Provide *Consultant* with all required approvals prior to discharging flushing water.
- 3.18.19 *Contractor* shall submit a written Testing, Pigging and Disinfection plan for approval by the *Consultant* a minimum of 2 weeks in advance of performing the work.
- 3.19 Cleaning and Swabbing
 - 3.19.1 Make arrangements with *Consultant* for scheduling of testing and disinfection of mains. Testing and disinfection to be witnessed by *Consultant*.
 - 3.19.2 Isolation of existing water system where required will be performed by Municipality. Do not operate any valves without *Consultant's* authorization.
 - 3.19.3 *Contractor* shall obtain potable water at *Contractor's* cost from a source approved by the *Consultant*. *Contractor* to provide confirmation of source of testing water 2 weeks in advance of loading the pipe.
 - 3.19.4 Remove foreign material from pipe and related appurtenances by swabbing. Load main with water and then swab by pushing soft density foam pigs through the main. The main shall be swabbed at a minimum in pairs or more as required until the water discharged immediately in front of and behind the pigs is clean and clear to the *Consultant's* satisfaction.
 - 3.19.5 Foam pigs to be sized a minimum of 50 mm larger than inside diameter of main.
 - 3.19.6 Foam pigs to be spaced approximately 20 m apart while swabbing is under way and the space between shall be filled with potable water.

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- 3.19.7 Do not dispose of water containing chlorine or volatile or waste materials, such as mineral spirits and paint thinner, into any surface waterway or storm or sanitary sewer. All discharges must comply with all applicable Acts, Regulations, Bylaws and Standards. This requirement may be relaxed only if written approval to exceed the limit concerned, from the authority having jurisdiction over the waterway or sewer, is provided to the *Consultant*.

3.20 Testing Procedure

- 3.20.1 Upon completion of construction of any section, which shall be defined as that pipeline and appurtenances located between any two adjacent line valves, make section ready for testing.
- 3.20.2 Before pipe is filled with water, pipe bedding, concreting of all valves and fittings and backfilling to be completed as required in this specification. Fill each section of pipe and allow to remain full of water for a period of at least 24 hours, and bleed off any trapped air prior to commencement of any pressure tests. Submit pipeline to a test pressure of 1.5 x working pressure (1,380 kPa/200 psi) applied at the lowest elevation in the section under test.
- 3.20.3 For the initial expansion phase of the test, add make-up water as necessary to maintain test pressure for 2 hours. During the testing phase, reduce the test pressure by 10 psi (69.0 kPa) and monitor pressure for 1 hour. Do not increase pressure or add make-up water.
- 3.20.4 If the test pressure cannot be reached, or if it takes an unreasonably long time to reach the test pressure, there may be a leak, entrapped air, an open valve, or the pressurizing equipment may be inadequate for the size of the test section. Correct these issues before continuing.
- 3.20.5 If no visual leakage is observed, and the pressure during the test phase remains steady (within 5% of the starting test pressure) for one hour, this will result in a passing test.
- 3.20.6 If retesting is necessary, depressurize the test section by reducing pressure or releasing test liquid at a controlled rate to prevent water hammer. Do not attempt to correct any issues or leaks with the pipeline while it is under pressure. Let the test section relax for at least 8 hours before re-pressurizing.
- 3.20.7 Should any test disclose excessive leakage, repair or replace defect and retest section until specified testing requirements is achieved.

3.21 Disinfection, General

- 3.21.1 After *Consultant* has certified that pipes and appurtenances have passed all specified tests, flush and disinfect pipes and appurtenances.

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- 3.21.2 Disinfect, flush, and bacteriological test in accordance with AWWA C651 and 3.22 of this section.
- 3.22 Disinfection and Flushing Procedures
- 3.22.1 Do not use granular hypochlorite for disinfection of PVC pipe with solvent welded joints, due to explosive reaction potential.
- 3.22.2 Flushing and disinfection to be witnessed by Consultant and Local Water Department.
- 3.22.3 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of [no greater than 0.3m/s to avoid transients.1.5] m/s , within pipe for minimum [10
- 3.22.4 Slug chlorinate with potable water in accordance with AWWA C651, Slug Chlorination Method. One foam pig shall precede the chlorinated slug. All interior surfaces of the watermain and fittings shall be exposed to a free chlorine concentration of 100 mg/L for at least 3 hours. *Contractor* to monitor free chlorine concentration as the slug moves down the pipeline. At no point can the concentration drop below 50 mg/L. Submit outline of proposed disinfection procedure accompanied by marked up schematic drawings to *Consultant* for approval 48h in advance of commencement of disinfection.
- 3.22.5 After completion of chlorination, flush chlorinated water from system, hydrants and services until chlorine concentration in remaining water is less than 0.3mg/L chlorine residual. Water with a concentration greater than 1mg/l shall be de-chlorinated prior to discharge to storm sewers or water courses. Release rate not to exceed downstream capacity of receiving system.
- 3.22.6 After final flushing, and no more than 72 hours before the new water main is connected to the distribution system, two consecutive sets of water samples taken at least 24 hours apart, shall be collected from the new main. Samples shall be taken at each blowoff valve, plus one set from each end of the line. Samples shall be tested at the *Contractor's* expense for total coliforms and Escherichia coli by a laboratory approved by the *Consultant* and the Provincial Health authority (in accordance with their list of approved laboratories). Sampling and analysis shall be done in accordance with Standard Methods for the Examination of Water and Wastewater. The following water quality parameters must be measured and found to be within the limits specified in the table below:

Parameter	Value	Unit
E.Coli	Absence	
Total Coliform	Absence	

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Residual Chlorine	1.0 to 2.4	mg/L
Free Chlorine	< 0.1	mg/L
pH	7.3 to 8.3	
Turbidity	0 to 3.0	NTU
Colour	0 to 2.0	TCU
V.O.Cs	< 0.010 (GCDWQ MACs for components	mg/L
Pipe Lubricant	Negative	
Taste and Odour	Inoffensive	
UV Scan	Negative vs. Plant Water	

3.22.7 The test has failed if any of the above parameters are outside the limits presented.

3.22.8 Upon completion of disinfection and flushing, *Contractor* shall remove test and bleed out apparatus and shall backfill and complete any work required prior to placing waterworks systems into service.

3.23 Connections to Existing Mains

3.23.1 Not required.

END OF SECTION

UTILITY TRACER WIRE

1.0 GENERAL

- 1.1 Section 33 11 01.01 refers to those portions of the *Work* that are unique to the supply and installation of tracer wire. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Waterworks Section 33 11 01
- 1.3 Submittals
 - 1.3.1 Contractor to submit shop drawings and technical data for all products and materials associated with the tracer wire system to the *Prime Consultant* for review and approval prior to installation.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 This section refers to the supply and installation of tracer wire
 - 2.1.2 All tracer wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.
- 2.2 Tracer Wire
 - 2.2.1 Open Trench - Tracer wire shall be Copper Clad Steel, High Strength with minimum 2 kN (450 lb.) break load, with minimum 0.762 mm (30 mil) HDPE insulation thickness.
 - 2.2.2 Trenchless Installation - Tracer wire shall be Copper Clad Steel, Extreme Strength with a minimum 15.6 kN (3500 lb.) break load, with minimum 1.143 mm (45 mil) HDPE insulation thickness.
- 2.3 Connectors
 - 2.3.1 Three wires shall be joined using a single 3-way lockable connector. Four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
 - 2.3.2 Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
 - 2.3.3 Non locking friction fit, twist on or taped connectors are prohibited.
 - 2.3.4 Direct bury of connectors is not permitted. All connectors must be installed at-grade within a test station manhole with single wire connected and ran to access box as outlined in the following sections.
 - 2.3.5 A minimum of 500 mm of excess/slack wire is required in all test station manholes or valve boxes after meeting final elevation for each wire.

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2.4 Termination/Access

- 2.4.1 All tracer wire termination points must utilize a tracer wire above ground access box, approved by the *Prime Consultant*, and mounted to the warning sign post 1 m above ground.
- 2.4.2 Termination points are to be located on the sign post at each valve location, or location where a connector is used as approved by the *Prime Consultant*.

2.5 Grounding

- 2.5.1 Tracer wire must be properly grounded at all dead ends/stubs.
- 2.5.2 Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 6 m (20 ft) of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 2.3 kg (0.5 lb.)) specifically manufactured for this purpose, and buried at the same elevation as the utility.
- 2.5.3 When grounding the tracer wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the tracer wire, at the maximum possible distance.
- 2.5.4 When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the tracer wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to tracer wire with a mainline to lateral lug connector.
- 2.5.5 Where the anode wire will be connected to a tracer wire access box, a minimum of 0.6 m (2 ft.) of excess/slack wire is required after meeting final elevation.

2.6 Prohibited Products and Methods

- 2.6.1 Uninsulated tracer wire
- 2.6.2 Tracer wire insulations other than HDPE.
- 2.6.3 Non locking, friction fit, twist on or taped connectors
- 2.6.4 Brass or copper ground rods
- 2.6.5 Wire connections utilizing taping or spray-on waterproofing
- 2.6.6 Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
- 2.6.7 Tracer wire wrapped around the corresponding utility
- 2.6.8 Brass fittings with tracer wire connection lugs
- 2.6.9 Wire terminations within valve boxes or manholes

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2.6.10 Connecting tracer wire to existing conductive utilities

3.0 EXECUTION

3.1 General

- 3.1.1 Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal for distances in excess of 1,000 m, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- 3.1.2 Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- 3.1.3 Connectors are only permitted for use at valves, couplers, private services, or intersections of 3 or more mainline pipe. All other tracer wire must be continuous and splice free unless otherwise approved by the *Prime Consultant*.
- 3.1.4 All connectors must be installed at-grade within a test station manhole. Underground installation of connectors is not permitted. The connector shall connect mainline tracer wires, and shall have a single wire that runs from the test station manhole and up the warning sign post into a termination access box mounted to the sign post. This tracer wire shall be installed in conduit that runs up the sign post and into the access box.
- 3.1.5 Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- 3.1.6 Tracer wire shall be installed at the north springline of the pipe and secured (taped/tied) at 3 m intervals.
- 3.1.7 Tracer wire must be properly grounded as specified.
- 3.1.8 Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access box located on the service sign post (See Tracer wire Termination/Access).
- 3.1.9 At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the tracer wire. (See Grounding).
- 3.1.10 Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the tracer wire.
- 3.1.11 In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall

UTILITY TRACER WIRE

be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

- 3.1.12 Above-ground tracer wire access boxes will be installed at all locations where a connector has been used and will be mounted to the warning sign of each post at each location.

3.2 Testing

- 3.2.1 All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, completed by a third party locating agency, selected by the *Contractor* and approved by the *Prime Consultant*. Testing shall be witnessed by the *Contractor* and *Prime Consultant* prior to acceptance.
- 3.2.2 *Contractor* shall pay costs for trace wire locating and testing.
- 3.2.3 Continuity testing in lieu of actual line tracing shall not be accepted.

END OF SECTION

POTABLE WATER RESERVOIRS

1.0 GENERAL

Section 33 11 02 refers to those portions of the Work that are unique to the disinfection and leakage testing of potable water reservoirs. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

2.0 PRODUCTS

Not applicable.

3.0 EXECUTION

1. Contractor is responsible for ensuring that groundwater level is maintained below the water level in the reservoir at all times during construction and testing.
2. Contractor is responsible to supply all necessary water and chemicals for leakage testing and disinfection.
3. Prior to filling the reservoir with water, Contractor must receive approval from the *Prime Consultant*. Internal inspection of the completed reservoir shall be completed by the Contractor and *Prime Consultant* prior to filling the reservoir. Any visual defects identified shall be repaired prior to proceeding with the leakage test specified below.
4. Contractor shall perform a leakage test of the reservoir under the supervision of the *Prime Consultant*. Contractor to provide 72hrs notice prior to commencing with the test. Leakage test will include:
 - (a) Isolate reservoir as directed by the *Prime Consultant*. Contractor responsible to supply and install any equipment required for isolation (e.g. pneumatic plugs)
 - (b) Fill reservoir to the overflow level with potable water
 - (c) Let reservoir sit for 24hrs
 - (d) Repair any obvious leaks during this period with sealing compound suitable for potable water
 - (e) Check reservoir level after 24hr period and measure difference from initial depth. Any leakage volume greater than 0.05% of the total volume constitutes a failed test
 - (f) If test fails, the reservoir is considered unacceptable and the Contractor shall perform all necessary repairs to correct the work. Once repairs have been completed, Contractor shall schedule another leakage test with the *Prime Consultant*.
5. Contractor to disinfect reservoir in accordance with AWWA C652 including collection of bacteriological samples tested for total coliforms, e coli, and background plate count. Presence

POTABLE WATER RESERVOIRS

of any coliforms or any plate count over 200 shall constitute a failed test. Contractor shall submit a written plan detailing the procedure to the *Prime Consultant* for approval. After successful disinfection of the reservoir, the Contractor shall de-chlorinate water, empty reservoir and discharge de-chlorinated water to a location approved by the *Prime Consultant*.

END OF SECTION

PIPE CULVERTS

1.0 GENERAL

- 1.1 Section 33 42 13 refers to those portions of the *Work* that are unique to the supply and installation of storm sewer pipe culverts. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 References
 - 1.2.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 43 00.

2.0 PRODUCTS

- 2.1 Corrugated Steel Pipe
 - 2.1.1 Corrugated steel pipe: to CAN3-G401. Wall thickness and corrugation as shown on Drawings.
 - 2.1.2 Water-tight cut-off collars: as shown on Drawings.
 - 2.1.3 Prefabricated end sections: as shown on Drawings.
 - 2.1.4 Corrugated fluming: to CAN3-G401.
- 2.2 Concrete Pipe
 - 2.2.1 Non-reinforced circular concrete pipe and fittings: to ASTM C14M maximum diameter 675 mm, strength class as shown on Drawings, designed for flexible rubber gasket joints to ASTM C443M.
 - 2.2.2 Reinforced circular concrete pipe and fittings: to ASTM C76M for all pipe greater than 675 mm diameter, strength class as shown on Drawings, designed for flexible rubber gasket joints to ASTM C443M.
 - 2.2.3 Reinforced concrete arch pipe: to ASTM C506M.
 - 2.2.4 Reinforced concrete elliptical pipe: to ASTM C507M.
 - 2.2.5 Reinforced concrete box culverts to ASTM C789 and C850.
 - 2.2.6 Lifting holes:
 - (a) Pipe 900 mm and less diameter: no lift holes.
 - (b) Pipe greater than 900 mm diameter: lift holes not to exceed two in piece of pipe.
 - (c) Provide pre-fabricated plugs to seal lift holes water after installation of pipe or box.
- 2.3 Plastic Pipe, Smooth Profile

PIPE CULVERTS

- 2.3.1 Type PSM Polyvinyl chloride (PVC) to highest requirements of: CAN/CSA B182.1 (100 mm to 150 mm diameter); CAN/CSA B182.2 (200 mm to 675 mm diameter); ASTM C-3034 (100 mm to 375 mm diameter) and ASTM F789.
 - (a) Dimension Ratio as specified on Drawings.
 - (b) Joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477 or F913.
 - (c) Normal pipe laying length joint to joint to be 3.96 m.
- 2.4 Plastic Pipe, Mainline Ribbed Profile
 - 2.4.1 Ribbed profile PVC pipe to CSA B182.4.
 - (a) Pipe stiffness class V.
 - (b) Joints: push-on type comprised of single elastomeric gasket to ASTM D3212 and ASTM F477 and F913.
 - (c) Normal pipe laying length joint to joint to be 3.96 m.
- 2.5 Concrete
 - 2.5.1 Concrete mixes and materials required for bedding cradles, encasement, and incidental uses: to Section 03 30 00 - Cast-in-Place Concrete.
 - 2.5.2 Concrete to be minimum 35 MPa.
- 2.6 Granular Pipe Bedding and Surround Material
 - 2.6.1 As shown on *Drawings*.
 - 2.6.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for material specification.
- 2.7 Backfill Material
 - 2.7.1 As shown on the *Drawings*.
 - 2.7.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for materials specifications.
- 3.0 EXECUTION
 - 3.1 Bypass
 - 3.1.1 Provide pumped or gravity pipe bypass around culvert as required to complete the Work. *Contractor* can schedule Work to occur outside of freshet when Spring Creek has minimal flow.
 - 3.2 Trenching and Backfill

PIPE CULVERTS

- 3.2.1 Do trenching and backfill work to Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 3.2.2 Obtain *Consultant's* approval of trench line and depth prior to placing bedding material or pipe.
- 3.2.3 Do not backfill until pipe grade and alignment checked and accepted by *Consultant*.
- 3.3 Bedding
 - 3.3.1 Dewater excavation, as necessary, to allow placement of culvert bedding in the dry.
 - 3.3.2 Place minimum thickness of 200 mm of approved granular material on bottom of excavation and compact to minimum 95% Standard Proctor density in compliance with ASTM D698.
 - 3.3.3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to chamber as shown on Drawings or as directed by *Consultant*, free from sags or high points.
- 3.4 Laying Corrugated Steel Pipe Culverts
 - 3.4.1 Commence pipe placing at downstream end.
 - 3.4.2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.
 - 3.4.3 Lay pipe with outside circumferential laps facing upstream and longitudinal laps or seams at side or quarter points.
 - 3.4.4 Lay paved invert of partially lined pipe with longitudinal centre line of paved segment coinciding with flow line.
 - 3.4.5 Do not allow water to flow through pipes during construction except as permitted by *Consultant*.
- 3.5 Joints
 - 3.5.1 Corrugated steel pipe:
 - (a) Match corrugations or indentations of coupler with pipe sections before tightening.
 - (b) Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.
 - (c) Insert and tighten bolts.

PIPE CULVERTS

- (d) Repair spots where damage has occurred to coating by applying two coats of asphalt paint approved by *Consultant* or two coats of zinc rich paint as applicable, to match pipe coating.

3.6 Laying Concrete Pipe Culverts

- 3.6.1 In general compliance with Section 33 40 01 - Storm Sewers.
- 3.6.2 Begin at downstream end of culvert with female end of first pipe section facing upstream.
- 3.6.3 Ensure barrel of each pipe is in contact with shaped bed throughout its length.
- 3.6.4 Do not allow water to flow through pipes during construction except as permitted by *Consultant*.

3.7 Joints: Concrete Culverts

- 3.7.1 In general compliance with Section 33 40 01 - Storm Sewers.
- 3.7.2 Joints to be made with rubber gaskets installed in accordance with manufacturer's recommendations.

3.8 Backfill

- 3.8.1 Backfill around and over culverts as shown on *Drawings* or as directed by *Consultant*.
- 3.8.2 Place granular backfill material, approved by *Consultant*, in layers to full width, alternately on each side of culvert, so as not to displace it.
- 3.8.3 Compact each layer to minimum of 95% Modified Proctor Density taking special care to obtain required density under haunches.
- 3.8.4 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross during construction of project. Width of fill, at its top, to be at least twice diameter of span of pipe and with slopes not steeper than 1:2.

3.9 Fluming

- 3.9.1 Assemble and install fluming as indicated on *Drawings*.
- 3.9.2 Set top edges of fluming flush with side slope.

END OF SECTION

MANHOLES AND CATHBASINS

1.0 GENERAL

- 1.1 Section 33 44 01 refers to those portions of the Work that are unique to the supply and installation of manholes, cleanouts, catchbasins, storm sewer endwalls, lawn drains and related appurtenances. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 References
 - 1.2.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Requirements - Section 01 43 00.
- 1.3 Samples
 - 1.3.1 Samples may be requested
- 1.4 Material Certification
 - 1.4.1 Products having CSA certification to be used where readily available. Product to be certified to CSA standards(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Consultant. Products to be marked with certification body logo and CSA standard markings.
 - 1.4.2 At least 14 days prior to commencing *Work*, submit to the Consultant manufacturer's recent test data and certification that materials meet requirements of this section. Include manufacturer's Drawings, information and shop drawings where pertinent.
 - 1.4.3 For cast iron products, provide load tests results performed by an independent laboratory for each casting lot as defined by ASTM A48.

2.0 PRODUCTS

- 2.1 Materials
 - 2.1.1 Concrete:
 - (a) To Section 03 30 00 - Cast-in-Place Concrete.
 - (b) Concrete to be minimum 35 MPa, Sulphate resistant Type HS Cement or as specified otherwise on *Drawings*.
 - 2.1.2 Concrete reinforcement: to Section 03 20 00 - Concrete Reinforcement.
 - 2.1.3 Precast manhole sections to be precast reinforced spun concrete to ASTM C478M and CSA A257.4-03 complete with ladder rungs.

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- 2.1.4 Precast "Tee" Sections: precast "Tee" sections constructed as an integral component of mainline pipe will be acceptable where shown on *Drawings* as an approved alternative.
- 2.1.5 Manhole lids: to be precast reinforced concrete shall be designed to withstand H20 loading.
- 2.1.6 Cast iron frame and cover: as shown on *Drawings*.
 - (a) Frame and cover must conform to Class 30B ASTM A48 and be designed to withstand H20 loading.
 - (b) Frame and cover must bear manufacturer identification on castings.
 - (c) Castings to be sand blasted or cleaned and ground to eliminate surface imperfections and coated with two applications of asphalt varnish.
- 2.1.7 Ladder rungs to be:
 - (a) As shown on *Drawings*.
 - (b) To conform to ASTM C497, ASTM C478M load test.
 - (c) 20 mm aluminum alloy #6061-76 (CSA-S157 and NBC 1977), complete with polyethylene anchor insulating sleeves and installed in 25 mm or 26 mm precast or drilled holes in manholes sections.
 - (d) Polypropylene encased steel ladder rungs: polypropylene ASTM D4101 steel core to be 12 mm diameter grade 60 as per ASTM A615M.
 - (e) Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.
 - (f) In compliance with all Workers' Compensation Board requirements.
 - (g) Safety platform: to be installed as shown on *Drawings* in all manholes in excess of 6 m deep.
 - (h) Precast catchbasin sections:
 - (i) As shown on *Drawings*.
 - (ii) To be precast reinforced concrete to ASTM C478M.
- 2.1.8 Not Used Inspection Chambers: as shown on *Drawings*.
- 2.1.9 Mortar:
 - (a) Aggregate: to CSA A82-56.
 - (b) Cement: to CAN/CSA-A8.

MANHOLES AND CATHBASINS

2.1.10 Adjusting rings manufactured to:

- (a) Concrete ASTM C478M
- (b) HDPE to ASTM D1248.

2.1.11 Concrete Brick: to CAN3-A165 Series.

2.1.12 Drop manhole pipe: to be as shown on *Drawings*.

2.1.13 Lawn drains to be as shown on *Drawings*.

2.1.14 Concrete bags to be: Jute, burlap or synthetic bag of suitable size and texture filled to 2/3 capacity with mixture of 1 part Portland cement to 2 parts sand, thoroughly mixed, and weighing approximately 27 kg.

2.1.15 Concrete blocks: to be H type concrete construction blocks conforming to latest ASTM specifications.

2.1.16 Prebenched manhole bases:

- (a) Where precast manhole sections are incorporated into precast base by bonding to concrete benching, use precast reinforced concrete manhole section to ASTM C478M complete with ladder rungs above benching.
- (b) Where base benching is cast monolithically with manhole walls, reinforce wall and joint sections as specified in ASTM C478M.
- (c) Precast concrete bases section minimum thickness to be 120 mm, measured from underside of base to lowest point in concrete channelling.

2.1.17 Flared End Outlet Structure

- (a) Precast unit complete with grillage. Provide shop drawings sealed by Professional Engineer per General Requirements.

3.0 EXECUTION

3.1 Excavation and Backfill

3.1.1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.2 Concrete Work

3.2.1 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcement.

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

3.3 Manhole Installation

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- 3.3.1 Install manholes as shown on Drawings, concurrently with pipe laying. Maximum of 3 uncompleted units behind point of pipe laying permitted.
- 3.3.2 Excavation to be free of water prior to placing concrete.
- 3.3.3 Place minimum 150 mm of 25 mm granular base under base compacted to minimum 95% SPMDD in compliance with ASTM D1557.
- 3.3.4 Construct base to ensure first precast riser section is set plumb.
- 3.3.5 Set all inlet and outlet pipes to specified alignments and elevations.
- 3.3.6 Connect PVC pipe into manhole using "manhole adaptor ring" or approved equal.
- 3.3.7 Connect concrete pipe into manhole using spigot or bell precast into manhole wall or, alternatively, grout pipe into pre-formed rough core in manhole wall using fast-setting grout.
- 3.3.8 Ensure placement of concrete does not disturb connecting pipes.
- 3.3.9 Set remaining precast riser sections plumb with joints, sealed with rubber gasket conforming to ASTM C443M to eliminate ground water infiltration. Grout inside and exterior of manhole joints.
- 3.3.10 Where possible, form channelling using half-sections of pipe or suitable fillings. Benching to direct flow parallel to main flow of sewer. Top of benching to be at least as high as crown of sewer pipe. Finish concrete to smooth surface using steel trowel.
- 3.3.11 Brace capped or plugged inlets or stubs to withstand hydrostatic testing head.
- 3.3.12 Installation of Masonry & Cementitious Riser Rings:
 - (a) Allowable number of courses is three and minimum is one.
 - (b) Allowable products; bricks, precast concrete risers, and cast-in place form system
 - (c) Due regard must be observed to the maximum distance to the first step.
 - (d) Pre-wet all joints before placing mortar.
 - (e) "Butter" inside and outside faces of bricks with mortar to ensure neat even finish. Pre-wet all joints before placing mortar.
 - (f) Grout inside and outside paces of brick with mortar to ensure neat even grout.
- 3.3.13 Plug lifting holes in pipe.
- 3.3.14 Install drop structures where required on *Drawings*.

MANHOLES AND CATHBASINS

- 3.3.15 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- 3.3.16 Ensure frames conform to contour of pavement or existing surface.
- 3.3.17 Paint manhole covers as specified on *Drawings*.
- 3.3.18 Pre-fabricated Corrugated Steel Pipe Manholes to be installed as shown on the *Drawings* and to manufacturers' specifications.
- 3.4 Cleanout and Inspection Chamber Installation
 - 3.4.1 Install cleanouts and inspection chambers as shown on *Drawings*, to standards and installation procedures described in 3.3.
- 3.5 Lawn Drain Installation
 - 3.5.1 Install lawn drains as shown on *Drawings*.
- 3.6 Endwall Installation
 - 3.6.1 Supply and install precast concrete endwalls where shown on *Drawings*.
- 3.7 Grillage Trash Screens
 - 3.7.1 Where specified, install grillage trash screens as shown on *Drawings*.
- 3.8 Adjusting Tops of Existing Units
 - 3.8.1 Remove existing gratings, frames and store for re-use at locations indicated on *Drawings*.
 - 3.8.2 Precast units:
 - (a) Raise or lower precast units by adding or removing precast sections as required.
 - (b) When amount of raise is less than 300 mm use standard manhole bricks, pre-cast riser rings or cast-in-place form system.
 - 3.8.3 Cast-in-Place units:
 - (a) Raise cast-in-place units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.
 - (b) Lower cast-in-place units with straight wall by removing concrete to elevation indicated for rebuilding.
 - (c) Install additional manhole ladder rungs in adjusted portion of units as required.
 - (d) Re-use existing gratings, frames.

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- (e) Re-set gratings and frames to required elevation on not more than 3 courses of brick. Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
- 3.9 Remove Existing Units
 - 3.9.1 Remove existing structures where shown on Drawings. Backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 3.10 Leakage Test
 - 3.10.1 Leakage testing of sanitary manholes in accordance with Section 33 30 01 - Sanitary Sewers.
 - 3.10.2 Consultant will issue Test Certificate for each manhole passing test.

END OF SECTION

DIVISION 40 – PROCESS

COMMON REQ FOR PROCESS PIPING SYSTEM

1.0 GENERAL

1.1 Summary

- 1.1.1 This Section specifies general requirements for the supply and installation of process piping, valves, fittings and related appurtenances associated with the *Work*. More detailed requirements are contained in other Sections. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* describe herein.
- 1.1.2 Design, select, locate and provide expansion joints, pipe guides and anchors required for final piping layout. Typical details, anchors, and thermal expansion allowance shown on the *Drawings* are provided only for general guidance.
- 1.1.3 All materials not specifically listed or specified, but required to complete the installation are the responsibility of the *Contractor*.
- 1.1.4 Related Requirements
 - (a) Section 40 05 07: Supports, Anchors and Seismic Bracing for Process Piping and Conveyors
 - (b) Section 40 05 23.24: 304 Stainless Steel Piping
 - (c) Section 40 05 63.33: Metallic Ball Valves
 - (d) Section 40 05 63.34: Butterfly Valves
 - (e) Section 40 05 63.35: Check Valves
 - (f) Section 40 05 63.35: Plug Valves
 - (g) Section 40 05 63.37: Pressure Relief Valves
 - (h) Section 40 05 63.38: Air Valve
 - (i) Section 40 05 61.43: Knife Gate Valve
 - (j) Section 40 33 01: Chemical Piping, Valves and Fittings

1.2 References

1.2.1 Definitions

- (a) Process Piping: Piping systems that are any of the following;
 - 1. Located above ground
 - 2. Located inside facilities

COMMON REQ FOR PROCESS PIPING SYSTEM

- 3. Located below ground within 1 m of facilities or from the facility to the first transition coupler, whichever is longer
- 4. Process air piping and fittings inside and outside of facilities.
- (b) Maximum working pressure: The greatest continual pressure at which the piping system operates.
- (c) Test pressure: The hydrostatic pressure used to determine system compliance.
- (d) Interior: Within an environmentally controlled enclosure where the temperature is maintained above 5 °C.
- (e) Submerged: Regularly or occasionally immersed in liquid; inside covered tanks and/or channels, and within 3 m above maximum water level of open tankage. Also includes pipes and appurtenances within manholes, vaults and channels.
- (f) Outdoor: Exposed, above ground, outside or within an enclosure that is not environmentally controlled.
- (g) Buried: Placed directly in soil and/or granular fill.
- (h) *Contractor's Engineer*: A professional engineer registered in the Province of British Columbia qualified to do detailed piping thermal expansion design at the *Contractor's* cost.

1.2.2 Reference Standards

- (a) Conform to the most recent version of all standards referenced in this Section.
- (b) ANSI B1.1: Unified Inch Screw Threads, UN and UNR Thread Form
- (c) ANSI/AWWA C606: Grooved and Shouldered Joints
- (d) ASME B31.3: Power Piping
- (e) ASTM B16.21: Non-metallic Flat Gaskets for Pipe Flanges
- (f) ASTM A193: Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- (g) ASTM A194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

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- (h) ASTM A307: Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
- (i) ASTM A354: Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
- (j) ASTM A563: Carbon and Alloy Steel Nuts
- (k) ASTM B32: Solder Metal
- (l) ASTM B633: Electrodeposited Coatings of Zinc on Iron and Steel
- (m) ASTM B766: Electrodeposited Coatings of Cadmium
- (n) ASTM F436: Hardened Steel Washers Inch and Metric Dimensions
- (o) AWWA C110: Ductile-Iron and Gray-Iron Fittings
- (p) AWWA C200: Steel Water Pipe, 6 In. (150 mm) and Larger
- (q) AWWA C227: Bolted, Split-Sleeve Restrained and Non-restrained Couplings for Plain-End Pipe
- (r) AWWA C228: Stainless Steel Pipe Flange Joints for Water Service – Sizes 2 IN. Through 72 IN. (50 mm through 1,800 mm)
- (s) AWWA C651: Disinfecting Water Mains
- (t) AWWA M11: Steel Pipe – A Guide for Design and Installation.
- (u) CSA G164: Hot Dip Galvanizing of Irregularly Shaped Articles
- (v) CSA W47.1: Fusion Welding of Steel Company Certification
- (w) CSA W48: Electrode and Filler Metals Certification
- (x) EJMA Standards: Standards of the Expansion Joint Manufacturers Association
- (y) SSPC SP-1: Solvent Cleaning
- (z) SSPC SP-3: Power Tool Cleaning
- (aa) SSPC SP-6: Commercial Blast Cleaning

1.3 Coordination

- 1.3.1 Prior to construction, coordinate with other divisions to locate openings and place sleeves or spools in cast in place concrete and/or masonry.

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- 1.3.2 Prior to demolition, coordinate with other divisions to locate pipe, sleeve and duct penetrations through existing structures.
- 1.4 Submittals - For Review
 - 1.4.1 Before fabrication, provide manufacturer data for each type of pipe material and for each fitting, valve, coupling, and all specified appurtenances used to complete the *Work* covered in this section.
 - 1.4.2 For all piping systems greater than 25 mm in diameter provide isometric drawings to indicate assembly details; pipe size, welds, flanges, couplings, valve placement, vents and drains, cathodic protection, seismic restraint system, expansion joints, guides, anchors, supports and provisions for thrust restraint, wall penetrations, as well as any other pertinent details.
 - 1.4.3 Provide details of any shop fabricated fittings.
 - 1.4.4 Where directed by the *Consultant*, provide mill test results or product samples.
 - 1.4.5 For expansion joints provide manufacturer's catalog data, *Shop Drawings* and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details.
 - 1.4.6 If requested, the piping fabricator shall submit a demonstrated fillet and butt weld on a test sample of pipe to be examined and approved by a certified inspection company. The test specimens will be submitted to the *Consultant's* inspection company at the *Owner's* expense. Any retesting required by the *Owner* shall be completed at the *Contractor's* expense.
 - 1.4.7 Bacteriological testing results following disinfection of raw and potable water piping.
 - 1.4.8 Provide a copy of this specification section and all referenced sections with each paragraph check-marked to show compliance or highlighted with notes indicating deviation.
- 1.5 Submittals - For Information Only
 - 1.5.1 Submit copies of all original submittals and all related correspondence made as part of regulatory submissions required by the British Columbia Power Engineers and Boiler Pressure Vessel Safety Act and Regulations and any submissions required by other regulatory authorities.
 - 1.5.2 Provide anchor and thermal expansion design details including locations, load information, design calculations and illustrative drawings, and calculations to

COMMON REQ FOR PROCESS PIPING SYSTEM

substantiate expansion joint selection and amount of pre-compression, stamped and signed by the *Contractor's* Engineer.

- 1.5.3 Current and complete documentation of welder's qualifications prior to the commencement of any welding. All welders who work on this project must provide the correct documentation.
- 1.5.4 Radiographic weld test and other shop inspection and test results.
- 1.5.5 Prior to commencing any welding of stainless steel pipe, submit a Welding Procedure Specification (WPS) including a written description of welding techniques including but not limited to materials, methods, and quality control. Certify that the technique is acceptable for the intended service condition. Written procedures to be signed and sealed at the *Contractor's* cost by a professional engineer registered in BC qualified for welding design.
- 1.6 Submittals – For Operation and Maintenance Manuals
 - 1.6.1 Provide manufacturer's data, supplier contact information, and *Shop Drawings* for:
 - (a) Expansion joints
 - (b) Couplings
- 1.7 Quality Assurance
 - 1.7.1 Provide complete, fully tested and operational process piping systems.
 - 1.7.2 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this *Work*.
 - 1.7.3 Complete all regulatory submissions as required by the BC Power Engineers and Boiler Pressure Vessel Safety Act and Regulations, and all other submissions as required by other regulatory authorities.
 - 1.7.4 All welding of pipe and fittings shall be undertaken by welders certified for pipe welding for each applicable pipe welding procedure through the BC Industry Training Authority (ITA) and holding a Level A or Level B Interprovincial Red Seal Ticket.
 - 1.7.5 Where pressure piping falls under the BC Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation, welders shall also be pressure pipe certified with the BC Safety Authority for each applicable weld procedure.
 - 1.7.6 The fabricator shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.

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- 1.7.7 All pipe fabrication and welding shall be in accordance with ASME B31.3 normal fluid service code for pressure piping or where applicable Section IX of the Boiler and Pressure Vessel Code.
 - 1.7.8 Perform visual examinations of all welding to reveal any surface or root defects, unacceptable weld fit-ups, arc strikes, weld spatter, or insufficient heat tint removal. Perform visual examination of shop welding before shipping.
 - 1.7.9 Provide radiographic inspections required to meet the welding standards cited in this Section. At the discretion of the *Consultant*, 5% of welds may be subject to radiographic inspection in the shop, the cost of which will be borne by the *Owner* unless tests prove the weld defective, then the cost to correct the defective *Work* plus the cost of additional radiographic inspection shall be borne by the *Contractor*.
 - 1.7.10 Spot-radiographic inspection of welds, or alternative method, may be conducted at the option and at the expense of the *Owner*. The *Consultant* will designate such company to carry out inspection of welds at the site of erection, and the *Contractor* shall fully co-operate with the *Consultant* and representatives in supply such labour and working space as may be required. Welding judged unacceptable shall be repaired using a method satisfactory to the *Consultant* at no additional cost to the *Owner*. The *Contractor* shall pay for the spot-radiographic inspection of all welds which are judged unacceptable.
 - 1.7.11 For each defective weld, two additional radiographic inspections at locations identified by the *Consultant* will be required, plus a radiograph of the repair. Costs for such additional radiographic inspections including the radiograph of the repair shall be borne by the *Contractor*.
 - 1.7.12 The *Consultant* may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. Any weld test specimen coupons submitted shall clearly identify the welder(s).
- 1.8 Delivery, Storage and Handling
- 1.8.1 Protect pipe and pipe coatings from damage.
 - 1.8.2 Store on site as recommended by materials manufacturer to prevent damage, undue stresses, or weathering. Store materials a minimum of 200 mm above ground with sufficient supports to prevent bending.
 - 1.8.3 Protect non-UV light inhibited plastic materials from sunlight.
 - 1.8.4 Provide shipping devices to maintain the face-to face dimension of each expansion joint during shipment, storage and installation.

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2.0 PRODUCTS

2.1 Bolts, Studs, Washers, and Tie-rods

2.1.1 Bolts and Studs

- (a) Provide hex head bolts and studs, threads to ANSI B1.1, standard coarse thread series.
- (b) Connecting stainless: Grade B8 ASTM A193, C1.1.
- (c) Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
- (d) Connecting steel, or unless otherwise specified: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
- (e) Axial stress in bolts shall not exceed 40% of material yield strength based on unthreaded body area.

2.1.2 Nuts and Washers

- (a) Provide hex head nuts, threads to ANSI B1.1, standard coarse thread series. Greater than 25 mm, provide heavy hex.
- (b) Connecting stainless steel: Provide nuts to ASTM A194 Grade 8.
- (c) Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be cadmium plated to ASTM B766. Always include washers.
- (d) Connecting steel, or unless otherwise specified: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.

2.1.3 Tie-rods

- (a) Provide tie-rods continuously threaded to ASTM A354 and fabricated in accordance with B1.1 (screw threads, coarse thread series). Tie rods to be steel cadmium plated in accordance with ASTM B766.

2.2 Expansion Joints

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- 2.2.1 Design and fabricate expansion joints in accordance with EJMA standards and to meet the requirements of this Section.
- 2.2.2 Expansion joint types are indicated. Alternative types may be considered if recommended by the *Contractor's Engineer*, and approved by *Consultant*.
- 2.2.3 Elastomer Expansion Joints
 - (a) Conform to the requirements of the Fluid Sealing Association, rubber Expansion Joint Division.
 - (b) Provide control rods to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Manufacturer to determine number and sizes of control rods.
 - (c) Up to and including 200 mm diameter, face to face dimension 150 mm, nominal. Greater than 200 mm diameter and less than or equal to 300 mm diameter, face to face dimension 200 mm nominal.
 - (d) Provide 304 stainless steel backup rings.
 - (e) Elastomer spool type: resilient arch, constructed of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body. Comes with split type backup rings. On fluids containing solids, provide filled arch type. Neoprene elastomer cover and elastomer tube liner.
 - (f) Elastomer spherical moulded: construct of multiplied plies of nylon tire cord fabric, and neoprene elastomer.
 - (g) Acceptable manufacturers: Red Valve, Senior Flexonics, Proco.
- 2.3 Fittings
 - 2.3.1 Provide fittings with wall thickness equal to or greater than the pipe, of the same, material, coating, lining and pressure rating as pipe or better.
 - 2.3.2 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.
 - 2.3.3 Provide concentric reducers in vertical lines unless indicated otherwise.
 - 2.3.4 Provide smooth flow long radius elbows for liquid service unless otherwise specified.
 - 2.3.5 Provide smooth flow standard radius elbows for process air service unless otherwise specified.

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2.4 Joints – Flanges

- 2.4.1 Flanges for mating to equipment or valves must be compatible with those items. In all situations similar faced flanges only shall be mated. Companion flanges for connection to cast iron or ductile iron or PVC equipment or valve flanges shall be flat faced and flush with the equipment or valve flange.
- 2.4.2 Vanstone style flanges are not permitted.
- 2.4.3 Class 150 – flat faced with full face gaskets, unless mating to raised face valves, lap joint flanges or equipment.
- 2.4.4 Class 300 – Not used.
- 2.4.5 If not specified or shown otherwise use slip-on flanges.
- 2.4.6 Provide flange isolation kits where dissimilar metals are joined.
- 2.4.7 Gaskets
 - (a) Conform to ASTM B16.21 and AWWA C228 Table 1.
 - (b) Minimum gasket thickness 3.175 mm.
 - (c) Provide full face gaskets for flat faced flanges
 - (d) Provide ring type gaskets for raised face flanges.
 - (e) Provide gasket materials suitable for the temperature, pressure and corrosivity of the fluid conveyed in the pipeline.
 - (i) Provide liquid service gaskets of EPDM or neoprene.
 - (ii) Provide air service gaskets of compressed Kevlar with neoprene binder, suitable for service conditions.

2.5 Joints – Threaded Couplings

- 2.5.1 Provide screwed joints with American Standard threads.
- 2.5.2 Provide Teflon tape suitable for pipe material and service.

2.6 Joints – Grooved Joint Couplings

- 2.6.1 Provide pipe grooving, couplings and gaskets conforming to ANSI/AWWA C606. Victaulic, Shurjoint, Gruvlok or approved equal.
- 2.6.2 Provide flexible style couplings for buried service pipe, and adjacent to pump or blower suction and discharge where used for noise and vibration control. Provide

COMMON REQ FOR PROCESS PIPING SYSTEM

rigid type couplings in other applications unless noted otherwise on *Drawings*. Only use flexible style couplings for PVC pipe.

2.6.3 Body Material as follows:

- (a) Carbon Steel Pipe – Provide ductile iron body. Buried or submerged installations to be epoxy coated to AWWA C116.
- (b) Stainless Steel Pipe – Provide stainless steel body.

2.6.4 Gaskets

- (a) Provide for liquid service Victaulic Grade “E” EPDM flush seal gasket or approved equal.
- (b) Provide for gas service Victaulic Grade “L” gasket or approved equal.

2.6.5 For steel pipe provide cut grooves on schedule 40, standard wall or thicker pipe, roll grooves for Sch. 10 and Sch. 5.

2.6.6 For plastic pipe provide roll grooves for schedule 40 piping. Provide roll grooves for schedule 80 and 120 piping smaller than or equal to 200 mm in diameter. Provide cut grooves for schedule 80 and 120 piping for 250 mm diameter and larger.

2.6.7 Grooved joint flange adapters shall be used only where specifically indicated.

2.7 Joints – Flexible Couplings

- 2.7.1 Provide cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts. Robar, Dresser or equal.
- 2.7.2 If joint restrained add restraining rods and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure, as recommended by the manufacturer.
- 2.7.3 Provide gasket suitable for service conditions.

2.8 Joints – Welding

- 2.8.1 Use welding materials conforming to CSA W48.
- 2.8.2 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

2.9 Joints – Soldered

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- 2.9.1 Use only lead free solder conforming to ASTM B32 and the BC Plumbing Code.
- 2.10 Lining and Coating
 - 2.10.1 Do not paint stainless steel pipe.
 - 2.10.2 Provide factory applied linings and coatings as specified for specific pipe services
 - 2.10.3 Galvanizing: Hot dip zinc coat to CSA G164, minimum 440 g/m³.
- 2.11 Piping
 - 2.11.1 Piping materials will be clearly marked to indicate size, type, class/schedule and coatings.
- 2.12 Piping Identification
 - 2.12.1 Label pipes with commodity code and flow direction arrows.
 - 2.12.2 Labels and tags: legend and arrows printed on vinyl coated pressure sensitive cloth tape.
 - 2.12.3 Colours for identification materials: to CSA B53 – Code for identification of Piping Systems
 - 2.12.4 For pipes 75 mm dia. (outside surface) and larger:
 - (a) legend – 40 mm high characters
 - (b) arrows – 40 mm wide (maximum)
 - 2.12.5 For pipes under 75 mm dia. (outside surface):
 - (a) legend – 20 mm high characters
 - (b) arrows – 20 mm wide (maximum)
 - 2.12.6 For ducts:
 - (a) legend – 65 mm high characters
 - (b) arrows – 65 mm wide (maximum)
 - 2.12.7 Pipe and duct duties and arrow directions will be provided by *Consultant*.
 - (a) Duties shall be spelt out in full.

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- (b) Duties for HVAC ducting shall read: "Supply", "Return", or "Exhaust" respectively.

2.12.8 *Contractor* shall mark-up *Drawings* with proposed flow arrow and text locations and submit to the *Consultant* with a sample of the proposed labels for approval before installing.

2.13 Component Tagging and Identification

2.13.1 Tag all valves and equipment with 304 stainless steel tags with 12 mm high engraved letters and numbers. Numbers and letters shall be filled with black paint. Attach to valve with 304 SS chain around valve shaft. For other equipment, glue or fasten tag to equipment as needed. Inscription shall contain P&ID identification tag, size, manufacturer and model number.

2.14 Pressure Gauges

2.14.1 Pressure gauge liquid seal diaphragm of the continuous type equal to "Ashcroft" or "Terice" shall be furnished.

2.14.2 Ball valves shall be provided for isolation of these gauges with diaphragms.

2.14.3 Gauge shall read to pressure indicated on *Drawings*, with a dial diameter not less than 100 mm.

2.14.4 Supply gauges, complete with pressure snubbers, diaphragm protection seals, and full vacuum protection.

3.0 EXECUTION

3.1 Preparation

3.1.1 Prior to installation, inspect and field measure to ensure that previous *Work* is not prejudicial to the proper installation of piping.

3.1.2 Make all minor modification to suit equipment and structural element locations and elevations, at no expense to the *Owner*.

3.1.3 Advise the *Consultant* of all modifications. Indicate all piping modifications on the *Shop Drawings* submitted prior to fabrication or installation. Do not commence *Work* on related piping until the *Consultant's* approval has been received.

3.1.4 Prior to valve and pipe appurtenance installation, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that

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valve location and orientation provides suitable access to all valve operators. Ensure that sufficient easily disassembled joints are provided to allow for removal and replacement of all valves and pipe appurtenances.

3.2 Pipe Handling

- 3.2.1 Inspect each pipe, fitting and piping appurtenance prior to installation. Do not install damaged material or materials with damaged linings or coatings.
- 3.2.2 Repair pipe with damaged protective coatings in accordance with coating manufacturer's directions and to the satisfaction of the *Consultant*.
- 3.2.3 Remove all foreign matter from inside of piping and piping appurtenances prior to installation.
- 3.2.4 Use proper implements, slings, tools and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

3.3 Conflicts

- 3.3.1 Confirm the pipework routing with the *Consultant* prior to commencement of fabrication and installation. Advise the *Consultant* of any conflicts with existing services, structures, or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict, as instructed by the *Consultant*.

3.4 Interior and Outdoor Pipe Installation

- 3.4.1 Piping installed in interior building spaces shall be fabricated and installed in accordance with the ASME Pressure Vessel Code.
- 3.4.2 Make adequate provision in piping runs for expansion, contraction, slope and anchorage.
- 3.4.3 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag and stress.
- 3.4.4 Provide temporary supports as necessary during construction to prevent overstressing equipment, valves or pipe.
- 3.4.5 Accurately cut all piping for fabrication to field measurements.
- 3.4.6 Install pipes in straight alignment. Variance from the true alignment shall not exceed 10 mm in any direction or as required in ASME B31.3 whichever is less.
- 3.4.7 Fabricate and assemble pipe runs to ensure that pipework is not stressed to achieve the designed alignment and that no stresses are transferred to equipment

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or equipment flanges. "Springing" of pipework to ensure alignment is not permitted. The *Contractor* shall undo and subsequently remake all pipework connections where so instructed by the *Consultant* to ensure that springing does not occur. Take care not to damage equipment, piping appurtenances, valves, flanges, or other joints.

3.4.8 Do not cut or weaken the building structure to facilitate installation unless specifically detailed on the *Drawings* or approved by the *Consultant* in writing.

3.4.9 Slope process air piping to condensate drains.

3.5 Connections to Equipment and Existing Piping

3.5.1 Verify fit and materials at each connection prior to making the connection.

3.5.2 Where joining piping to existing equipment, confirm flange type on the equipment and install matching pipe flanges to suit.

3.5.3 Modifications to either new or existing materials required to make connections shall be approved by the *Consultant* in writing prior to the connections being made.

3.6 Pipe Joints

3.6.1 General

(a) Provide joints that can be readily disassembled at the minimum within 1.0 m of any connection to equipment, on both sides of structural penetrations, and within 0.6 m of all threaded end valves.

(b) Allow a minimum of 150 mm to face or 75 mm to edge of flanges or grooved joint couplings from wall, floor or ceiling unless otherwise shown.

3.6.2 Threaded

(a) Unless specifically noted on the *Drawings*, threaded couplings shall only be used on piping with nominal diameters less than 65 mm.

(b) Ream the ends of all pipes to remove all burrs and cuttings when fabricating threaded joints.

(c) Clean out pipe prior to joining.

(d) Apply Teflon tape to male threads and join pipe. Do not use extra tape to make up for slack in the joint.

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- (e) Install threaded pipe with as few joints as possible. Short lengths of pipe coupled tighter shall not be used, except where a union is specifically shown on the *Drawings*.
- (f) If it is necessary to back off a screwed joint after it is made, the thread shall be cleaned and new compound applied.
- (g) Threads shall not be caulked.
- (h) Bushings shall not be used.
- (i) Nipples in threaded piping shall be shoulder nipples. Close nipples shall not be used unless specifically indicated.

3.6.3 Flanged

- (a) Clean flanges and gaskets prior to connection.
- (b) Lubricate gaskets with soapy water and apply anti-seize compound to stainless steel bolts.
- (c) Bring flanges into close parallel and lateral alignment.
- (d) Tighten bolts progressively, proceeding from side to side of the flange. Wrenches used for tightening bolts shall be in good condition and properly sized to prevent rounding of nut and bolt heads. Apply manufacturer's torque recommendations when connecting to valves and equipment. Do not over torque bolts.
- (e) Do not use washers to take up excess bolt length.
- (f) Bolt projection beyond nuts shall be approximately two full threads.
- (g) Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place strain on equipment.
- (h) Install flange adapters in accordance with manufacturer's recommendations.
- (i) Install lap joint flanges in vibration free service only. Do not install in buried or submerged environments.

3.6.4 Grooved Joint Couplings

- (a) Install grooved joints and grooved joint flange adapters as recommended by manufacturer using manufacturer's recommended lubricants on gaskets.

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- (b) All grooving tools and accessories to be manufactured by grooved product supplier.
- 3.6.5 Solvent Cemented
 - (a) Refer to specification 40 05 31.13.
- 3.7 Expansion Joints
 - 3.7.1 Accurately align pipelines to receive expansion joints before installing the joint or connector. Do not stretch, compress, misalign or offset the joint or connector to fit the piping.
 - 3.7.2 Align and install each expansion joint in accordance with EJMA standards, and in accordance with manufacturer's written instructions.
 - 3.7.3 Properly guide and anchor all expansion joints.
 - 3.7.4 Provide sufficient bends and expansion joints to allow for thermal movement of piping allowing for both the operating temperature range as defined by the specific pipe specifications, and the ambient temperature range.
 - (a) Indoor temperature range: 0°C to 40°C
 - (b) Outdoor temperature range: -42°C to 35°C
- 3.8 Welding – General
 - 3.8.1 All piping is to be shop welded.
 - 3.8.2 Metal surfaces in and adjacent to the welding groove shall be dry before welding commences and kept dry and free from dirt, loose scale, slag, grease or any other foreign contaminant.
 - 3.8.3 All welds after welding is complete must be cleaned and surface prepared as required for the final coating, finish or passivation method to be applied.
 - 3.8.4 The end of each pipe shall be carefully fitted to butt accurately with proper gap to the preceding pipe or fitting. Before placing the pipe in position, the ends of the pipe shall be made truly circular by an approved method and, if necessary, for large pipes "spiders" shall be placed in each to keep them truly circular.
- 3.9 Field Welding

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- 3.9.1 In general field welding is not acceptable. Field welding may be performed only under exceptional circumstances and with the prior written consent of the *Consultant*.
- 3.9.2 Field welding shall conform to the general requirements of AWWA C206 "Field Welding of Steel Water Pipe Joints", and the quality requirements under "Welding-General" in this specification.
- 3.9.3 Field welding shall not be done under conditions that would impair the completed weld including but not limited to: moisture; blowing sands or dust; high winds; low temperatures. If, in the *Consultant's* opinion, protection from prevailing weather conditions is necessary, then all welding shall cease until this protection is provided at the *Contractor's* cost, and welds done under poor conditions shall be re-made. The *Contractor* shall be prepared for such events and will not be compensated for downtime associated with delays of this nature.
- 3.9.4 When the ambient temperature is below 0°C all welding operations shall cease unless an appropriate welding procedure has been submitted. Written procedures to be signed and sealed at the *Contractor's* cost by a professional engineer registered in BC qualified for welding design.
- 3.9.5 In general, field welds shall be butt type, suitably bevelled to the satisfaction of the *Consultant*.
- 3.9.6 Pipes cut in the field for closing pieces and other field joints shall be cut to a smooth uniform level. Edges shall be smooth and not serrated and shall be ground smooth if they are rough after cutting.
- 3.10 Pipe Structural Penetrations
 - 3.10.1 Coordinate with other divisions to locate and place sleeves or cast-in-place pipe sections prior to the construction of concrete and masonry building elements.
 - 3.10.2 For pipe grouted or cast into concrete or block walls, provide anchor rings in accordance with AWWA M11.
- 3.11 Drains, Vents, Flushing Connections, Sample Points
 - 3.11.1 Provide manual air vents at the high points of each reach of pipeline. Refer to the Standard Details. Pipe air vents to the nearest floor.
 - 3.11.2 Provide manual drains at the low points of each reach of pipeline. Refer to the Standard details. Pipe drains to a sump, gutter floor drain, or other approved collection point.

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- 3.11.3 Mount drain and vent isolation valves in a location accessible from floor level and no greater than 1.2 m above the floor.
- 3.11.4 Install flushing connections as shown.
- 3.12 Pipe Coating and Lining
 - 3.12.1 Coat and line all fittings and joint types to match the pipe in which they are installed.
 - 3.12.2 In general, field lining and coating in the field is not allowed, except to repair damaged coating and lining.
 - 3.12.3 Prepare all coated or shop primed surfaces in the field by cleaning in accordance with SSPC SP-1 (Solvent cleaning). Clean damaged areas of shop primed surfaces in accordance with SSPC SP-3 (Power Tool Cleaning). Repaint as recommended by coating manufacturer with primer for shop primed surfaces, or sealer for coated surfaces.
 - 3.12.4 Prepare bare metal surfaces in accordance with SSPC SP-6 (Commercial Blast).
 - 3.12.5 Apply primer and finish coats in accordance with manufacturer's recommendations.
- 3.13 Testing
 - 3.13.1 All piping shall be pressure tested, and witnessed by the *Consultant*.
 - 3.13.2 Give *Consultant* 24 hours' notice of testing.
 - 3.13.3 Thoroughly clean all piping prior to pressure testing.
 - 3.13.4 Prior to pressure testing ensure piping is adequately restrained.
 - 3.13.5 Do not insulate, bury, concrete surround or otherwise conceal *Work* until piping systems are tested and accepted.
 - 3.13.6 Supply all equipment, gauges and materials including fluids for pressure testing.
 - 3.13.7 Install fittings for air relief, gauges and drainage as needed to complete testing. After testing remove and plug fittings.
 - 3.13.8 Cap and plug all lines that are normally open ended. Remove on completion of testing.
 - 3.13.9 Isolate all low pressure equipment or pipeline appurtenances during testing to protect the equipment or pipeline appurtenances from damage.
 - 3.13.10 Repair and replace any defective *Work* using new material.

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3.13.11 Testing Piping Carrying Liquid Commodities

- (a) Test welded metal piping to AWWA C200.
- (b) There shall be no loss of pressure during testing, and no visual evidence of leakage.
- (c) Test duration: 2 hours.
- (d) Test pressure: 1.5 times the maximum working pressure or 250 psi. Confirm system working pressure with *Consultant* prior to pipe testing.

3.13.12 Testing Piping Carrying Gaseous Commodities

- (a) Use dry air or commercial grade nitrogen for testing.
- (b) All tests shall include a preliminary check out of no more than 200 kPa or half the test pressure, whichever is less. Pressure shall be gradually increased in steps.
- (c) All joints shall be wetted using a mixture of soap and water. There shall be no loss of pressure not associated with changes in temperature, and no obvious evidence of leakage.
- (d) Test duration: 4 hours
- (e) Test pressure: 1.5 times the maximum working pressure. Review test pressures with *Consultant* prior to proceeding with test.

3.14 Cleaning and Flushing

3.14.1 Flush and drain liquid pipes after pressure tests.

- (a) Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline. Remove instrumentation or piping appurtenances that may be damaged by this procedure and replace after cleaning. Give lines smaller or equal to 150 mm an initial flush or purge.
- (b) If recommended by equipment supplier, install temporary screens with visible locator tabs in the suction piping of equipment. Maximum opening size – 25 mm.
- (c) Dispose of flushing water in a manner which causes no damage to buildings or site-works in a manner approved by the *Consultant*.

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3.14.2 Purge piping with air before testing. Upon completion of testing, drain and dry the piping with a dry air stream.

3.15 Disinfection

3.15.1 Piping intended for raw and potable water service shall be flushed, disinfected and bacteriologically tested in accordance with AWWA C651.

(a) Do not use calcium hypochlorite for disinfection of solvent cemented PVC pipe.

3.15.2 Bacteriological testing and reporting to include total coliforms, fecal coliforms and background colonies on the total coliform plate.

3.15.3 Maximum acceptable count of coliform and background colony forming units: 200 CFU. The presence of any coliform bacteria or background bacteria over the maximum allowable limit shall constitute a failed test.

3.16 Operations and Maintenance Manuals

3.16.1 Include copies of all manufacturer's information provided in *Shop Drawing* submittals for all piping appurtenances in the operations and maintenance manuals.

3.16.2 Include name and contact information of supplier for each piping appurtenance in the operations and maintenance manuals.

END OF SECTION

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PUMPING

1.0 GENERAL

1.1 Summary

- 1.1.1 This Section specifies the supply and installation of piping supports, anchors, thrust restraints and seismic bracing. This includes piping supports, anchors, thrust restraints and seismic bracing for Process Piping (including piping inside tanks). This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.2 Design, select, locate and provide pipe hangers, supports, anchors, thrust restraints and seismic bracing.
- 1.1.3 No attempt has been made to indicate all necessary pipe supports, anchors, thrust restraints and seismic bracing in the *Drawings*. Details provided are intended as a general guide for quality only. The intent has been to indicate general arrangements and typical spacing, but does not relieve the *Contractor* of the responsibility of designing and supplying a complete support system.
- 1.1.4 Related Requirements
 - (a) Section 40 05 01: Common Requirements for Process Piping Systems.
 - (b) Section 40 05 23.24: 304 Stainless Steel Piping
 - (c) Section 40 33 01: Chemical Piping, Valves and Fittings

1.2 References

1.2.1 Definitions

- (a) *Contractor's Engineer*: A professional engineer registered in the Province of British Columbia qualified to do detailed piping structural design at the *Contractor's* cost.
- (b) *Service loads*: All static and dynamic loads which must be resisted by pipe hangers and supports including but not limited to:
 - (i) Weights of pipes, valves, fittings, insulating materials, suspended hanger components, normal fluid contents.
 - (ii) Weight of hydrostatic test fluid or cleaning fluid
 - (iii) Reaction forces due to operation of all valves
 - (iv) Wind, snow or ice loadings on outdoor piping
 - (v) Loads from future piping shown on *Drawings*
 - (vi) Vibration
 - (vii) Thrust forces caused by moving liquids and internal pressure

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PUMPING

- (viii) Forces resulting from thermal expansion/contraction due to commodity and ambient temperature fluctuations
- (c) *Design Loads*: That combination of service loads producing the maximum load effects to be resisted by the pipe hangers and supports in accordance to the B.C. Building Code.
- (d) *Seismic Loads*: In accordance to the B.C. Building Code.
- (e) *Allowable Load*: the maximum design load as recommended by the manufacturers: maximum allowable stress levels not to exceed those listed in MSS SP-58.

1.2.2 Reference Standards

- (a) Conform with the most recent version of all standards referenced in this Section.
 - (i) B.C. Building Code
 - (ii) B.C. Plumbing Code
 - (iii) ANSI/ASME B31.3 Process Piping
 - (iv) MSS SP-89 – Pipe Hangers and Supports: Fabrication and Installation Practices
 - (v) MSS SP 58, Pipe Hangers and Supports – Materials, Design and Manufacture
 - (vi) MSS SP-60 – Pipe Hangers and Supports – Selection and Application
 - (vii) SMACNA – Guidelines for Seismic Restraints

1.3 Submittals - For Review

- 1.3.1 Details including precise location and factored design loads where piping is supported by any proposed supplementary structural members. Review by *Consultant* will be for support by the existing structure. Sizing of proposed supplementary structural members will remain the responsibility of the *Contractor's Engineer*.
- 1.3.2 Manufacturer's pipe hanger and support cut sheets.
- 1.3.3 Details of pipe thrust restraints and harnesses. Sizing of proposed thrust restraints and harnesses remain the responsibility of the *Contractor's Engineer*.

1.4 Submittals – For Information Only

- 1.4.1 Before commencement of installation, provide hanger, support, anchor and seismic restraint system design details including dimensions, dimensioned

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locations, load information, design calculations and illustrative drawings, stamped and signed by the *Contractor's Engineer*.

1.5 Delivery, Storage and Handling

1.5.1 Deliver materials and unload at site using methods which do not damage coatings or any parts.

1.5.2 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

1.6 Site Conditions

1.6.1 $S_a(0.2) = 0.28$, $S_a(0.5) = 0.17$, $S_a(1.0) = 0.094$, $S_a(2.0) = 0.056$, $PGA = 0.073$, Site Class D.

2.0 PRODUCTS

2.1 General

2.1.1 Design pipe support systems to support *Design Loads* with a factor of safety of 4.0 or as required for seismic bracing, whichever is greater.

2.1.2 Provide seismic restraints to resist pipe movements and loads occurring as a result of seismic events.

2.1.3 Where structural bearings are not in suitable locations, provide supplementary structural members.

2.1.4 Support plastic piping with at least 50 mm measured around the pipe perimeter and 50 mm longitudinal smooth bearing surface in contact with the pipe.

2.2 Maximum support spacing for horizontal straight runs of pipe is as listed in the following table. Provide additional supports as required to support the design loads.

Pipe Size	Stainless Steel (m)	PVC SCH. 80 (m)
	Liquid Service	Liquid Service
25 mm	2.1	1.8
38 mm		2.0
50 mm	3.0	2.1
65 mm		2.3
75 mm	3.7	2.4
100 mm	4.3	2.7

2.2.1 Space plastic pipe supports to allow for expansion and contraction as recommended by manufacturers at elbows and changes in direction.

(a) Where spacing for thermal expansion and contraction cannot be achieved provide expansions loops in accordance with manufacturer recommendations on straight pipe runs.

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PUMPING

2.3 Materials

- 2.3.1 304 stainless steel: For all steel pipe supports.
- 2.3.2 Type 304 Stainless steel nuts, bolts, washers and threaded rods.
- 2.3.3 Reinforced cast in place concrete.
- 2.3.4 Provide isolation to prevent contact between dissimilar metals.
- 2.3.5 Isolate copper tubing from supports with a double thickness of Plycoflex 310 on Greenline accessory tape between the copper pipe and the supports.
- 2.3.6 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located less than 2,300 mm above the floor.

2.4 Manufactured Pipe Hangers and Supports

- 2.4.1 Acceptable Manufacturers:
 - (a) Unistrut or approved equal
 - (b) B-Line, Myatt, Standon or approved equal
- 2.4.2 Acceptable Types:
 - (a) Pipe stanchion with saddle and yoke
 - (b) Pipe stanchion with adjustable roller hanger
 - (c) Riser Clamp
 - (d) Offset Pipe Clamp
 - (e) Framing Channel Pipe Strap
 - (f) Framing Channels and Connection Fittings
 - (g) Framing Channel Post Base

2.5 Thrust restraints

- 2.5.1 Prevent transmission of pipe movement and thrust forces onto equipment flanges or connections.
- 2.5.2 Where thrust restraints are used to prevent pipe movement and the transmission of thrust forces onto equipment flanges or connections:
 - (a) Design pipe thrust restraints for thrust loads developed by 1.5 times the maximum pipe test pressure.
 - (b) Provide compression coupling joints with rod type thrust harnesses anchored in accordance with AWWA M11.

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PUMPING

- (c) Minimum tie-rod diameter – 19 mm.

2.6 Anchors

- 2.6.1 Anchor locations shown on the *Drawings* are preliminary only. Provide number and location of anchors as determined by *Contractor's Engineer*.
- 2.6.2 Reinforce piping as required at anchor locations to withstand applied forces.

2.7 Seismic Restraints

- 2.7.1 Unless otherwise required by local building codes, seismic restraints may be omitted from:
 - (a) Compressed air piping less than 25 mm diameter.
 - (b) All piping suspended by individual hangers 300 mm or less in length from the top of the pipe to the bottom of the support for the hanger.
- 2.7.2 Do not brace piping systems to dissimilar points of a building or to dissimilar building systems that may respond in a different mode during an earthquake.
- 2.7.3 Size restraints to fit the outside diameter of insulation, where insulation is specified.
- 2.7.4 Do not use branch lines to brace main lines.
- 2.7.5 Do not limit thermal expansion and contraction of the piping system by seismic bracing.
- 2.7.6 Provide a means to reduce noise and vibration transmission between linked fitting parts.

3.0 EXECUTION

- 3.1 Provide pipe support system to adequately secure the pipe and prevent undue vibration, and stress, and to prevent the transmission of forces to equipment and tanks.
- 3.2 Support piping in accordance with the pipe manufacturer's recommendations.
- 3.3 Support piping so that no pockets will be formed in the span due to sagging of the piping between supports.
- 3.4 Support piping so that temporary supports will not be required when removing parts of the piping system for equipment maintenance.
- 3.5 Provide hangers and or base supports within 1 metre of each change in direction on each piping leg, on one side of each valve, and on the first spool piece or fitting from a piece of equipment.
- 3.6 Secure supports to elbows where elbows change the run of a horizontal pipe to a vertical direction.

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PUMPING

- 3.7 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.
- 3.8 Do not support piping from masonry wall construction.
- 3.9 Do not support piping from equipment or other pipes.
- 3.10 Do not drill or burn holes in the building structural steel without prior written permission from the *Consultant*.
- 3.11 Do not use hanger components for rigging and erection purposes.
- 3.12 When fabricating products under this specification, use welding procedures to minimize distortion and avoid damage to finished work or bonded materials. Finished products to be true to line, free from twists, bends, open joints, sharp corners and sharp edges.
- 3.13 Recoat cut ends of galvanized framing channel with zinc dust-zinc oxide coating.
- 3.14 Hanger and support components in contact with plastic pipe to be free of burrs and sharp edges.
- 3.15 Rollers to roll freely without binding.
- 3.16 Locate any cast in place concrete supports to prevent encasement in concrete of valves, pipe appurtenances or easily disassembled pipe joints.
- 3.17 Finished floor beneath base plates and framing channel post bases to be roughed prior to grouting. Grout between base plate and floor to be free of voids and foreign material.
- 3.18 Adjust stanchions to obtain required pipe slope and elevation prior to grouting of baseplates.
- 3.19 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- 3.20 Locate the first seismic restraint on a piping system not more than 3.0 m from the main riser, entrance to a building or piece of equipment.
- 3.21 Install seismic bracing within 45 degrees above and 45 degrees below horizontal relative to the horizontal centreline of the pipe.

END OF SECTION

304 STAINLESS STEEL PIPING

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to supply, fabrication, and installation of 304 Stainless Steel process piping as identified on the *Drawings*:

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Related Requirements

(a) Section 40 05 01: Common Requirements for Process Piping Systems

1.2 References

1.2.1 Reference Standards

(a) Conform with the most recent version of all standards referenced in this Section.

(i) ANSI/ASME B16.5:

(ii) ANSI/ASME B16.9:

(iii) ANSI/ASME B16.11:

(iv) ANSI/ASME B16.21:

(v) ANSI/ASME B36.19: Stainless Steel Pipe

(vi) ASTM A182: Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings and Valves and parts for High Temperature Service

(vii) ASTM A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications

(viii) ASTM A312: Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes

(ix) ASTM A380: Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems

(x) ASTM A403: Wrought Austenitic Stainless Steel Piping Fittings

(xi) ASTM A480: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

304 STAINLESS STEEL PIPING

- (xii) ASTM A778: Welded, Unannealed Austenitic Stainless Steel Tubular Products
- (xiii) ASTM A967: Chemical Passivation Treatments for Stainless Steel Parts
- (xiv) AWWA C220: Stainless Steel Pipe ½ In (13 mm) and Larger
- (xv) AWWA C226: Stainless-Steel Fittings for Waterworks Service, Sizes ½ in. through 72 in (13 mm through 1,800 mm)
- (xvi) AWWA C227: Bolted, Split-Sleeve Restrained and Non-restrained Couplings for Plain-End Pipe
- (xvii) AWWA C606: Grooved and Shouldered Joints

1.3 Delivery, Storage and Handling

- 1.3.1 Protect materials from contamination from dirt or road salt by shrink wrap or other suitable packaging, and end caps, prior to and during shipment.
- 1.3.2 Store materials in such a way to prevent scratching and scoring of the surface and to avoid contact with dirt or carbon steel.

1.4 Design Conditions

1.4.1 Water Treatment Process Piping

- (a) Normal commodity temperature range: 0.5 to 25 °C.
- (b) Normal service operating pressure range: 0 to 50 PSI
- (c) Maximum (intermittent short term) operating pressure: 260 PSI
- (d) Test pressure: 100 PSI

304 STAINLESS STEEL PIPING

1.4.2 Process Air Piping

- (a) Normal commodity temperature range: 0 to 75 °C.
- (b) Normal service operating pressure range: 0 to 6 PSI
- (c) Test pressure: 9 PSI

2.0 PRODUCTS

- 2.1 Provide piping systems as detailed below with components suitable for the operating conditions.

Component	Size Range (mm)	Description	Applicable Standards
Pipe (general)	75 and under	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	100 and up	304L Stainless Steel. Sch 10S, welded	ASTM A312 ANSI/ASME B36.19
Pipe above roof line, buried or where penetrating structures	50 to 250	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	300 and up	304L Stainless Steel. STD wall, welded	ASTM A778 ANSI/ASME B36.19
Coating		Not applicable	
Lining	All	No. 1 mill interior finish or better	ASTM A480
Fittings	75 and under	304L Stainless Steel, Class 3000, socket weld Sch 40S bore, or threaded.	ASTM A182, ANSI/ASME B16.11
	100 and up	304L Stainless Steel, Sch 40S, buttweld. Elbows S.R. unless indicated otherwise. No mitred elbows allowed.	
Fittings above roof line, buried or where penetrating structures	100 and up	304L Stainless Steel, Sch 40S, buttweld. Elbows S.R. unless indicated otherwise. No mitred elbows allowed.	
Unions	75 and under	304L Stainless Steel, Class 3000, socket weld Sch 40S bore, or threaded.	ASTM A182, ANSI/ASME B16.11
Couplings, Grooved Joint	50 to 600	Grooved Joint Couplings as specified in Section 40 05 01	AWWA C606

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Flanges – slip on or weld neck	75 to 600	304 Stainless Steel, Class 150. Slip-on or weld neck. Machine flat face where connecting to flat faced flanges	ASTM A182 ANSI/ASME B16.5.
Flanges – lap joint. Not for buried service.	75 to 600	304 Stainless Steel stub end, Sch 40S butt weld except above roof Sch 40S, 304 SS backing ring	ASTM A774 ANSI/ASME B16.5
Blind Flanges	75 to 600	304 Stainless steel, solid type.	
Gaskets	All	Flanges, Non-metallic, non-asbestos, flat ring	ANSI/ASME B16.21
	All	Couplings; Grooved Joint, Victaulic Grade E EPDM flush seal or approved equal for liquid service. Victaulic Grade L Silicone flush seal or approved equal for air service.	AWWA C606

3.0 INSTALLATION

3.1 Stainless Steel Pipe Welding and Fabrication

- 3.1.1 Stainless steel fabrication shall be done in an approved CSA W47 fabrication shop set up to handle, fabricate and weld stainless steel using handling procedures designed to eliminate carbon contamination of the stainless steel including but not limited to: the use of stainless steel tools including wire brushes, chisels, files and hammers, welding gloves and grinding wheels. Only 300 series stainless steel brushes or wheels shall be used on austenitic and nickel alloys.
- 3.1.2 Areas used for fabrication of austenitic and nickel alloys shall be separated from carbon steel areas by methods suitable to prevent contamination by dirt, carbon steel shavings, grinding dust and sparks, and zinc dust from painting operations. Welding gloves and tools used during the fabrication of stainless steel shall not have been used on previous carbon steel work.
- 3.1.3 Where tape is used for backing purge gas the tape shall use an adhesive backing such that when no longer required it can be completely removed with residual adhesive removed by a suitable solvent or abrasive.
- 3.1.4 Clean piping to a pre-weld zone extending 50 mm on either side of the weld with alcohol or acetone.
- 3.1.5 All welding of the root pass of austenitic stainless steel pipe shall be done using the Gas Tungsten Arc Weld (GTAW) process with shielding gas protection of the backside of the weld sufficient to reduce oxygen content to a level that can avoid

304 STAINLESS STEEL PIPING

granulation and ensure a high quality corrosion resistant weld. Large bore piping may be internally back welded to achieve the same result.

- 3.1.6 The Shield Metal Arc Weld (SMAW) process may only be used for fill passes or fillet welds.
- 3.1.7 Solar Flux is not acceptable.
- 3.1.8 Clean welds after fabrication in accordance with ASTM A380.
- 3.1.9 Pickle and passivate welds after fabrication in accordance with AWWA C220, ASTM A380 and ASMT A967 by immersing in a liquid bath of pickling solution NSF certified for drinking water.
- 3.1.10 Any noticeable discolouration on the piping after welding shall be removed by pickling.
- 3.1.11 Once sufficient pickling time has elapsed to re-passivate the stainless steel surface, clean the piping of all acids by thoroughly rinsing the pipe with water.
- 3.1.12 Thread stainless steel pipe in accordance with threading machine manufacturer's instructions.
- 3.2 Pipe Grooving
 - 3.2.1 Groove stainless steel pipe in accordance with grooving machine manufacturer's instructions.
 - 3.2.2 Contamination from iron particles by pressure contact with rollers or tooling should, if at all possible, be avoided. Where stainless steel rollers or tools are unavailable, adhesive plastic films or tape can be used to prevent direct contact. They shall be removed after fabrication.
- 3.3 Fabricated Fittings
 - 3.3.1 Shop fabricated fittings made from rolled stock in accordance with ASTM A240 shall be in a solution annealed condition. Shop fabricated fittings made from pipe shall be in accordance with AWWA C220, ASTM A312, ASTM A778. Design standard shall be in accordance with AWWA C226 and thickness of all reinforcement collars and pads shall be determined by the appropriate formula in the latest edition of AWWA M11.
- 3.4 Pipe Coating: Do not paint stainless steel piping.

END OF SECTION

COMMON REQUIREMENTS FOR PROCESS VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This Section specifies supply and installation of all valves and related appurtenances installed on process piping systems. This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.2 Related Requirements

- (a) Section 40 05 01: Common Requirements for Process Piping Systems
- (b) Valve data sheets and details are provided in separate Sections for each valve type
 - (i) Section 40 05 64.36: High Performance Butterfly Valves for Air or Gas Service
 - (ii) Section 40 05 63.33: Metallic Ball Valves

1.2 References

1.2.1 Reference Standards

- (a) Conform with the most recent version of all standards referenced in this Section.
 - (i) ANSI B1.20.1: Pipe Threads, General Purpose, Inch
 - (ii) ANSI B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - (iii) ANSI B16.5: Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - (iv) MSS SP-25: Marking System for Valves, Fittings, Flanges and Unions
 - (v) AWWA C504 (for gear actuators only): Rubber-Seated Butterfly Valves, 3 In. (75 mm) through 72 In. (1800 mm).

1.3 Submittals - Review

1.3.1 Provide catalogue cuts and/or shop drawings for each type of valve and actuator indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and maximum pull on actuator, and valve end configuration.

1.3.2 Provide valve pressure/temperature rating. For bidirectional valves provide rating for both sealing directions.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 1.3.3 For butterfly and globe valves provide headloss vs. percent open curves.
- 1.3.4 Canadian Registry Number (CRN) designated by the Province of British Columbia.
- 1.3.5 A copy of the specific valve specification sections marked to indicate with check marks where the valve supplied meets the specification and with written amendments with explanation where the product differs from the specification.
- 1.3.6 On piping submittals, indicate direction of sealing.
- 1.4 Submittals – For Operations and Maintenance Manuals
 - 1.4.1 Submit operation and maintenance data for incorporation into operation and Maintenance manual, including detailed exploded views, a complete numbered list of replacement and repair parts, and supplier and parts manufacturer's contact information.
- 1.5 Quality Assurance
 - 1.5.1 If a CRN is not available, provide a letter notarized in Canada and stating:
 - (a) The standard or code under which the valve was manufactured (ANSI, MSS, AWWA, etc.)
 - (b) If not stated under the code in Item (a), state the pressure/temperature rating of the valve body, seat, and all seals.
 - (c) The quality control program under which the valve was manufactured.
 - 1.5.2 Provide valves marked in accordance with MSS SP-25 for type, size, rating, and where applicable, direction of flow.
- 1.6 Delivery, Storage and Handling
 - 1.6.1 Deliver valves and unload at site using methods which do not damage casings, coatings or any valve or actuator parts.
 - 1.6.2 Clear tag each valve stating size, type, coatings and mating parts.
 - 1.6.3 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 Provide valves of the same type, size range and service from a single manufacturer.
 - 2.1.2 All valves to have true alignment or bores.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 2.1.3 Unless otherwise indicated on the Process and Instrumentation drawings valves shall be the same size as the pipe run in which they are to be installed.
- 2.1.4 Valves to open counter-clockwise.
- 2.1.5 The process drawings indicate major process valves required for the process to operate as intended. Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but is not shown in the drawings, inform the *Consultant* and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the *Consultant's* approval.
- 2.2 Valve Ends
 - 2.2.1 Valves less than 75 mm diameter shall have female threaded connections conforming to ANS B1.20.1. Valve sizes greater or equal to 75 mm shall have flanged connections to ANSI B16.1 or ANSI B16.5. Valves with grooved joint ends are not to be used without the written approval of the *Consultant*.
 - 2.2.2 Not used.
 - 2.2.3 Lug style water body valves shall have tapped holes.
- 2.3 Manual Lever or Handwheel Actuators
 - 2.3.1 Provide lever actuators for quarter turn valves. Operator to be perpendicular to the pipe run when the valve is closed.
 - 2.3.2 Provide lever operator for ball valves less than 150 mm diameter, butterfly valves less than 250 mm diameter, and plug valves less than 100 mm diameter, unless noted otherwise on drawings.
 - 2.3.3 Not used.
 - 2.3.4 Provide handwheel actuator for butterfly valves 250 mm and greater.
 - 2.3.5 Maximum pull on the end of the lever arm or at the rim of a handwheel not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. If greater force is required, provide a gear operator.
 - 2.3.6 Provide padlockable lockout feature on all control valves and manual isolation and shut-off valves.
 - 2.3.7 Provide valve stem extensions where additional clearance is required for pipe insulation or where operation without the extension is difficult.
 - 2.3.8 Minimum hand wheel diameter:
 - (a) 38 mm valve: 75 mm handwheel
 - (b) 50 mm valve: 85 mm handwheel

COMMON REQUIREMENTS FOR PROCESS VALVES

- (c) 250 mm valve: 400 mm handwheel
- 2.3.9 Minimum lever operator length:
 - (a) 25 mm valve: 125 mm lever
 - (b) 38 mm valve: 150 mm lever
 - (c) 50 mm valve: 150 mm lever
 - (d) 75 mm valve: 175 mm lever
 - (e) 100 mm valve: 225 mm lever
 - (f) 150 mm valve: 250 mm lever
 - (g) 200 mm valve: 300 mm lever
- 2.4 Manual Gear Actuators
 - 2.4.1 Provide manual gear actuators for valves not specified to have a manual lever or handwheel actuator.
 - 2.4.2 Gear operator to be worm gear type equipped with a non-rising stem handwheel and an integrated visual indicator of the valve position. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant recommended by the gear operator manufacturer for the specific application. Gear operators for direct bury or submergence to be manufactured in accordance with AWWA C504.
 - 2.4.3 Equip operators with mechanical stop-limiting devices to prevent over travel of the disc, ball or plug in the open and closed positions, self-locking to hold the valve in any intermediate position between full open and full closed. Actuator components between the input and the stop limiting device shall be designed to withstand, without damage, a rim pull of 890 N for a handwheel or chainwheel and an input torque of 400 N m for wrench nuts.
 - 2.4.4 Actuator shall provide 1.25 times required operating torque under full rated line pressure for direct bury or submergence applications, or for commodities with 2% or greater solids content; 1.0 times required operating torque under full rated line pressure in other applications.
 - 2.4.5 Maximum pull at rim of hand wheel with gear operator – 300 N.
 - 2.4.6 Manual operators for buried service valves to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures up to 700 kPa. Where angle valve stem extensions are employed, they shall be angle geared. Provide valve stem extension to surface with cast iron valve box, lid and rock plate.
 - 2.4.7 Actuator body to be exterior epoxy coated.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 2.4.8 Orientation of valve as per mechanical drawings or to allow for the greatest degree of hand wheel access.
- 2.4.9 For manual valves on pipes 75 mm and greater mounted over 2 m above the operating floor, provide chain wheel gear operators, sized so that a force of 150 N is sufficient to open the valve when one side of valve is at test pressure and the other side is at atmospheric pressure. Chain pulley to mesh positively with the chain. Extend chain from valve operator to 1.2 m above the operating floor or as directed by the *Consultant*, with exact dimensions field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.
- 2.5 Electric Actuators
 - 2.5.1 Not used.
- 2.6 Valve Identification
 - 2.6.1 Tag all valves using AISI 304 stainless steel tags with 12 mm high engraved letters and numbers. Fill numbers and letters with black paint. Attach tag to valve using a 304 stainless steel chain or braided wire. Inscription to include valve ID number from the Process and Instrumentation drawings, valve size in mm, manufacturer and model number.
- 2.7 Coating
 - 2.7.1 Coat all carbon steel, ductile iron and cast iron valves and actuators for corrosion protection.
 - 2.7.2 All valves and actuators to be provided with standard shop finish rated and warrantied for the intended service application.

3.0 EXECUTION

- 3.1 Preparation
 - 3.1.1 The valve and piping arrangement indicated on the drawings is based on typical dimensions for valves of the specified type. Make all necessary modifications in the *Work* to allow for discrepancies between the valve dimensions shown and those supplied for the *Work*, at no extra cost.
 - 3.1.2 Ensure that valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for automatic actuators.
 - 3.1.3 Ensure that valve location and orientation provides sufficient space for tightening of flange and valve nuts with a standard wrench.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 3.1.4 Ensure that valve actuators can operate without conflicting with other piping, equipment, structures or insulation. Do not cut insulation to allow valve actuators to operate. Where conflicts are identified, inform the *Consultant* and propose modifications. Do not commence work on the affected piping run until modifications are approved.
- 3.2 Installation
 - 3.2.1 Install all valves in accordance with manufacturer's instructions.
 - 3.2.2 In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball and plug valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.
 - 3.2.3 Mount butterfly valves and trunnion ball and plug valves with the shaft in a horizontal orientation. Plugs to rotate to top of pipe to open. Disks to swing up in direction of flow to open.
 - 3.2.4 Provide spool pieces between butterfly valves, swing check valves and fittings as required to allow for free disc movement.
 - 3.2.5 Do not over torque bolts to correct for misalignment.
 - 3.2.6 Support valves in position using temporary supports until valves are fixed in place.
 - 3.2.7 Not used.
 - 3.2.8 Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.
- 3.3 Coating
 - 3.3.1 Repair and damage to shop coating as recommended by valve manufacturer, including and not limited to:
 - (a) Steel brushing for removal of any rust
 - (b) Solvent cleaning of repair and surrounding area
 - (c) Priming coat
 - (d) Two coats of top coat
- 3.4 Testing
 - 3.4.1 All valves to be shop tested according to current applicable AWWA Standards and the standards under which the valves were manufactured.
 - 3.4.2 Operate valves under simulated and/or real process conditions to ensure valves operate as intended.

COMMON REQUIREMENTS FOR PROCESS VALVES

3.4.3 Pressure test valves in conjunction with the pipes in which the valves are installed.

END OF SECTION

KNIFE GATE VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to stainless steel knife gate valves from 100mm to 900mm diameter provided for the following commodities as identified on the *Drawings*.

(a) Raw Water (RAW)

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific design conditions for valves installed in piping identified in Section 40 05 24.23.

1.1.4 Related Requirements

(a) Section 40 05 01: Common Requirements for Process Piping Systems

(b) Section 40 05 51: Common Requirements for Process Valves

(c) Section 40 05 24.23: Steel Pipe For Bulk Material Conveyance

2.0 PRODUCTS

2.1 Acceptable manufacturers: Red Valve Series D Flexgate, Bray, Dezurik KSL-SD, or approved equal.

2.2 Valve shall be manufacturer rated for light to moderate slurry service.

2.3 Where applicable or shown on the *Drawings*, provide bevel gear style operator.

2.4 Valves to be resilient seated and bi-direction rated to 250 psi working pressure.

2.5 Provide valves as detailed below.

Component	Description
Body	Ductile iron, factory applied two part epoxy.
Valve Ends	Lugged style to ASME/ANSI B16.5 for flanged connections
Packing	Braided PTFE impregnated synthetic fiber
Gate	Type 316 stainless steel to ASTM A240
Gland	Carbon Steel or Ductile Iron
Sleeve	Natural rubber, Buna-N, or EPDM.
Yoke	Carbon Steel or Ductile Iron
Stem and Extension	8-18 stainless steel or as indicated on the drawings
Fasteners	Appropriate grade of stainless steel such as 18-8 for all rivets, grease fittings, nuts, bolts, screws, washers, caps etc.

KNIFE GATE VALVES

Bevel Gear Operator	Epoxy coated CI or DI housing, heavy duty hardened steel gears, EPDM seals, SS hardware and packed with grease.
Floor Boxes	Cast iron, fusion bonded epoxy coatings in and out.
Gearboxes	Gear boxes where applicable to be to of a heavy duty design, use epoxy coated cast iron housing and flanges, hardened steel gears, sleeves, shafts and bearings, stainless steel fasteners, nitrile rubber seals, grease packed with Renolit CL-X2, enclosure to be IP68 rated for continuous submergence in municipal secondary effluent.

3.0 EXECUTION

3.1 Not used.

END OF SECTION

METALLIC BALL VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to metallic ball valves 10 mm to 65 mm diameter as identified on the *Drawings*.

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

2.1.1 Manual Ball Valves: Bray Flow-Tek or approved equal

2.1.2 Electrically Actuated Ball Valves: Bray Flow-Tek, Series F15 or approved equal

2.2 Valves to be rated to 250 PSI.

2.3 Provide Manual Ball Valves as detailed below:

Component	Description
Body	304 or 316 stainless steel, full port, two piece, ASTM A351 CF8M
Valve Ends	NPT Female threaded ANSI B1.20.1
Coating	Not applicable
Lining	Not applicable
Ball	304 or 316 floating ball, ASTM A351 CF8M
Seats	Reinforced PTFE
Stem	316 SS, blow-out proof.
Packing	Reinforced PTFE
Actuator	304 or 316 SS locking lever handle, vinyl coated

3.0 EXECUTION

3.1 Not used.

END OF SECTION

BUTTERFLY VALVES

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to butterfly valves 100 mm to 750 mm diameter as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers and models:

2.1.1 In-Pump Station Butterfly Valve:

- (a) 150 mm – 450 mm: Bray, Series 31H-375N or approved equal
- (b) Electrically Actuated Butterfly Valve: Bray, Series 31-324N or approved equal

2.1.2 Submerged Applications:

- (a) Val-Matic (Reservoir)
- (b) Bray (Raw water pump station)

2.2 Valves to be rated to 250 PSI.

2.3 Provide In-Pump Station Butterfly Valves (150 mm – 450 mm) as detailed below:

Component	Description
Body	Ductile iron
Valve Ends	Lugged style, ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Disc	316 stainless steel
Seat	EPDM
Seals	EPDM
Seat Ring	Stainless steel

BUTTERFLY VALVES

Stem	416 stainless steel
Bolting	304 stainless steel
Operator	Gear operator and handwheel or as noted on the <i>Drawings</i> .

2.4 Electrically Actuated Butterfly Valves (300 mm to 450 mm) as detailed below:

Component	Description
Body	Ductile iron
Valve Ends	Lugged style, ANSI Class 125/150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Disc	316 stainless steel disc
Seat	EPDM, bonded
Seals	EPDM
Seat Ring	Stainless steel
Stem	416 stainless steel
Stem Packing	Vee-type
Bolting	304 stainless steel
Operator	Rotork IQT3 Series Electric Actuator (open/close service): Model: IQT Watertight enclosure: IEC529, IP68 (3m for 72 hours) NEMA 4, 4X, 6 double sealed enclosure Two conduit entries for terminal connections Integral controls: Open/Stop/Close, and Local/Remote Bluetooth non-intrusive commissioning LEDs showing Valve Open/Intermediate/Closed Temperature rating: - 30 °C to + 60 °C On-board data logger Absolute position sensing Declutchable manual override Duty cycle: 60 starts per hour, 15 minute run time Power rating: 208V/3ph/60Hz Control rating: 120 VAC

2.5 Provide Submerged Butterfly Valves as detailed below:

2.5.1 Wet Well – 600 mm:

Component	Description
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BUTTERFLY VALVES

Body	Ductile iron
Valve Ends	AWWA Class 150B flanged ends
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Disc	Ductile iron
Seat	Buna N
Seals	Buna N
Seat Ring	Stainless steel
Stem	Stainless steel
Stem Packing	Vee-type
Bolting	304 stainless steel
Operator	Extended Bonnet c/w handwheel. Handwheel to be 1.5 m above finished floor or as noted on the <i>Drawings</i> . Contractor to grout around valve riser to ensure leak proof seal with wet well slab.

3.0 EXECUTION

3.1 Not used.

END OF SECTION

CHECK VALVES

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to check valves 100 mm 600 mm diameter as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

- 2.1.1 Pump Style Check Valve:
 - (a) Water
 - (i) 75-300 mm: Val-Matic, Wafer Series 8800 (raw water pumps) or approved equal
- 2.1.2 Wet Well Inlet Check Valve: Tideflex, Series 35-1 Check Valve NSF-61 (Wet Well inlet)

CHECK VALVES

2.2 Provide 75 mm to 300 mm Water Pump Style Check Valves as detailed below:

Component	Description
Body	Ductile iron
Valve Ends	ANSI Class 150 flanged ends
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Seat	Buna-n
Disc	Silicon bronze (up to 30 mm), aluminium bronze (350 mm)
Spring, pins, thrust bearing	316 Stainless steel
Stabilization sphere	Buna-n
Pressure Rating	Rated to 250 PSI

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CHECK VALVES

CHECK VALVES

2.3 Provide 600 mm Duckbill Style Check Valves as detailed below:

Component	Description
Sleeve Material	EPDM
Certification	NSF 61
Clamps	304 stainless steel
Max. Back Pressure	12 PSI
Line Pressure	15 PSI

3.0 EXECUTION

3.1 Not used.

END OF SECTION

GLOBE VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to globe valves ranging in size from 75 mm to 400 mm as identified on the *Drawings*.

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

2.0 SPECIFIC DESIGN CONDITIONS FOR VALVES IDENTIFIED ON THE DRAWINGS. PRODUCTS

2.1 Acceptable manufacturers:

2.1.1 Pressure reducing and dual solenoid valves

(a) CLA-VAL

2.2 Valves to be rated to 250 PSI.

2.3 Provide Pressure Reducing/Sustaining Valves as detailed below (to be installed at the Chidley PRV):

Component	Description
Sizes	75 mm and 450 mm
Model	CLA-VAL 90-01KO
Body and cover	Ductile iron
Valve Ends	ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Diaphragm	EPDM
Accessories	Pilot strainer, open/close speed control, anti-cavitation trim
Pilot, tubing, seat assembly, anti-cavitation trim and fasteners	Stainless steel
Position indicator	Model X101
Set point	To be determined

GLOBE VALVES

2.4 Provide Dual Solenoid Valves as detailed below:

Component	Description
Sizes	100 mm and 450 mm
Model	CLA-VAL 390-02
Body and cover	Ductile iron
Valve Ends	ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Diaphragm	EPDM
Accessories	Pilot strainer, open/close speed control, anti-cavitation trim
Pilot, tubing, seat assembly, anti-cavitation trim and fasteners	Stainless steel
Options	Valves to come with CRD-34 electronic actuated pilot system to accept 4-20 mA input and output signal. Provide IP-68 enclosure. Refer to electrical drawings and specifications for additional details regarding power supply and control wiring.
Control	One valve to be designated lead and the other standby Lead valve to open and close based on Cousins Road Reservoir level Lead valve to modulate based on pressure or flow set point when filling the reservoir

3.0 EXECUTION

- 3.1 Install per manufacturer's recommendations.
- 3.2 Contractor must ensure that a CLA-VAL technician inspects the installed valves and assists with Commissioning. Contractor to allow for the CLA-VAL technician to complete a minimum of two trips at two days per trip.

END OF SECTION

PRESSURE RELIEF VALVE

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to plug valves 150 mm diameter as identified on the *Drawings*.

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

2.1.1 Pressure Relief Valves:

(a) 150 mm: Singer or approved equal

2.2 Valves to be rated to 250 PSI.

2.3 Provide Pressure Relief Valves as detailed below:

Component	Description
Body and cover	Ductile iron
Valve Ends	ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Diaphragm	Rolling style, EPDM
Accessories	Pilot strainer, open/close speed control, anti-cavitation trim
Pilot, tubing, seat assembly, anti-cavitation trim and fasteners	Stainless steel
Position indicator	Model X107
Set point	To be determined

3.0 EXECUTION

3.1 Not used.

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PRESSURE RELIEF VALVE

END OF SECTION

AIR VALVE

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to 25 mm to 75 mm diameter air valves as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

2.1.1 Air Valves:

- (a) Water Service - 25 mm to 75 mm – Vent-o-mat, model RBX

2.2 Valves to be rated to 175 PSI.

2.3 Provide Air Release Valves as detailed below:

Component	Description
Body and cover	Stainless steel
Function	Combination air release and air/vacuum
Float	HDPE
Seat	EPDM
O-rings	EPDM
Vent Pipe	Provide SS schedule 40 vent pipe per typical detail or as otherwise specified on the <i>Drawings</i> .

3.0 EXECUTION

3.1 Not used.

END OF SECTION

CHEMICAL PIPING, VALVES AND FITTINGS

1.0 GENERAL

- 1.1 These specifications apply to chemical related system piping, valves, fittings and appurtenances shown on all the Process and Instrumentation *Drawings* (P-Series) related to systems conveying:
 - 1.1.1 PACI Coagulant (ISOPAC)
 - 1.1.2 Sodium Hydroxide (50% stock solution concentration)
 - 1.1.3 Sodium hypochlorite (15% stock solution concentration)
 - 1.1.4 Polymer (mid-point filter aid and solids dewatering)
- 1.2 Reference Sections
 - 1.2.1 Section 40 05 01 – Common Requirements for Process Piping Systems
 - 1.2.2 Section 40 05 07 – Supports, Anchors, and Seismic Bracing for Process Piping
- 1.3 This section applies to all piping:
 - 1.3.1 Above ground;
 - 1.3.2 Piping located inside facilities.
- 1.4 Provide complete, fully tested and operational chemical system components and materials to meet requirements described herein and in complete accord with applicable codes and ordinances.
- 1.5 Provide true union connections for all fittings connecting to rigid piping and leak free connections for fittings connecting to tubing (e.g., ChemFlare™ or approved equivalent).
- 1.6 Submittals for Review
 - 1.6.1 Before fabrication, provide manufacturer data for each type of pipe material and for each fitting.
 - 1.6.2 Before fabrication, provide *Shop Drawings* for fabricated fittings.
 - 1.6.3 Before delivery to site provide manufacturer data for each valve, coupling, expansion joint, guide and appurtenance used to complete the *Work* covered in this section.
 - 1.6.4 *Shop Drawings*: *Shop Drawings* for all piping systems greater than 19mm diameter, shall be furnished prior to fabrication. Indicate in orthogonal and/or isometric drawings as required to furnish the assembly details, solvent weld joint placement, vents, drains, instrument connections, supports, anchors, and the provisions for thrust and seismic restraint as well as any other pertinent details.

CHEMICAL PIPING, VALVES AND FITTINGS

- 1.6.5 Do not commence *Work* on items requiring submittals until *Consultant's* review is complete.

2.0 PRODUCTS

2.1 Ball Valves

- 2.1.1 Ball valves locations and sizes shown on the *Drawings*.
- 2.1.2 Ensure that all valve materials including body, seal, seats, fasteners, etc. conform to the requirements summarized in 2.5 of this Section.
- 2.1.3 Ball valves for general chemical use shall be:
- (a) For PVC - socket ends for 65mm diameter and smaller and flanged ends for 75mm and larger.
 - (b) For Chemflare – To suit tubing.
- 2.1.4 Valve shall be full ported and rated for 1,035 kPag (150 psig).
- 2.1.5 Valves used for sodium hypochlorite systems shall be the vented type.
- 2.1.6 Valves shall be manufactured by Chemline, Hayward, PLAST-O-Matic, or approved equal.

2.2 Check and Foot Valves

- 2.2.1 Check valves locations and sizes shown on the *Drawings*.
- 2.2.2 Ensure that all check and foot valve materials conform to the chemical compatibility identified in 2.5 of this Section.
- 2.2.3 Check valves for general chemical use shall be:
- (a) For PVC - socket ends for 65mm diameter and smaller, and flanged ends for 75mm and larger.
 - (b) For Chemflare – To suit tubing.
- 2.2.4 Check valve shall be full ported and rated for 1,035 kPag (150psig).
- 2.2.5 Check valves shall be manufactured by Chemline, PLAST-O-Matic, or approved equal.

2.3 Injection Quills

- 2.3.1 Injection Quills shall be the retractable type, allowing the Quill assembly to be completely removed and serviced during system full operation with full gauge pressure in the main process piping.
- 2.3.2 Injection Quill assembly shall have a built-in check valve. Quill housing shall have a ball style isolation valve manufactured from stainless steel.

CHEMICAL PIPING, VALVES AND FITTINGS

- 2.3.3 Injection Quill body and all wetted parts shall be manufactured from materials per 2.5 of this section.
- 2.3.4 Unless otherwise specified, the quills shall utilize 25 mm diameter connections (12 mm tube) with the exception of the sodium hypochlorite injection quill which shall be 38 mm (25 mm tube). Injection quills shall be capable of dosing flow rates between 0 mL/min and 1,500 mL/min with the exception of the sodium hypochlorite quill which shall be capable of dosing flow rates between 0 mL/min and 4,500 mL/min.
- 2.3.5 Injection Quills shall be rated for a maximum operating pressure of 1,035kPag (150psig). Quill shall be connected to housing using a compression style connection. Safety chains manufactured from stainless steel shall also connect the Quill to the housing.
- 2.3.6 Injection Quill length shall be sized and manufacturer approved according to process pipe diameter (see Process *Drawings*) and target flow range per 2.3.4, and installed as per manufacturers recommendations.
- 2.3.7 Injection Quills shall have NPT male threaded or flanged connections. Use Teflon tape on threaded connection prior to installation.
- 2.3.8 Injection Quills shall be manufactured by SAF-T-Flo or approved equal.
- 2.4 Component Tagging and Identification
 - 2.4.1 Tag all valves and minor equipment with 304 stainless steel tags with 12 mm high engraved letters and numbers. Numbers and letters shall be filled with black paint. Inscription shall contain P&ID identification tag, size, model and manufacturer.
- 2.5 General Material Compatibility Requirements.
 - 2.5.1 Sodium Hypochlorite (15%): Use CPVC or PVC plastics, Viton seals and gaskets and Hastelloy alloy C-276 metals if required.
 - 2.5.2 PACI (Isopac) Coagulant: Use CPVC or PVC plastics, Viton A or teflon seals and gaskets and Hastelloy alloy B metals if required.
 - 2.5.3 Sodium Hydroxide (50%): Use PVC plastics, EPDM or teflon seals and gaskets.
 - 2.5.4 Polymers: Use PVC plastics, viton seals and gaskets.
- 2.6 Fittings, Joints and Piping:
 - 2.6.1 Provide fittings of the same material, size and wall thickness as the pipe.
 - 2.6.2 Chemical piping routing has not been shown on the layout *Drawings*. Submit *Shop Drawings* detailing alignment for approval prior to installation.

CHEMICAL PIPING, VALVES AND FITTINGS

- 2.6.3 Pipe shall be Chemflare PFA Tubing as manufactured by Chemline Plastics or Schedule 80 PVC as indicated on *Drawings*. Size as indicated on the *Drawings*.
- 2.6.4 PVC joints shall be socket joints except where flanges are indicated on the *Drawings*. Flanges shall be socket type.
- 2.6.5 Ensure that piping materials conform to the requirements summarized in 2.5 of this Section.
- 2.6.6 Schedule 80 CPVC materials shall be Type 4, Grade 1, conforming to ASTM D1784, ASTM F441/442, sockets and pressure rating to ASTM D2672. Solvent weld cement shall conform to ASTM F4933.
- (a) Use XIRTEC primer and XIRTEC 24 cement or approved equal.
- 2.6.7 For joints on plastic and thermoplastic pipe:
- (a) Permanent, no future disassembly required: Use socket welded joints.
- (b) Temporary, future disassembly required: Use flanged joints.
- 2.6.8 Provide flexible tubing where indicated on the Process *Drawings*. Use stainless steel braided over flexible tubing material that is compatible with the specific application. Refer to Section 2.5 for material requirements.
- 2.7 Pipe Colour Coding
- 2.7.1 Colour code all chemical piping. Colour coding shall conform with CGSB-24.3-92 standards. Colour coding shall consist of adhesive banding Adhesive bands to 50mm in width and two tone. Colour schedule as follows:
- | Description | Adhesive Banding Colour | Letter/Arrow Color |
|---------------------|---|--------------------|
| Sodium Hypochlorite | Yellow Background with Orange Centre Band | Black |
| Sodium Hydroxide | Yellow Background with Orange Centre Band | Black |
| PACI | Yellow Background with Orange Centre Band | Black |
| Polymers | Yellow Background with Orange Centre Band | Black |
- 2.7.2 Place flow arrows every 2.0m on centre. Adjacent to each flow arrow shall be 12mm high letters indicating the type of chemical being conveyed.
- 2.8 O-rings, seats and seals:
- 2.8.1 Internal component o-rings, seats, seals, etc. shall conform to chemical compatibility requirements outlined in Section 2.5.
- 2.9 Pipe Support Systems
- 2.9.1 Supply and install supports per Section 40 05 07.

CHEMICAL PIPING, VALVES AND FITTINGS

2.10 Back Pressure Valves

2.10.1 Back pressure valves locations and sizes shown on the *Drawings*.

2.10.2 Ensure that all materials conform to the chemical compatibility identified in 2.5 of this Section.

2.10.3 Back pressure valves for general chemical use shall be:

- (a) For PVC - socket ends for 65mm diameter and smaller, and flanged ends for 75mm and larger.
- (b) For Chemflare – To suit tubing.

2.10.4 Back pressure valve shall be full ported and rated for 1,035 kPag (150psig).

2.10.5 Back pressure valves shall be manufactured by Chemline, PLAST-O-Matic, or approved equal.

3.0 EXECUTION

3.1 Preparation

3.1.1 Prior to installation, inspect and field measure to ensure that previous *Work* is not prejudicial to the proper installation of piping.

3.1.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.

3.1.3 Advise the *Consultant* of all modifications. Do not commence *Work* on the related piping until the *Consultant's* approval has been received.

3.2 Pipe Handling

3.2.1 Each pipe and fitting shall be inspected prior to installation. Damaged pipe shall not be installed.

3.2.2 To ensure chemical contamination does not occur remove all foreign matter from inside of pipe prior to installation.

3.3 Conflicts

3.3.1 Confirm the routing of each section of pipework with the *Consultant* prior to commencement of installation. Advise the *Consultant* of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict, as approved by the *Consultant*.

3.4 Socket Welded Joints:

3.4.1 Install all piping and fittings as per manufacturer's recommendations.

3.4.2 Apply solvent weld primer then cement as per manufacturer's recommendations.

CHEMICAL PIPING, VALVES AND FITTINGS

- 3.4.3 Properly align all joints. All misaligned joints upon system inspection will require correction at the *Contractor's* expense.
 - 3.4.4 Allow manufacturer initial set time prior to handling joint. Carefully handle joint after initial setup. Allow for manufacturers recommended joint cure times before final installation or stressing pipe assembly.
- 3.5 Inspection
 - 3.5.1 The *Consultant* may use any method of inspection necessary to establish quality of the installation procedure.
 - 3.5.2 If equipment fails to meet the performance requirements, immediately make the necessary repairs, replacements, modifications and adjustments to ensure equipment functions as intended at no additional cost to *Owner*.
- 3.6 Interior Pipe Installation
 - 3.6.1 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag and stress.
 - 3.6.2 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.
 - 3.6.3 Accurately cut all piping for fabrication to field measurements.
 - 3.6.4 Pipes shall be installed in straight alignment. Variance from the true alignment shall not exceed 10mm in any direction. Pipe runs shall be fabricated and assembled to ensure that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment shall not be permitted. The *Contractor* shall undo and subsequently remake all pipework connections where so instructed by the *Consultant* to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.
 - 3.6.5 Do not cut or weaken the building structure to facilitate installation.
 - 3.6.6 Provide readily disassembled joint at 150 mm of either side of wall or floor penetration unless shown otherwise.
- 3.7 Pipe Through Walls and Floors
 - 3.7.1 Provide PVC sleeving through wall or floor slabs. Fill space between conveyance piping and sleeve with expandable foam. Ensure filling product is compatible with piping material.
 - 3.7.2 Co-operate with other divisions to locate and place sleeves or cast-in-place pipe sections prior to the construction of concrete and masonry building elements.
- 3.8 Valves

CHEMICAL PIPING, VALVES AND FITTINGS

- 3.8.1 Tag all valves as per the P&ID (I-Series *Drawings*) numbering. Include valve size, manufacturer and model.
- 3.8.2 Orient valves as per mechanical *Drawings* or to allow for the greatest degree of operator access.
- 3.8.3 Field test all valves as per manufactures recommendations. Test for correct valve function and actuation as well as pressure testing as part of the pipeline system.
- 3.9 Pressure Testing
 - 3.8.4 Give *Consultant* 24 hours notice of testing.
 - 3.8.5 Do not insulate or otherwise conceal *Work* until piping systems are tested and accepted.
 - 3.8.6 Supply all water required for pressure testing.
 - 3.8.7 Supply all pumps, compressors, gauges, etc. required for testing.
 - 3.8.8 Cap or plug all lines which are normally open ended. Remove on completion of testing.
 - 3.8.9 Isolate all low pressure equipment and valves during testing so as not to place any excess pressure on the operating equipment.
 - 3.8.10 Where defective material or equipment is identified, repair or replace using new material.
 - 3.8.11 Flush, drain and dry chemical lines with compressed air after pressure tests.
- 3.10 Pressure Testing of Chemical Lines
 - 3.8.12 All proposed pressure piping that is to convey liquid chemical shall be hydrostatically pressure tested.
 - 3.8.13 *Contractor* must provide any additional piping support required for the additional testing loads if using liquid to pressure test air lines. Test duration for air piping is four hours.
 - 3.8.14 Perform hydrostatic pressure and leakage testing of above ground piping as follows:
 - (a) All pressure testing shall be done in the presence of the *Consultant*.
 - (b) The duration of the test shall be 2 hrs.
 - (c) Prior to hydrostatic testing, all water retaining structures, pipework and conducts shall be thoroughly cleaned.
 - (d) If required, safety relief valves shall be supplied with test gags for hydrostatic testing purposes. Upon completion of testing, the gags shall be

CHEMICAL PIPING, VALVES AND FITTINGS

removed and the system shall be repressed to the relieving pressure of the relief valves to ensure proper valve operation.

- (e) Test pressure shall be a 690 kPa (100 PSI).
- (f) Maintain system pressure to within ± 2.0 kPa of test pressure throughout the duration of the test without the addition of make-up water.
- (g) Visually inspect all joints and flanges. There should be no visual evidence of leakage throughout the duration of test. Zero leakage is required.

END OF SECTION

COMMISSIONING OF PROCESS SYSTEMS

1.0 GENERAL

1.1 Description

- 1.1.1 The Work includes the provision of all necessary testing, calibration, and installation verification, for each component, equipment, instrumentation, etc. Once verification that all components, equipment instrumentation, etc. are functioning as intended, the *Contractor* shall commence with commissioning and start-up activities as specified herein.
- 1.1.2 Testing of the components, equipment, instrumentation and control equipment shall be coordinated.
- 1.1.3 Provide a coordinated commissioning and start-up program to the *Owner* and *Consultant* for approval at least two and a half weeks in advance of any activities. A minimum of two weeks' notice shall be provided by the *Contractor* to the *Owner* and *Consultant* prior to any Commissioning and Start-Up activities. Activities shall only commence once the Commissioning and Start-Up Plan has been approved by the *Owner* and *Consultant*.
- 1.1.4 Commissioning and start-up shall be performed in cooperation with the *Consultant* and include verification of all of the systems (operation) described herein after their installation is completed. Cooperation will be required to facilitate the timely performance of these activities and under the direction of the *Consultant*. The *Contractor* will coordinate and schedule all activities associated with commissioning and start-up, and shall cooperate and arrange the commission schedule to facilitate the timely performance and completion of this work. Start-up activities shall be conducted for at least <INSERT NUMBER> consecutive days.

2.0 PRODUCTS

- 2.1 Not Applicable

3.0 EXECUTION

3.1 Testing

- 3.1.1 Prior to the completion of the Work, perform comprehensive testing of all installed equipment, components, instrumentation, etc. Include the following activities:
 - (a) Pressure testing of components and piping.
 - (b) Flow and pressure validation of all liquid pumps including chemical dosing pumps.
 - (c) Performance testing of all equipment including but not limited to process and chemical pumps, pressure reducing/sustaining valve assemblies, flow

COMMISSIONING OF PROCESS SYSTEMS

control valve assemblies, chemical storage equipment, instrumentation, ,
etc.

- (d) Test and calibrate all instrumentation to ensure proper functionality. Refer to Division 26 for further requirements.
- (e) Demonstrate that all components, equipment and instrumentation are working as intended.

3.1.2 If required, provide the services of a manufacturer's representative for equipment to assist with any of the equipment tests to be performed. Any components, or systems found to be defective or deficient during the tests shall be repaired or replaced.

3.1.3 Coordinate test schedules with the *Consultant*.

3.1.4 The participation in testing activities and the use of the equipment during testing periods by the *Owner* is to be allowed provided it does not adversely affect specified testing requirements. Such participation shall not relieve the *Contractor* of any of the obligations stipulated herein.

3.1.5 Prior to the commencement of any testing, the *Contractor* shall ensure that all spare parts, expendables, and test equipment pertinent to the system being tested are on site.

3.1.6 Test equipment shall include all necessary pumps, gauges, meters, process instrument calibrators for 4-20 mA, 24 VDC devices and signal generators or simulators. Test equipment shall be provided by the *Contractor* and shall remain the property of the *Contractor* at the end of all testing.

3.2 Calibration

3.2.1 In situ, calibrate and adjust all components, equipment and instrumentation to verify correct operation, range adjustment, compensation, scaling, etc. Where required, provide instrument calibration services for all individual components such as signal transmitters, analyzers, transducers, power supplies, and like equipment where appropriate.

3.2.2 Provide certified calibration reports for each component, equipment and instrument. In the reports, include, but do not limit to, such information as:

- (a) Device tag number
- (b) Equipment descriptions
- (c) Service applications
- (d) Flow and pressure validation (if applicable).
- (e) Process variable measurement range

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- (f) Description of calibration equipment used
 - (g) Date, name, and signature of technician
- 3.2.3 Include calibration reports in the operating and maintenance manuals.
- 3.3 Installation Verification
 - 3.3.1 When the system installation has been completed (or part thereof), perform detailed verification checks for all sub systems supplied and installed as part of the Work. In the checks and reviews, include the following:
 - (a) Certify that the equipment, components and instrumentation has been installed as per the *Contract Drawings* and Manufacturer recommended installation procedures, reporting any discrepancies to the *Consultant*.
 - (b) Certify that the equipment, components and instrumentation power and grounding requirements have been satisfied, reporting any discrepancies to the *Consultant*.
 - (c) Certify that the installation (or part thereof as completed) is ready for commissioning and start-up.
 - (d) Witnessed Functional Acceptance Test shall be done on the complete control system.
 - 3.3.2 Undertake any corrective action found to be necessary during the course of the verification checkout and review.
 - (a) Report any discoveries of defects or deficiencies in writing to the *Consultant* for any equipment supplied by the Owner.
 - (b) Allow for the participation of the *Owner's* personnel in the verification checks. Such participation shall not relieve the *Contractor* of any of the obligations.
 - (c) Prepare the various reports and certificates described herein. Forward three (3) copies of each report or certificate to the *Consultant*. Clearly identify any discrepancies which require action on the part of the *Consultant*.
- 3.4 Commissioning and Start-Up
 - 3.4.1 Prior to commissioning and start-up activities, a series of operational tests will be performed by the *Contractor*, including, but not be limited to:
 - (a) Verification that all major equipment is installed and functioning as intended, including but not limited to pumps, valves, actuators, filters, instrumentation, etc.

COMMISSIONING OF PROCESS SYSTEMS

- (b) Perform testing of each subsystem. Upon confirmation that subsystems are functioning correctly perform testing of entire system.
 - (c) Complete any corrective action necessary that has been identified as part of the checkout procedure, on an ongoing basis.
- 3.4.2 Conduct final verification of commissioning of all systems through actual operation of the various parts of the process as determined by the *Owner* and the *Consultant*.
- 3.4.3 Coordinate work with supplier and Manufacturer representative and verify that their equipment and control systems are operating as part of the overall control system.
- 3.4.4 System commissioning will be considered complete when, in the opinion of the Consultant, the entire system has properly operated for seven (7) continuous days, 24 hours per day without interruption. This 7-day period is in addition to any test periods or operational demonstrations specified elsewhere. The objective will have been achieved once it has been demonstrated that all systems are operating and have complied with the specified performance requirements herein.

END OF SECTION

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

1. GENERAL

1.1 INTENT

- .1 The work in this section to include, but not necessarily be limited to the following:
 - .1 Supply, installation, connection and calibration of all instruments as listed in Division 40.
 - .2 Valves, flow meters and other in-line instruments supplied and connected in this section to be installed in Division 40.
 - .3 Shipment of instrumentation components to the control and instrument panel manufacturer where applicable.
 - .4 Supply, installation and connections of all cable, conduit and wiring for the control and instrumentation systems.
 - .5 Supply, installation and connection of control panels.
 - .6 Installation and connection of Programmable Logic Controller.

1.2 INSTRUMENT SUB-CONTRACTORS

- .1 The work as specified in this Section to be performed by a qualified control and instrumentation sub-contractor.

1.3 SHOP DRAWINGS

- .1 Submit the following items:
 - .1 Field Instruments listed in Division 40.
 - .2 Uninterruptible Power Supply.
 - .3 Control Panels.
 - .4 Control Relays.
 - .5 Rail-Mount Terminals.
 - .6 Rail-Mount Breakers
- .2 Shop drawings to indicate (where applicable):
 - .1 Instrument tag numbers(s).
 - .2 Available range.
 - .3 Materials of construction.
 - .4 Wetted materials.
 - .5 Accuracy.

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- .6 Rating of enclosure.
- .7 Other details listed on the Instrument Specification Sheet

2. PRODUCTS

2.1 CALIBRATION

- .1 Prior to start-up, submit to Owner representative calibration sheets for instrument which is adjustable indicating the setpoint(s) and by whom the calibration was performed.
- .2 For micro-processor based instruments in which parameters must be entered as part of configuring or calibration, list all the values entered.
- .3 List the settings of all DIP-switches, jumpers, etc.

2.2 SPARE PARTS

- .1 Provide the following spare parts:
 - .1 Five bulbs of each type used.
 - .2 Ten fuses of each type and rating used.
 - .3 Two control relays of each type used.
 - .4 Two rail-mount circuit breakers of each type used.
 - .5 Two push-button and selector switch contact blocks to each type used.

3. EXECUTION

3.1 INSTRUMENT TAGGING

- .1 Provide each instrument with a tag stamped or engraved with the Instrument number.
- .2 Tags to be brass, stainless steel or laminated plastic.
- .3 Affix tags to instruments with stranded stainless steel wire or adhesive. Do not use adhesive on curved surfaces.

3.2 MANUFACTURER'S REPRESENTATIVE

- .1 Where indicated, retain the services of the instrument representative to inspect the installation of the instrument and to calibrate and configure it.

3.3 START-UP

- .1 Upon completion of work, all circuits are to be operational and all instruments operating within manufacturer's specifications.

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- .2 Prior to notifying Owner representative to start-up system, check all correctness, verify all PLC inputs, and outputs, and complete Record Drawings as described in this section.
- .3 Electrical controls, circuits and systems shall be tested by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates in accordance with the contract drawings and the description of operation for the equipment. Where field conditions prevent actual equipment functioning during testing, the contractor shall simulate the intended operating condition in the associated control circuits.
- .4 The contractor shall locate the cause of any malfunction and make the necessary wiring and / or equipment changes or corrections to obtain the particular systems intended operation as defined by the contract drawings. Such changes shall be included in the test report.
- .5 Control Panels shall be operated through all design functions. This shall include remote operation of all equipment and actuation of alarms and indicating devices according to design requirements.
- .6 Complete operation tests shall be given to all relays, and control devices to show that the equipment performs all design functions and meets design and procurement specifications.
- .7 During start-up, assist Owner's Representative in debugging system operation and correct any deficiencies and omissions which appear.

3.4 RECORD REPORTS

- .1 During each of the aforementioned tests, the electrical contractor shall maintain a comprehensive set of test reports defining the specific condition in which the apparatus is left, after it has been given approval for use in its intended service. The completed report shall become the property of the Owner.
- .2 A check list type report for each individual item of major electrical equipment should be headed with but not limited to the following identification data, defining:
 - .1 Equipment Name.
 - .2 Item Tag Number.
 - .3 Manufacturer.
 - .4 Type of Class.
 - .5 Application.
 - .6 Plant Location.
 - .7 Voltage Rating.
 - .8 Date of Test.
 - .9 Ambient Conditions.

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- .10 Testers Signature.
- .3 Among the specific requirements of testing to determine the equipment's operation condition relative to that particular apparatus, all items shall be visually inspected and evaluated on the report as to its general condition both exterior and interior.
- .4 Unless otherwise directed by Owner's Representative, the forms used for testing shall be those, which are available by the particular equipment's manufacture

END OF SECTION

PROCESS MEASUREMENT DEVICES

1. GENERAL

1.1 INTENT

- .1 All field instruments required including:
 - .1 Radar Level Transmitters
 - .2 Float Level Switches
 - .3 Temperature Sensors
 - .4 Humidity Sensor
 - .5 Conductivity level switches
 - .6 Smoke Detectors
 - .7 Door Contacts

1.2 RELATED SECTIONS

- .1 Division 23 – Mechanical, all sections
- .2 Division 26 – Electrical, all sections

1.3 UNIFORMITY OF INSTRUMENTS

- .1 Instruments of one manufacturer to be used throughout to the extent practical. Variations will be permitted only where the major supplier cannot supply a particular instrument as specified.
- .2 Note that where the specifications specify a variety of instrument manufacturers, these are to establish standards of quality.
- .3 All instruments must be CSA approved and meet all applicable industry standards and codes.

1.4 DRAWINGS AND DESIGN

- .1 The drawings are intended to show the major details of the controls and instrumentation work but it is the Contractor's responsibility to examine the electrical, mechanical, structural and architectural drawings before beginning the work and report to the Owner's Representative any discrepancies or interferences which may occur.
- .2 Control and instrumentation system layouts shown on the drawings are generally diagrammatic and the locations of equipment are approximate. Exact routing of conduits, cables, wiring, tubing and air headers to be governed by the mechanical, structural and architectural conditions which prevail.

PROCESS MEASUREMENT DEVICES

- .3 The Owner's Representative reserves the right to change the location of any piece of equipment without extra payment therefore, providing only that the change is requested before installation and that the new location is within 1.5 meters of the original location.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings.
- .2 Indicate:
 - .1 Instrument manufacturer's name, type, model, year, and serial number.
 - .2 The manufacturer's specifications for each instrument.
 - .3 Outline and arrangement drawings.
 - .4 Cross-sectional drawings.
 - .5 Materials of construction.
 - .6 Available range and accuracy.
 - .7 All other pertinent product information and data.

1.6 OPERATION & MAINTENANCE DATA

- .1 Provide operating & maintenance data for incorporation into the Operation and Maintenance Manual.
- .2 Data to Include:
 - .1 Manufacturer's name, type, model year, capacity and serial number.
 - .2 Details on operation, servicing and maintenance.
 - .3 As-built wiring diagrams.
 - .4 Available range, accuracy and rating information of instrument.

2. PRODUCTS

2.1 GENERAL

- .1 Manufacturer and Supplier:
 - .1 All instruments shall be of a manufacturer/supplier with service facilities in Alberta.

PROCESS MEASUREMENT DEVICES

- .2 Serial Numbers and Nameplates:
 - .1 Each piece of equipment shall be stamped with a serial number, prior to shop performance testing.
 - .2 Each piece of equipment shall be provided with a substantial steel or brass nameplate attached to the unit, clearly inscribed with the manufacturer's name, year of manufacture and the principal rating data.
- .3 Painting:
 - .1 Paint all equipment where applicable to appropriate sections in Division 09.
- .4 Instrument Description:
 - .1 All instruments are given a description "Tag #". The Tag # refers to the description relative to the P & I drawings and mechanical drawings for reference.

2.2 RADAR LEVEL TRANSMITTERS

- .1 Applicable Equipment: LT 710, LT 720
- .2 Liquid Type:
 - LT 710: Potable Water
 - LT 720: Sewage
- .3 Location:
 - LT 710: Potable Water Storage Tank
 - LT 720: Septic Tank
- .4 Mounting: As per manufacturer's requirements and as indicated on drawings.
- .5 Specified Equipment:
 - .1 Manufacturer: Vega or approved equivalent
 - .2 Model: C21
 - .3 Type: Radar W-band 80 GHz
 - .4 Range: 20 meters
 - .5 Accuracy: +/- 2 mm
 - .6 Enclosure: NEMA 4X
 - .7 Connections: NPT
 - .8 Power: Loop powered 24 VDC
 - .9 Output: 4-20mADC, HART
 - .10 Cable: Molded Polyurethane Jacket
 - .11 Cable Length: As required to accommodate mounting depth.
- .6 Measurement Range: 0-3.0 m.
- .7 Accessories:
 - .1 Provide aluminum brackets to mount radar transmitter below access hatch of above ground reservoir.
 - .2 Alternative Manufacturer: Endress & Hauser

PROCESS MEASUREMENT DEVICES

2.3 FLOAT LEVEL SWITCHES

- .1 Applicable Equipment: LSLL 710, LSHH 720.
- .2 Liquid Type:
 - .1 LSLL 710: Potable Water.
 - .2 LSHH 720: Sewage.
- .3 Location:
 - .1 LSLL 710: Potable Water Tank.
 - .2 LSHH 720: Septic Tank.
- .4 Specified Equipment LSLL 710:
 - .1 Manufacturer: SJE Rhombus.
 - .2 Model: Pump Master.
 - .3 Type: Liquid level regulator.
 - .4 Output: to PLC.
- .5 Specified Equipment LSHH 720:
 - .1 Manufacturer: Flygt or equivalent.
 - .2 Model: ENH-10.
 - .3 Type: Liquid level regulator.
 - .4 Output: to PLC.
- .6 Accessories:
 - .1 Appropriately sized weights as required.
 - .2 Cable as required.
- .7 Mounting: As per manufacturer's requirements.

2.4 TEMPERATURE SENSORS

- .1 Applicable Equipment: TE 790, TE 791.
- .2 Type: RTD Sensor.

PROCESS MEASUREMENT DEVICES

- .3 Location:
 - .1 TE 790: Pump Room.
 - .2 TT 791: Mech/Elect Room.
- .4 Specified Equipment:
 - .1 Supplier: WIKA Instruments LTD
 - .2 Model: Drawing No. ATS-17932-sheet no.1
 - .3 Type: Wall mount NEMA 4
 - .4 Electrical connection: ¾"NPT
 - .5 Output: 4-20mADC c/w HART

2.5 HUMIDITY SENSOR

- .1 Applicable Equipment: AT 797
- .2 Equipment: Wall mount Humidity Sensor.
- .3 Operating voltage: 24 VDC 4- 20 mA
- .4 Location: Wall near control panel
- .5 Manufacturer: Honeywell H7635C

2.6 CONDUCTIVITY LEVEL SWITCHES

- .1 Applicable Equipment: LSH 780
- .2 Liquid Type: Raw Water
- .3 Location: Pump Station
- .4 Specified Equipment:
 - .1 Manufacturer: Ametek B/W Controls
 - .2 Type: Shielded Wire Suspension Electrodes
 - .3 Holder: Cord Grip
 - .4 Wetted Parts Material: Stainless Steel
 - .5 Relay Power: 120 VAC
 - .6 Relay Type: High Level Alarm
 - .7 Relay Mounting: Standard 8 pin octal base
 - .8 Part Numbers:
 - .1 Electrodes: 6013-W6 (Quantity 2 per installation).
 - .2 Wire: 6013-SW-[length in feet as required].
 - .3 Cord Grip Electrode Holders: 6012-CG2.
 - .4 Relay: 5400-A-L1.

PROCESS MEASUREMENT DEVICES

- .5 Relay Base: 5400-SR.
- .6 Mounting: As per manufacturer's requirements.

2.7 SMOKE DETECTORS

- .1 Applicable Equipment: ASH 761, ASH 762, ASH 763, ASH 764
 - .1 Equipment: Smoke Detector.
 - .2 Location: Ceiling height, and as indicated on drawings.
 - .1 ASH 761: Pump Room Northwest.
 - .2 ASH 762: Pump Room Northeast.
 - .3 ASH 763: Pump Room South.
 - .4 ASH 764: Mech/Elect Room.
 - .5 ASH 765: Washroom.
 - .3 Operation: Capable of detecting products of combustion, unaffected by change in temperature, humidity, and pressure.
 - .4 Type: Plug-in photoelectric smoke detector with fixed temperature heat sensor.
 - .5 Electrical: Power 24VDC c/w relay contacts for remote monitoring.
 - .6 Approved Products: System Sensor i3 Series Model C4WTR-BA.

2.8 DOOR CONTACTS

- .1 Applicable Equipment: ZSC 752, ZSC 753, ZSC 754, ZSC 755.
- .2 Equipment: Magnetic door contact.
- .3 Location:
 - ZSC 752: Pump Room Overhead Door.
 - ZSC 753: Pump Room Mandoor East.
 - ZSC 754: Pump Room Mandoor West.
 - ZSC 755: Mechanical/Electrical Room Mandoor.
- .4 Specified Equipment:
 - .1 Manufacturer: GRI- George Risk Industries Inc
 - .2 Model: 4402- standard
 - .3 Switch Type: SPDT 30VDC
 - .4 Connection: Unit c/w jacketed cable and flying leads
 - .5 Operation: Contact close on opening of door

3. EXECUTION

3.1 INSTALLATION

PROCESS MEASUREMENT DEVICES

- .1 The Contractor to be responsible for the correct installation and assemble of all items of equipment. Manufacturer's instructions to be carefully read and rigidly adhered to in the installation.
- .2 Any damage resulting from failure to observe the installation instruction or as a result of proceeding without sufficient knowledge of proper installations techniques will be the Contractor's responsibility.
- .3 Mounting of Instruments & Accessories:
 - .1 Instruments to be installed in accordance with the drawings. Instruments shall be rigidly supported, level and plumb, and in such a manner as to provide accessibility, protection from damage, isolation from heat, shock and vibration, and freedom from interference with other equipment, piping and electrical work.
 - .2 Instruments not to be installed until heavy construction work adjacent to the instruments has been completed.
 - .3 Instruments devices, including accessories, to be located where they will be accessible from structural platforms, permanent ladders, or grade. Locally mounted indicating instruments to face toward and within reading distance of a normal operating area.
 - .4 Sufficient clearance to be allowed for removal of equipment for maintenance and repair.
 - .5 Field located instruments to be mounted on building columns and walls or pipe stands and/or other means of support as required in accordance with manufacturer's instructions and the Contract Drawings.

3.2 TESTING, ADJUSTING AND COMMISSIONING

- .1 Testing, adjusting and commissioning of all instruments shall be in accordance with Section 40 90 00.

END OF SECTION

PROCESS CONTROL HARDWARE

1. GENERAL

- .1 Not Applicable.

2. PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS AND COMPUTER EQUIPMENT

- .1 Provide PLC, HMI, and miscellaneous equipment as per control system drawings.

3. EXECUTION

3.1 INSTALLATION

- .1 Contractor is responsible for installation, wiring, testing, and assisting the Owner's Representative in commissioning of all PLC equipment, HMIs and communication equipment.
- .2 Contractor shall supply and deliver to the Owner's Representative any of the products identified herein for the purpose of programming. The Owner's Representative will advise the contractor when and which items will be required on a later date. The contractor will pay all costs associated with handling, extended warranties, etc.
- .3 The Contractor to be responsible for the correct installation and assemble of all items of equipment. Manufacturer's instructions to be carefully read and rigidly adhered to in the installation.
- .4 Provide weather proof installation for all exterior installation.
- .5 The contractor shall supply and install all materials for a complete and operational system.

3.2 PROGRAMMING

- .1 Programming and commissioning of the control hardware (Programmable Logic Controller [PLC] and Human Machine Interface [HMI]) will be performed by the Owner's representative. The contractor will carry an allowance for this work. Invoices for the work will be issued to the Contractor for payment. Contractor will not mark up invoices. As this work is not completed by, nor involves suppliers and/or subcontractors, the Contractor shall not retain a 10% Lien Holdback relative to this work.
- .2 Prior to the Owner's representative coming to site process control system commissioning, the Contractor is to submit documentation to the Owner confirming that the facility and all equipment is ready for commissioning. The Contractor shall submit paperwork confirming the equipment has been energized, all equipment has been wired and all wiring has been loop checked, the correct spans have been inputted into the instrumentation and that the facility is ready for commissioning. If the Contractor requests the owner's representative

PROCESS CONTROL HARDWARE

to be on site, and the station is not ready for commissioning, the Owner reserves the right to charge the Contractor for the representative's time.

3.3 SOFTWARE

- .1 Software required for the control system integration will be provided by the Owner's representative. The contractor will carry an allowance for this work. Invoices for the work will be issued to the Contractor for payment. Contractor will not mark up invoices. As this work is not completed by, nor involves suppliers and/or subcontractors, the Contractor shall not retain a 10% Lien Holdback relative to this work.

END OF SECTION

INSTRUMENT CONTROL PANEL

1. GENERAL

- .1 Not Applicable.

2. PRODUCTS

2.1 CONSTRUCTION

- .1 As per Control Panel Bill of Materials.

2.2 TERMINALS

- .1 As per Control Panel Bill of Materials.

2.3 LABELING

- .1 Each terminal to be labeled with snap on plastic tags, as per Control cabinet's bill of Materials, machine-printed.
- .2 All panel-mounted devices to be labelled by means of engraved lamacoid labels, white lettering on black.
- .3 Write on labels are not acceptable.

2.4 CONTROL RELAYS

- .1 Control relays to be rail mounted, with built-in LED or neon operation indicator, varistor protection, coil voltage as required, CSA approved.
- .2 Contacts to switch 10A 120/240V AC inductive or resistive.
- .3 Operating times to be 20 mS max for AC coil, 30 mS max for DC coil.
- .4 Life expectancy to be 100 000 operations @ 10A 120/240V AC.
- .5 Relays to be Phoenix Contact.

2.5 TIME-DELAY RELAYS

- .1 Time-delay relays to be installed in socket, with manually-adjustable timing via knob with dial, output status light, operating voltage as required, ON-delay or OFF-delay time as indicated, CSA approved.
- .2 Contacts to switch 5A 120/240V AC inductive or resistive.
- .3 Life expectancy to be 100 000 operations @ 2A 120/240V AC.
- .4 All relays to be OMRON type H3BH, H3G, H3CA, or H3CR or approved alternative.

2.6 PILOT LIGHTS

- .1 Water and dust-proof with internal Gasket, jeweled lens, color as shown on drawings, bulb voltage 120VAC.

INSTRUMENT CONTROL PANEL

- .2 Lights to be the following:
 - .1 Allen-Bradley 800T LED 'push to test' model.

2.7 PUSH BUTTONS

- .1 Water and dust-proof with internal Gasket, flush head, contacts rated 5A 20/240 VAC, accepting AWG 18-12 wires, removable contact blocs.
- .2 Push buttons to be the following:
 - .1 Allen-Bradley 800T.

2.8 SELECTOR SWITCHES

- .1 Manual selector switches to be Water and dust-proof with internal Gasket, standard black lever actuator, Maintained position unless indicated, contacts rated 5A 120/240 VAC, accepting AWG 18-12 wires, removable contact blocks.
- .2 Selector switches to be one of following:
 - .1 Allen-Bradley 800T.

2.9 WIRE DUCTS

- .1 Use Panduit or equivalent plastic type.
- .2 Wiring not installed in wire ducts are to be neatly bundled and secured with wrap around spiral banding, secured with cable ties and mounting bases.

2.10 POWER SUPPLY 24VDC

- .1 As per Control Panel Bill of Materials.

END OF SECTION

INSTRUMENT WIRING

1. GENERAL

- .1 Not Applicable.

2. PRODUCTS

2.1 WIRE AND CABLE

- .1 Wire for 120 VAC control signals to be as specified in Division 26, except that control wiring within cabinets shall be AWG 16 stranded copper.
- .2 Colour code all control wires as follows:
- | | |
|----------------|--------|
| 120VAC Hot | Black |
| 120VAC Neutral | White |
| 24VAC Hot | Brown |
| 24VAC Neutral | White |
| 24VDC Positive | Red |
| 24VDC Negative | Blue |
| 12VDC Positive | Orange |
| 12VDC Negative | Yellow |
| GROUND | Green |
- .3 Wire for 24 VDC analog instrument signals to be stranded copper, AWG 18, twisted pair, individual or overall foil shield, 300V rating.

3. EXECUTION

3.1 TERMINATION OF CONDUCTORS

- .1 Where spares conductors are pulled into an instrument, junction box or control panel the conductors shall be left long enough to reach anywhere within the enclosure. The spare conductors shall be labeled with cable destination and tied back.

3.2 CABLE LABELING

- .1 Label each cable where it enters a panel or instrument with machine-printed heat shrink tag.
- .2 Write on labels are not acceptable.

3.3 CONDUCTOR LABELING

INSTRUMENT WIRING

- .1 Conductors to be labeled at each end by slip-on plastic tags Wieland type Z5 or Weidmuller type Z or by machine-printed heat-shrink labels.
- .2 Write-on labels and wrap around machine-printed labels are not acceptable.

3.4 CONTROL CABLE SHIELD TREATMENT

- .1 Where drain wire is to be isolated, trim foil and drain wire flush with jacket and apply minimum 20 mm opaque heat shrink centered over the end of jacket.
- .2 Where drain wire is to be terminated, trim foil flush with jacket. Apply transparent heat shrink over exposed length of drain wire. Apply minimum 20 mm opaque heat shrink centered over end of jacket/foil.
- .3 Where shield drains are grounded at the control panel then these are to be commoned together on an isolated instrument ground with a single connection to the electrical safety ground.

END OF SECTION

**DIVISION 43 – PROCESS GAS AND LIQUID
HANDLING, PURIFICATION AND STORAGE
EQUIPMENT**

SUBMERSIBLE SUMP PUMP

1.0 GENERAL

- 1.1 Section 43 21 39 refers to those portions of the *Work* that are unique to the supply and installation of submersible sump pumps. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Intent
 - .1 Provide complete, fully tested and operational pump systems to meet requirements described herein and in complete accordance with applicable codes and ordinances.
 - .2 *Contract Documents* of this Division and *Process Drawings* are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
 - .3 Uncrate equipment, move in place and install complete; start up and test.
- 1.3 Submittals
 - .1 *Shop Drawings*: Contractor shall provide *Shop Drawings* which are to include: dimensions, parts list, materials of construction and motor data.
 - .2 Operating/Maintenance Manuals: Provide manuals per Section 01 33 00.
 - .3 Record Drawings: Provide drawings as per Section 01 33 00

2.0 PRODUCTS

- 2.1 Pump Selection
 - .1 Submersible Sump Pumps
 - .1 Pump shall be capable of delivering 2 L/s at 6.0 m TDH For the WTP Tie ins, and 6 L/s at 15m TDH For the midline PS.
 - .2 Pump shall be manufactured by ECOFLO, model SPP50W or approved equal.
 - .3 Motor shall be ½ HP, 120V or as needed for the flow and TDH requirements.
 - .5 To come with sufficient cord length to suit sump and receptacle location

3.0 EXECUTION

SUBMERSIBLE SUMP PUMP

3.1 Installation

- .1 All equipment shall be installed in accordance with the manufacturer's installation instructions.

END OF SECTION 43 21 39

VERTICAL TURBINE PUMPS

1.0 GENERAL

1.1 Description

- 1.1.1 This section refers to those portions of the *Work* that are unique to the supply and installation of vertical turbine line shaft pumps. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Reference Sections

- 1.2.1 Division 26 – Electrical
1.2.2 Division 40 – Process Integration

1.3 Submittals for Review

- 1.3.1 The *Contractor* shall submit to the *Consultant* a complete set of shop drawings for review and approval prior to submittal of equipment purchase order. Shop drawing documentation shall be submitted in digital PDF file format. Equipment general arrangement drawings shall be submitted in both PDF and in digital DWG or DXF AutoCAD compatible formats.
- 1.3.2 It is the *Contractor's* responsibility to coordinate requests for information with the equipment Supplier and or Manufacturer. It will not be the responsibility of the *Consultant* to obtain information related to incomplete shop drawing submittal documentation. Submittals containing incomplete or missing information will not be accepted for review and will be promptly returned to the *Contractor* as incomplete.
- 1.3.3 Shop drawings containing the below information shall be submitted for review and approval by the *Consultant* prior to the issuance of a purchase order and the subsequent authorisation for production release by the Manufacturer. Omission of any of the below information will constitute an incomplete shop drawing submission.
- (a) Proposed pump and motor manufacturer, model, pump type, and general description.
 - (b) Submit Manufacturer general arrangement drawings clearly identifying all general and essential dimensions (including clearance requirements) of pump assembly, column, discharge head, motor and all support and mounting assemblies. Drawing shall clearly show the distance from the invert of the suction bell to the centerline of the discharge head to ensure the column length is correctly sized and conforms to the elevations and

VERTICAL TURBINE PUMPS

dimensions shown on the *Drawings*. The drawings shall be scalable with the proposed scale clearly identified. In addition provide all dimensional drawings in digital AutoCAD format. Digital AutoCAD drawings in model space shall be drawn to a 1:1 scale.

- (c) Detailed bill of materials and parts summary for all pump intake, impeller assembly, column, discharge head, motor and all support and mounting assemblies and related components. Include manufacturer's name, description, and catalogue number for each part. The information should clearly summarize the proposed material for each part, material coating details if applicable, and governing standard. Provide a list of local or regional parts suppliers for all equipment.
- (d) Provide specifications related to sealing arrangements, impeller design, bearings, shafts, columns, lubrication, discharge head, flanges, base plates, connections, instrumentation, motor details, integrated controllers, etc.
- (e) Provide noise rating for combined operation of pump and motor at full load.
- (f) Provide detailed coating type, specifications, and application method for all coated surfaces related to the pump, support system and motor.
- (g) Submit certification documentation. All equipment and components shall be CSA approved. All equipment and components in contact with water are to be NSF 61 certified or suitable for potable water applications.
- (h) Manufacturer to undertake a reed critical frequency analysis to determine if natural frequency resonance between pump head and motor are within limits.
- (i) Submit manufacturer general operational and installation literature for the proposed equipment. The literature should identify features or operational requirements that will impact the design such as minimum clearances for disassembly.
- (j) Detailed pump information submittal to include the following:
 - (i) Rated pump speed in Revolutions per Minute (RPM);
 - (ii) Manufacturers pump flow vs head curves at full RPM and at every 5Hz speed reduction increments for variable speed applications. Provide manufacturers curve number information;

VERTICAL TURBINE PUMPS

- (iii) Pump hydraulic efficiency curves including Best Efficiency Point (BEP) at full RPM and at every 5Hz speed reduction increments for variable speed applications;
- (iv) Pump flow vs. Net Positive Suction Head Required (NPSHr) curves at full RPM and at every 5Hz speed reduction increments for variable speed applications;
- (v) Pump flow vs. input shaft power curve at full pump RPM;
- (vi) Hydraulic properties of pump including specific speed (N_s) and suction specific speed (N_{ss});
- (vii) Manufacturers Acceptable Operating Region (AOR) as a percentage of BEP;
- (viii) Minimum continuous allowable flow to ensure adequate cooling.
- (ix) If applicable Manufacturer recommendations regarding canned intake mounting and design if different from typical HI standards.
- (x) Number of pump stages. Performance curves shall be reflective of the total number of proposed stages;
- (xi) Minimum manufacturer's liquid level submergence distance over pump suction bell for wet well applications and impellers for dry well applications;
- (xii) Maximum passable solid sphere size;
- (xiii) Proposed impeller outer diameter or trim dimension;
- (xiv) Provide moment of inertia values;
- (xv) Provide axial and radial thrust values;
- (xvi) Provide support and mounting information including the total dry and wet mass of pump, column, discharge head and mounting base plate. Provide baseplate configuration including fastener size and dimensions. Identify lifting connection points or method.
- (xvii) Identify column diameter and couplings locations.
- (xviii) Provide discharge head information including process flanged connection size.
- (xix) Identify liquid pressure and temperature rating for pump connections.

VERTICAL TURBINE PUMPS

- (xx) Provide design lifespan of bearings in hours;
- (xxi) Provide design lifespan of bearings, sleeves and seals in hours of operation under normal operating conditions.
- (k) Detailed motor information to be submitted and to include the following information:
 - (i) Rated and nominal motor speeds in RPM;
 - (ii) Nominal motor power rating in horsepower;
 - (iii) NEMA ratings for frame, insulation class, enclosure type, and efficiency;
 - (iv) NEMA bearing rating and design life in hours;
 - (v) Provide motor voltage, phase number, hertz, starting amps, running amps, locked rotor amps and service factor. Provide motor efficiency and power factor ratings at 50%, 75% and 100% motor loads;
 - (vi) Provide motor performance curves that graph percent of rated motor output vs. efficiency, power factor, RPM, input power and amperage;
 - (vii) Identify manufacturer allowable number of starts per hour;
 - (viii) For Variable Frequency Drive (VFD) applications, identify and confirm inverter duty rating and manufacturer approval for intended motor control application;
 - (ix) Provide single or three phase wiring diagrams;
 - (x) Provide integrated motor instrumentation and fault monitoring module information if applicable;
 - (xi) Provide moment of inertia values;
 - (xii) Provide radial thrust values;
 - (xiii) Provide heat rejection data and manufacturer recommended environment ambient air temperature allowable operating ranges.
 - (xiv) Provide total mass of motor and accessories.

- 1.3.4 The Manufacturer shall verify each pump's performance and operational integrity by completing factory bench testing (non-witness) to ensure each pump achieves the specifications outlined herein and on the *Drawings*. A summary of each set of

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test results shall be submitted to the *Consultant* for review and approval with the shop drawing submission. The Manufacturer performance testing submittal shall include the following information:

- (a) Date and location of pump and motor performance test, test number and name of certified tester and reviewer;
- (b) Project name, client name, pump identification and intended use (e.g. Booster Pump No. 1), pump model number, pump serial number and pump P&ID tag number corresponding to the Instrumentation *Drawings*;
- (c) Testing summary shall note the ambient air and water temperature conditions at the time of the test;
- (d) The Manufacturer shall factory test pump flow and input shaft power through the full range of operating discharge head conditions (shutoff head to run-out). Testing shall monitor and record both the suction and discharge pressures through the full testing period. Test data shall be provided in both graph and table formats. In the table summary each row shall clearly show the target discharge pressure, suction pressure, flow, pump RPM and time-stamp.
- (e) Actual test performance data shall be overlaid in graph format with the data submitted during the shop drawing phase for ease of comparison. If factory performance test data deviates from performance data submitted during the shop drawing phase it should be clearly identified. Test acceptance grades and tolerances for all pumps shall conform to those defined by ANSI/HI 14.6-2016 Test Acceptance Grade 1U including optional power requirement (up to + 10%). If the factory testing reveals that the pump falls outside the acceptance performance tolerance, the *Consultant* reserves the right to reject the pump. The final acceptance or rejection of a pump falling outside the performance tolerance range will be at the *Consultant's* discretion and reviewed on a case by case basis. Final approval or rejection status will be contingent on factors such as the magnitude of the performance deficiency, the performance safety factor used in the system design, pump size, pump process importance, pump redundancy and intended application;
- (f) Manufacturer to complete hydrostatic pressure testing of the pump to conform to ANSI/HI 2.6 for 125% of the pump's rated shut-off pressure. Provide test verification with review submittal;

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- (g) Submit documentation showing the results of the vibration testing. All pumps shall be checked to ensure proper balancing of impeller, drive shafts, shaft couplings and motors. Vibration measurements and limits to conform to ANSI/HI 9.6.4 – 2009;
 - (h) Motor shall be factory tested and conform to the latest applicable standards of NEMA, ANSI, IEEE and ASTM.
- 1.3.5 An O&M manual shall be submitted for both the pump and motor per Section 01 33 00. The O&M manual shall contain the following information:
 - (a) Manufacturer and supplier names and contact information;
 - (b) Detailed installation instructions. Including electrical wiring, fastener torque charts, baseplate mounting, leveling, recommended lifting procedures, etc.;
 - (c) Manufacturer safety procedures related to installation, inspection, operation and maintenance;
 - (d) Pre start-up check list including recommended procedure for checking mounting and securements, alignment, rotational checks, wiring loops inspections, etc.;
 - (e) Manufacturer recommended start-up, commissioning, performance testing and shutdown procedures.
 - (f) Routine servicing information including inspection, lubrication level verification and replacement, mechanical seals, stuffing boxes, couplings and gaskets. Documentation shall identify approved lubrication types, location of grease nipples, drainage and filling points and recommended lubrication methods;
 - (g) Include recommended cleaning methodology;
 - (h) Provide servicing dismantling and repair documentation procedures for removal and replacement of major items such as impellers, housings, seals, gaskets, shafts, bearings, bushings, etc.;
 - (i) Provide manufacturer troubleshooting guide summarizing common issues and solutions;
 - (j) Provide parts and spare parts list and any specialized tools required for general operation and maintenance;

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- (k) Provide a list of all parts that will typically be replaced during the expected lifespan of the pump and motor. Identified parts shall have corresponding model and ordering numbers. Include expected delivery times for all spare parts;
 - (l) Manufacturer control description and requirements related to the typical operation of each pump and motor.
- 1.4 Quality Assurance
 - 1.4.1 Refer to *Contract Documents*.
 - 1.4.2 Components and equipment fabrication shall meet all necessary federal and provincial standards and be suitable for operation under the conditions outlined herein. Certifications stating that the equipment conforms to federal and industrial standards shall be provided during the initial shop drawing review phase. In the case where components or equipment is deemed non-compliant with the required standards and certifications outlined herein, the *Contractor* will be responsible for all costs and labour associated with the replacement.
- 1.5 Delivery, Storage and Handling
 - 1.5.1 Refer to *Contract Documents*.
 - 1.5.2 Shipment and delivery of pump to site shall only occur after *Consultant* approves the shop drawings and factory performance testing. See Submittal section for details. Ensure that transportation, handling and storage of pumping equipment conforms to Manufacturer requirements and does not compromise equipment integrity.
- 1.6 Warranty
 - 1.6.1 Refer to *Contract Documents*.
 - 1.6.2 The *Contractor* shall be responsible for providing and honouring issues that fall within the warranty period. This includes issues related to both installation and or Manufacturer defects. The *Contractor* will be responsible for addressing and coordinating all warranty issues including those relating to improper installation or Manufacturer defects.
 - 1.6.3 The *Contractor* shall be liable for all direct and indirect costs related to additional labour, materials and component replacement that fall under the warranty period.
 - 1.6.4 The *Contractor* shall warranty the pumping related equipment for a period of 24 months from the date of successful commissioning. This includes all components associated with the pump, motor, base support and control system (if applicable).

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The *Contractor* will be responsible to coordinate the extension of the Warranty period with the Manufacturer if required. In the event of major equipment failure during the initial warranty period, the warranty period commencement date shall be restarted to the date of reinstallation and placement back into service.

2.0 PRODUCTS

2.1 Scope of Supply

2.1.1 The *Contractor* shall supply a fully operational pumping system. The supply and installation shall conform to the requirements outlined herein and the Instrumentation and Process *Drawings*. In general, the scope of supply includes:

- (a) Five (4) 125 HP complete pump assemblies (including pump, motor, and any proprietary tools required for maintenance) for the Raw Water Pumps as shown on the *Drawings* (tag# VP-110, VP-120, VP-210, VP-220).
- (b) One (1) 30 HP complete pump assembly (including pump, motor, and any proprietary tools required for maintenance) for the Raw Water Pump (Jockey) and as shown on the *Drawings* (tag# VP-130).
- (c) One (1) 30 HP complete pump assembly (including pump, motor, and any proprietary tools required for maintenance) for the Recirculation Pump and as shown on the *Drawings* (tag# VP-150).

2.2 Acceptable Manufacturer and Pump Models

2.2.1 Goulds or approved equal. Selected models are listed in the table below:

Pump	Goulds Model
Raw Water Pumps	125 HP - VIT-DITM, 12CHC – 5 stages
Raw Water Pump (Jockey)	30 HP – VIT-DITM, 10RAHC – 7 stages
Recirculation Pump	30 HP – VIT-DIFM, 14RJLC – 1 stage

2.3 Design Criteria and Required Performance

2.3.1 The proposed pumps shall achieve the performance criteria summarized in the following table(s):

Table 2.2.1a – Raw Water Pumps

Parameter or Description	Value
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Equipment Tags:	VP-110, VP-120, VP-210, VP-220
Application:	Raw Water Transmission
Process Liquid Description:	Raw Water
Process Liquid Temperature Range:	0.5 to 20° Celsius
Total Number of Pumps:	5
Pump Operating Configuration	Three Duty, One Standby
Nominal Power Rating:	125 HP
Pump Control:	Variable Speed
Pump Nominal Speed:	1,700 RPM
Duty Point Flow (max) :	65 L/s
Duty Point Head (max):	102.1 m
Min Hydraulic Efficiency at Duty Point:	86.8 %
NPSHr Maximum Allowable	3.9 m (absolute)

Table 2.2.1b – Raw Water Pump (Jockey)

Parameter or Description	Value
Equipment Tags:	VP-130
Application:	Raw Water Transmission
Process Liquid Description:	Raw Water
Process Liquid Temperature Range:	0.5 to 20° Celsius
Total Number of Pumps:	1
Pump Operating Configuration	One Duty
Nominal Power Rating:	30 HP
Pump Control:	Variable Speed
Pump Nominal Speed:	1,770 RPM
Duty Point Flow (max) :	20 L/s
Duty Point Head (max):	60.96 m

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Min Hydraulic Efficiency at Duty Point:	70.30 %
NPSHr Maximum Allowable:	2.3 m (absolute)

Table 2.2.1c – Recirculation Pump

Parameter or Description	Value
Equipment Tags:	VP-150
Application:	Recirculation
Process Liquid Description:	Raw Water
Process Liquid Temperature Range:	0.5 to 20° Celsius
Total Number of Pumps:	1
Pump Operating Configuration	One Duty
Nominal Power Rating:	30 HP
Pump Control:	Variable Speed
Pump Nominal Speed:	1,770 RPM
Duty Point Flow (max) :	115 L/s
Duty Point Head (max):	15 m
Min Hydraulic Efficiency at Duty Point:	78.90 %
NPSHr Maximum Allowable:	6.1 m (absolute)

- 2.3.1 The proposed pump flow vs. head curve shall be continuously rising from the design point to the minimum continuous flow (or shutoff head). The head at shut-off shall be at least 135-160 percent of the head at the best efficiency capacity. The pump curve shall be stable, with only one possible flow value for each value of head.
- 2.3.2 The ratio of flow at BEP (QBEP) to the flow at the design point (QDP) shall satisfy the below ratios to ensure optimal pump operation and efficiency. The proposed pumping selection shall meet the following criteria:
- (a) For single duty pump operation: $1 < QBEP/QDP < 1.25$
 - (b) For two duty pumps in parallel operation: $1.1 < QBEP/QDP < 1.30$
 - (c) For three duty pumps in parallel operation: $1.2 < QBEP/QDP < 1.50$

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2.4 Materials

- 2.4.1 All wetted materials, epoxy coatings and lubricants shall be NSF 61 certified.
- 2.4.2 Discharge head to be fabricated from steel or ductile iron.
- 2.4.3 Carbon steel base plate to ASTM A36 to be used.
- 2.4.4 All shafts and shaft sleeves shall be fabricated from AISI 316 or AISI 416 stainless steel or approved equal material.
- 2.4.5 Pump column to be fabricated from schedule 40 carbon steel.
- 2.4.6 Impellers shall be manufactured from AISI 304 or AISI 316 stainless steel or a lead free alloy such as bronze.
- 2.4.7 Ductile iron or cast iron shall be utilized for bowls.
- 2.4.8 AISI 304 or AISI 316 stainless steel for intake strainer and shaft couplings.
- 2.4.9 Seals
 - (a) All pumps shall have Mechanical seals using EPDM in conjunction with stainless steel housing and silicon carbide or tungsten carbide as manufactured by Crane or approved equal.
- 2.4.10 All bearings and wear sleeves shall be manufactured from an industry proven and extremely hard wearing material with a strong resistance to abrasion and wear such as silicon carbide or tungsten carbide.
- 2.4.11 All rubber gaskets and seals (including o-rings) to be EPDM or approved equal.
- 2.4.12 All fasteners shall be AISI 316 stainless steel and be high strength conforming to Grade 8 ASTM 193/194 or better. All interface locations between carbon steel and stainless steel shall have insulators to prevent galvanic corrosion.
- 2.4.13 All wetted parts and exterior of discharge heads to be NSF-61 epoxy coated on all pumps.

2.5 Mechanical

- 2.5.1 The proposed pumps shall conform to the physical requirements summarized in the below tables:

Table 2.4.2a – Raw Water Pumps

Description	Value
Equipment Tags:	VP-110, VP-120, VP-210, VP-220

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Description	Value
Maximum Number of Allowable Impeller Stages:	5
Pump Process Discharge Flange Size:	203.2 mm
Pump Pressure Rating:	250 PSI
Pump Process Connections Flange Rating:	ANSI Class 150
Pump Base Plate Dimensions:	560 mm x 560 mm
Pump Impeller Configuration:	Enclosed
Pump Shaft Seal Type:	Mechanical
Pump Discharge Head Center Elevation:	Refer to <i>Drawings</i>
Pump Suction Bell Elevation:	Refer to <i>Drawings</i>
Pump Column Breaks Required:	Yes
Pump Column Coupling Interval:	1,500 mm (to match line shaft)
Pump Column Coupling Type:	Threaded
Requires Suction Strainer:	No
Suction Strainer Opening Size:	N/A

Table 2.4.2b – Raw Water Pump (Jockey)

Description	Value
Equipment Tags:	VP-130
Maximum Number of Allowable Impeller Stages:	7
Pump Process Discharge Flange Size:	152.4 mm
Pump Pressure Rating:	250 psi
Pump Process Connections Flange Rating:	ANSI Class 150
Pump Base Plate Dimensions:	508 mm x 508 mm
Pump Impeller Configuration:	Enclosed
Pump Shaft Seal Type:	Mechanical
Pump Discharge Head Center Elevation:	Refer to <i>Drawings</i>
Pump Suction Bell Elevation:	Refer to <i>Drawings</i>
Pump Column Breaks Required:	Yes

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Pump Column Coupling Interval:	1,500 mm (to match line shaft)
Pump Column Coupling Type:	Threaded
Requires Suction Strainer:	No
Suction Strainer Opening Size:	n/a

Table 2.4.2c – Recirculation Pump

Description	Value
Equipment Tags:	VP-150
Maximum Number of Allowable Impeller Stages:	1
Pump Process Discharge Flange Size:	254 mm
Pump Pressure Rating:	250 psi
Pump Process Connections Flange Rating:	ANSI Class 150
Pump Base Plate Dimensions:	610 mm x 610 mm
Pump Impeller Configuration:	Enclosed
Pump Shaft Seal Type:	Mechanical
Pump Discharge Head Center Elevation:	Refer to <i>Drawings</i>
Pump Suction Bell Elevation:	Refer to <i>Drawings</i>
Pump Column Breaks Required:	Yes
Pump Column Coupling Interval:	1,500 mm (to match line shaft)
Pump Column Coupling Type:	Threaded
Requires Suction Strainer:	No
Suction Strainer Opening Size:	N/A

- 2.5.2 Pump discharge process connection shall be flanged, with raised faces and constructed to ANSI B16.5 standards. Process flange to be ANSI configured and rated at 150, 300 or 400LB pressure class as identified in Section 2.4.2. Process flanges and other pressurized components to be Manufacturer rated for the appropriate working pressure class and to accommodate 125% of the pumps shutoff head value as per ANSI/HI 2.6 hydrostatic testing requirements.

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- 2.5.3 Pump impellers are factory configured with either open, semi-open or closed depending on the application and operator preference. See above Section 2.5.2 for pump specific requirements. Impellers shall be adjustable by means of a top shaft-adjusting nut.
- 2.5.4 Pumps shall be field serviceable with all parts easily dismantled and replaceable without the need for special proprietary tools. If special tools are required for field servicing they shall be supplied with the pump.
- 2.5.5 All bearings and races shall be replaceable. Bearings design shall conform to or exceed the ABMA L-10 system for a minimum design lifespan of 100,000 hours.
- 2.5.6 Entire pump assembly including all shafts and impellers shall be dynamically factory balanced in accordance with ANSI/HI 9.6.4. The measured vibration levels during field tests shall not exceed 6.15 mm/sec RMS in any horizontal direction or vertical direction, as outlined in ANSI/HI 9.6.4, at any flow or speed within the entire operating range, from minimum to maximum.
- 2.5.7 The Total Indicated Runout (TIR) of each shaft section shall be less than or equal to 0.004"/5' and shall not exceed 0.006" in a 10' length.
- 2.5.8 Upper shaft seals shall be accessible and replaceable on-site and use either mechanical or a conventional stuffing box with packing. See above Section 2.5.2 for pump specific requirements.
- 2.5.9 Pump shall have factory identification plate with Manufacturer name, model number, serial number, assembly date, speed rating, impeller curve number, power rating, flow and head.
- 2.5.10 *Contractor* shall provide a stamped stainless steel tag with the pump's P&ID tag number and process name at an easily identifiable location.
- 2.5.11 Provide pump head with lifting points capable of structurally lifting the entire pump assembly (discharge head, column and impeller assembly) mass in a single lift.
- 2.5.12 *Contractor* shall coordinate with the Manufacturer the correct column length based on the appropriate elevations shown in Section 2.5.2 and on the Process *Drawings*. For internal removal using a lifting rail, pump column may be required to be removed in sections. Provide flanged or threaded column breaks and lineshaft couplings at the increments stated in Section 2.5.2 for facility internal removal type applications. Ensure line shaft and column joints are located at the same interval. See Process *Drawings* for additional details.

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2.5.13 For raw water application provide basket style suction strainers as required. See Section 2.5.2 for pump specific requirements including strainer nominal opening size.

2.6 Electrical

2.6.1 Pump manufacturer to provide a motor specifically designed and suited for the proposed applications and the intended control method.

2.6.2 The motor requirements for each pumping system are summarized in the below table(s):

Table 2.5.2a – Raw Water Pumps

Description	Value
Equipment Tags:	VP-110, VP-120, VP-210, VP-220
Integrated Motor Temperature Sensor:	Yes
Integrated Motor Vibration Sensor:	Yes
Motor Fault Alarm Monitoring	Yes
Motor Control Method:	VFD
Motor Frequency Rating:	60HZ
Motor Enclosure Type:	WPI
Minimum Motor Efficiency at Full Load:	95.4%
Motor Minimum Power Factor Ratio at Full Load:	0.87
Motor NEMA Efficiency Rating:	Premium Efficient
Motor Nominal Power Rating:	125 HP
Motor Number of Phases:	3Φ
Motor Speed (Nominal):	1,800 RPM
Motor Supply Voltage:	575 Volts
NEMA Motor Design Rating:	Class B
NEMA Insulation Class	Class F

Table 2.5.2b – Raw Water Pump (Jockey)

Description	Value
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Equipment Tags:	VP-130
Integrated Motor Temperature Sensor:	No
Integrated Motor Vibration Sensor:	No
Motor Fault Alarm Monitoring	Yes
Motor Control Method:	VFD
Motor Frequency Rating:	60HZ
Motor Enclosure Type:	WPI
Minimum Motor Efficiency at Full Load:	94.10%
Motor Minimum Power Factor Ratio at Full Load:	0.858
Motor NEMA Efficiency Rating:	Premium Efficient
Motor Nominal Power Rating:	30 HP
Motor Number of Phases:	3Φ
Motor Speed (Nominal):	1,800 RPM
Motor Supply Voltage:	575 Volts
NEMA Motor Design Rating:	Class B
NEMA Insulation Class	Class F

Table 2.5.2c – Recirculation Pump

Description	Value
Equipment Tags:	VP-150
Integrated Motor Temperature Sensor:	No
Integrated Motor Vibration Sensor:	No
Motor Fault Alarm Monitoring	Yes
Motor Control Method:	VFD
Motor Frequency Rating:	60HZ
Motor Enclosure Type:	WPI
Minimum Motor Efficiency at Full Load:	94.1%
Motor Minimum Power Factor Ratio at Full Load:	0.90
Motor NEMA Efficiency Rating:	Premium Efficient

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Motor Nominal Power Rating:	30 HP
Motor Number of Phases:	3Φ
Motor Speed (Nominal):	1,800 RPM
Motor Supply Voltage:	600 Volts
NEMA Motor Design Rating:	Class B
NEMA Insulation Class	Class F

- 2.6.3 For VFD applications motor shall be Manufacturer inverter duty rated. See above Section 2.6.2 for pump specific requirements.
- 2.6.4 All vertical turbine pump motors shall use a non-reverse ratchet coupling.
- 2.6.5 Each motor shall be CSA approved and carry a CSA inspection label.
- 2.6.6 The motor shall be sized to ensure that the rated service factor is not entered at any point along the pump curve.
- 2.6.7 Each pump motor shall be controlled from the MCC as located and shown on the *Drawings*. Motor control to be either Full Voltage Non Reversing (FVNR), use Soft Starts (SS) or Variable Frequency Drives (VFD's). See Section 2.6.2 for pump specific requirements.
- 2.6.8 Motor shall be duty rated for continuous operation with periodic changes in load and speed and conform to the IEC S8 rating requirements.
- 2.6.9 Motor hourly start limit shall meet or exceed those defined by NEMA for Design A and Design B motors. For VFD and SS applications, Manufacturer to provide maximum allowable hourly starts if they exceed NEMA guidelines.
- 2.6.10 Typical enclosure types for the intended applications include Totally Enclosed Fan Cooled (TEFC), Open Drip Proof (ODP), Hazardous Location (HAZ) and Explosion Proof (EXPL). See Section 2.6.2 for pump specific enclosure requirements.
- 2.6.11 If specified, motors shall have Manufacturer installed sensors to monitor various alarm, fault and operating parameters. Integrated motor sensors shall be relayed directly to the MCC and or through a Manufacturer supplied proprietary monitoring module. Monitoring parameters may include temperature, vibration and insulation resistance. See Section 2.6.2 for pump specific requirements.
- 2.6.12 Motor shall be dynamically balanced at the factory.
- 2.6.13 The airborne noise level measured 1.0 meter from the motor in a free field shall not exceed 80 dBA.

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- 2.6.14 Each motor shall have manufacturer applied identification plate including information such as manufacturer name, model number, serial number, assembly date, horsepower, RPM, hertz, phase, volts, FLA, maximum ambient temperature, NEMA frame rating, NEMA insulation class rating, enclosure type, duty rating, NEMA full load efficiency, and service factor.
- 2.6.15 Provide lifting points capable of lifting the entire pumping and motor assembly in a single lift.
- 2.7 Controls
 - 2.7.1 Pump controls as per Division 26 and as shown on the Electrical and Instrumentation *Drawings*.
- 2.8 Protective Coatings
 - 2.8.1 All protective pump coatings in contact with water are to be NSF 61 certified.
- 2.9 Spare Parts
 - 2.9.1 The *Contractor* in coordination with the Manufacturer shall provide a list of recommended spare parts and maintenance materials. The costs of each recommended unit shall be provided as a separate line item with the submittal for the *Owner* to select.
 - 2.9.2 Selected spare parts shall be suitably packaged with labels indicating the contents of the package and the intended equipment name and P&ID tag number. Coordinate storage location of spare parts on site with Owner.

3.0 EXECUTION

- 3.1.1 The *Contractor* shall provide and coordinate a site visit(s) by the Manufacturer's representative to conduct a pre start-up installation inspection, functional testing, commissioning and operator training. The *Contractor* will be responsible for determining the amount of time and associated costs required by the Manufacturer's representative to travel to site and complete each of the tasks summarized herein.
- 3.1.2 The *Contractor* shall provide the *Owner* and the *Consultant* with copies of the Manufacturer's installation, functional testing and commissioning protocols 21 calendar days ahead of the site visit for review and approval. Dates shall not be changed without the consent of the *Owner* and *Consultant*, and without at least 48 hours of notice.

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- 3.1.3 Prior to on-site visit(s) submit name, qualifications, and experience of Manufacturer's field technical representative. *Owner* may reject the proposed technical representative based on insufficient experience.
- 3.2 Installation
 - 3.2.1 A Manufacturer's Representative shall be on-site to verify that the pump installation meets the Manufacturer's criteria.
 - 3.2.2 Installation shall be in strict accordance with the Manufacturer's recommendations and process/instrumentation *Drawings* and shall include everything necessary for proper pump operation once connected to the power supply and discharge piping.
 - 3.2.3 Manufacturer's representative to complete visual inspection to verify that each pump is installed correctly. Visual inspection shall verify that pumps meet the mechanical, hydraulic, structural and electrical requirements outlined in the specification, *Drawings* and recommended by the Manufacturer. Pre start-up check list including recommended procedure for checking mounting and securements, alignments, manual rotational checks, wiring loops inspections, process connections, etc. shall be completed.
 - 3.2.4 The Manufacturer's Representative shall submit a completed and signed pre-start-up inspection check list to the *Consultant* prior to undertaking functional testing.
- 3.3 Functional Testing
 - 3.3.1 A Manufacturer's Representative shall be on-site during the Functional Testing of each pump to ensure proper operation prior to final commissioning.
 - 3.3.2 The Manufacturer's representative will perform all required checks to ensure that each pump and motor meet the specifications.
 - 3.3.3 Functional testing shall be conducted using the intended process liquid and with the system inlet and outlet conditions setup to reflect the intended operating condition(s).
 - 3.3.4 *Contractor* and manufacturer's representative shall complete a field test in accordance with Hydraulic Institute Standards following successful installation.
 - 3.3.5 Field test parameters measured must include flow, head, amperage draw, vibration monitoring (5 readings on motor and 1 reading on head unit), and external bearing temperature. The test will be judged successful if: a) the pump performs equal to or better than the supplied pump curve (+10%, -0% flow at the rated TDH); b) the wire-to-water efficiency meets or exceeds the guarantee; +10%, -0% power required compared to pump power curve at any point on the curve); and c)

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vibration levels are within acceptable limits (< 6.15 mm/sec RMS unfiltered or the manufacturer's limit whichever is more stringent). If the test is judged to not be successful the *Contractor* will be responsible for all costs associated with diagnosing and repairing/replacing the pump. The flow and head measurement may be made with permanently installed instruments illustrated on the *Drawings*. The *Contractor* is responsible for providing the testing equipment for vibration, temperature, and amperage draw.

3.3.6 Additional items to complete during the field test include:

- (a) Through the MCC or Manufacturer supplied module confirm that all motor sensors and fault monitoring are functional and online.
- (b) Using a hand held decibel meter ensure sound level of the pump drive system and motor are within Manufacturer limits.

3.3.7 The results must be summarized into a field test report provided by the Supplier.

3.3.8 The *Consultant* and *Owner* reserve the right to be on-site during the function testing period. Provide the *Consultant* with a signed copy of the functional testing completion certificate for review and approval prior to commissioning.

3.4 Commissioning

3.4.1 A Manufacturer's Representative shall be on-site during the final commissioning.

3.4.2 The Manufacturer's representative and *Contractor* shall verify that each pump operates as intended through the full range of anticipated conditions. This would include the following:

- (a) Confirm that pump initiation and shutdown sequencing operate as intended via the controller in both auto and manual control modes.
- (b) Confirm proper duty cycling and duty rotation of each pump (if applicable).

3.4.3 Provide *Consultant* and *Owner* with signed commissioning certificate to be added to the O&M manual.

3.5 Operator Training

3.5.1 The *Contractor* shall coordinate the Manufacturer technical representative to provide an on-site training session for the operators. Coordinate training date with the *Consultant* and *Owner*. Ensure *Consultant* and *Owner* are notified at least two weeks in advance of available training dates.

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- 3.5.2 During the on-site training, the Manufacturer representative shall provide blank templates for detailed daily, weekly, monthly and yearly inspections and maintenance logs. The templates to be appended to the O&M manual.
- 3.5.3 The *Owner* may video tape or record the training session for future reference and operator familiarity.

END OF SECTION

DIVISION 44 – POLLUTION CONTROL EQUIPMENT

DUST CONTROL

1.0 GENERAL

- 1.1 Section 44 11 13 refers to those portions of the work that are unique to the supply and application of materials for dust control. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Environmental Procedures Section 01 35 43
 - 1.2.2 Soil Stripping and Stockpiling Section 31 14 13
 - 1.2.3 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.2.4 Granular Base Section 32 11 23
- 1.3 References
 - 1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 01 43 00: Quality Assurance.
- 1.4 Samples
 - 1.4.1 Samples may be required at the discretion of the *Consultant*.
- 1.5 Delivery, Storage and Handling
 - 1.5.1 Deliver calcium chloride to site in substantial and moisture-proof bags indicating name of manufacturer, name of product, net weight or mass, and percentage of calcium chloride guaranteed by manufacturer.

2.0 PRODUCTS

- 2.1 Materials
 - 2.1.1 The *Contractor* shall supply the dust control material in accordance with the most recent Alberta Transportation Recognized Products list, with final approval from the *Consultant*.
 - 2.1.2 Calcium chloride: to CAN/CGSB-15.1, Type 1-Regular (77%) or as liquid at 35% solution concentration.
 - 2.1.3 Magnesium chloride as 29 to 35% solution concentration.
 - 2.1.4 Water: to *Consultant's* approval.
 - 2.1.5 Aqueous magnesium chloride or calcium chloride may be used provided application is not in an environmentally harmful manner.
 - 2.1.6 Lignosulphonates may be used subject to conditions specified in 3.2. Environmental Restrictions herein.
 - 2.1.7 Used oil or "cut back" bitumen products are not permitted.

3.0 EXECUTION

- 3.1 Application
 - 3.1.1 Control dust at all times for duration of *Contract*.

DUST CONTROL

- 3.1.2 Apply aqueous solutions with distributors equipped with spray system that will ensure uniform application and with means of shut-off.
- 3.1.3 Apply aqueous solutions at following rates:
 - 3.1.3.1 Calcium chloride (25%) at 2.4 L/m² on roads not previously treated and 3.0 L/m² for road stabilization.
 - 3.1.3.2 Calcium chloride (35%) or magnesium chloride (30%) at 1.6 L/m² on roads not previously treated and 2.0 L/m² for road stabilization.
- 3.1.4 Apply flake calcium chloride at rate of 1.00 kg/m².
- 3.1.5 The completed treatment shall provide a smooth and relatively dust free surface.
- 3.2 Environmental Restrictions
 - 3.2.1 No application on slopes where precipitation may cause chemical to drain into watercourses.
 - 3.2.2 No application within 10m minimum on either side of watercourses.
 - 3.2.3 No application of lignosulphonates in residential areas when air temperature exceeds 26°C.
 - 3.2.4 No application of lignosulphonates when rain is imminent as minimum drying time of six hours is required.

END OF SECTION

**DIVISION 46 – WATER AND WASTEWATER
EQUIPMENT**

PROCESS EQUIPMENT SPECIFICATIONS

1.0 GENERAL

1.1 Description

- 1.1.1 This section specifies general standards applicable to all process mechanical equipment to be supplied as part of the Project.
- 1.1.2 All materials not specifically listed or specified, but required to complete the installation are the responsibility of the *Contractor*.
- 1.1.3 For instrumentation, control and electrical elements and devices, including control panels and their components, use this Section in conjunction with Division 26 for conformance to style, quality, product, and mounting requirements.

1.2 Definitions

- 1.2.1 “*Supplier’s Representative*” means a factory trained representative qualified to provide detailed installation instructions for equipment, inspect equipment installation, supervise equipment testing, and provide training on equipment maintenance and operation.

1.3 Reference Divisions

- 1.3.1 Division 26 Electrical
- 1.3.2 Division 33 Utilities
- 1.3.3 Division 40 Process
- 1.3.4 Division 43 Process Gas and Liquid Handling, Purification and Storage Equipment
- 1.3.5 Division 46 Water and Wastewater Equipment

1.4 Reference Standards

- 1.4.1 ASTM A380

1.5 Submittals for Review

- 1.5.1 Provide shop drawings conforming to the general requirements.
- 1.5.2 Provide, in addition to the submittal requirements of specific equipment specification sections, the following:
 - .1 Product literature with specific items to be supplied clearly indicated.

PROCESS EQUIPMENT SPECIFICATIONS

- .2 Process flow diagrams and process and instrumentation diagrams using ISA symbols for equipment which interfaces with the plant Programmable Logic Controller.
- .3 Assembly drawings showing dimensions, details of connections, anchorage and terminations of equipment for connection by others.
- .4 Equipment capacity. For pumps, blowers, compressors and fans, provide curves relating capacity to operating total dynamic head, and indicate operating point(s).
- .5 List of materials of construction, detailing component parts and reference ASTM, ANSI, CSA etc. specifications.
- .6 Electrical single line diagram.
- .7 PLC and control panel details.
- .8 Motor data including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and illustrative construction drawings.
- .9 Enclosure ratings for motors, starters and control panels.
- .10 Gearbox and drive data including AGMA/AFBMA ratings for components, tolerances, and details and materials of construction.
- .11 Details of coating systems.
- .12 Details of methods of preventing galvanic corrosion between mating surfaces constructed of dissimilar metals.
- .13 Layout drawings showing location of ancillary devices, conduit, junction boxes, safety and control devices and conduit entries for feeding or controlling the equipment.
- .14 Instrument Loop Diagrams, Motor Control Schematics, Interconnecting Wiring Diagrams and Instrumentation and Control Schematics.
- .15 Instrument details.
- .16 Valve and valve actuator details.
- .17 Design loadings to be transmitted to foundations or supports, including size and location of anchor bolts or other attachments to foundations or supports.
- .18 Manufacturer technical assistance contact information.

PROCESS EQUIPMENT SPECIFICATIONS

1.6 Submittals for Information Only

1.6.1 Provide submittals for information only conforming to the general requirements.

1.6.2 Provide:

- .1** Installation instructions indicating assembly, mounting and anchorage requirements, alignment and assembly tolerances, and points of connection for ancillary services.
- .2** Start-up instructions including lubricant requirements, electrical requirements, etc.
- .3** Certification by a professional engineer registered in the Province of AB that anchor bolt calculations have been performed for all pieces of equipment indicating adequacy of bolt type, sizing and anchor embedment for all forces including seismic.

1.6.3 Provide operations and maintenance data.

- .1** In information supplied, cross off all data not applicable to the specific equipment model supplied, and highlight all data applicable to the specific equipment model supplied.
- .2** Provide running clearances and tolerances
- .3** Provide exploded views and drawings to illustrate relations of component parts of equipment and systems.
- .4** For operating and maintenance instructions for each piece of equipment provide typewritten text as required to supplement product data. Provide logical sequence of instructions for each operations and maintenance procedure, incorporating manufacturer's instructions.
- .5** Provide complete and detailed lubricating and servicing schedule and recommended lubricants to be utilized.
- .6** Equipment and Instrument calibration reports
- .7** Local service representative(s), and local source of supplies and replacement parts.

1.6.4 Provide certificate of final inspection and approvals from the local electrical inspection authority.

1.7 Quality Assurance

PROCESS EQUIPMENT SPECIFICATIONS

- 1.7.1 All instrumentation, control and electrical devices to be CSA approved and to bear the CSA approvals sticker.
- 1.7.2 Provide all supports, anchorage and mounting of all equipment in accordance with the manufacturer's recommendations, the National Building Code, AB Building Codes, and S series drawings, and industry standard requirements unless otherwise specified.
- 1.7.3 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.
- 1.7.4 Stainless Steel Corrosion Control
 - .1 Factory weld with 316L filler wire using inert gas welding process. Solar flux is not acceptable. Provide a cross section equal or greater than the parent metal.
 - .2 Make all welds using the automatic orbital weld, gas tungsten arc welding (GTAW) or TIG process with an internal inert gas purge to exclude oxygen in the weld root area. Welds shall be full penetration, free of cracks overlaps and cold laps. Maximum misalignment 1.6 mm or half the pipe wall thickness, whichever is less. Maximum weld reinforcement and concave root 1.6 mm. Maximum undercut 0.8 mm or 10% of base metal thickness, whichever is less. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.
 - .3 Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:
 - (i) Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or stainless steel deburring and finish grinding wheels. Ensure brush material is compatible for stainless steel applications. Brushes to be manufactured from type 316 stainless steel.
 - (ii) Passivate and finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380.
 - .4 Use graphite-free anti-seize compound on all stainless steel bolt-ups.
 - .5 Provide electrical isolation kits on all flanged connections where stainless steel pipe is connected to a dissimilar metal in outdoor conditions, including valves and fittings.

PROCESS EQUIPMENT SPECIFICATIONS

1.7.5 Vibration Loosening Prevention

- .1 Provide lock nuts or double nuts with lengthened bolts as suitable for the service to prevent loosening of bolt and nut assemblies if they are subject to vibration during equipment operation.

1.8 Delivery, Storage and Handling

- 1.8.1 Follow all of manufacturer's recommendations for delivery, site storage and handling of equipment.
- 1.8.2 Protect all finished surfaces of exposed flanges and interior of equipment and piping by wooden blank flanges, bolted to the equipment flanges.
- 1.8.3 Protect all coatings from damage during shipping.
- 1.8.4 Any finished iron or steel surfaces not coated shall be properly protected to prevent rust and corrosion.
- 1.8.5 Shrink-wrap stainless steel components if delivering during winter months to protect against chloride corrosion from road salt.

1.9 Warranty

- 1.9.1 Each system *Supplier* shall guarantee that the equipment supplied shall be capable of performing the functions described in the *Specifications*.
- 1.9.2 Provide in addition to warranties described in the General Conditions and Supplemental General Conditions specified guarantees and warranties in the relevant specification Section.

2.0 PRODUCTS

2.1 Acceptable Manufacturer / Qualifications

- 2.1.1 Each equipment specification lists a Design Standard upon which the design has been based, including dimensions, quality of workmanship, operating protocol, basic materials and ancillary services.
- 2.1.2 Where Acceptable Products or Acceptable Manufacturers have also been listed in an equipment specification, those products are considered as being capable of meeting the basic functional requirements of the equipment, but may not be the same as the Design Standard in detail.
- 2.1.3 Where "or approved equal" has been listed, acceptance is at the sole discretion of the *Consultant* and refers only to equipment that has been specifically approved by addendum prior to tender closing.

PROCESS EQUIPMENT SPECIFICATIONS

- 2.1.4 Provide all ancillary services, material upgrades etc. as necessary to satisfy quality requirements defined by the Design Standards.
- 2.1.5 Make all minor changes in arrangement, piping and/or electrical connections etc. as necessary to suit the requirements of the Acceptable Products or Acceptable Manufacturers.
- 2.1.6 No additional payment will be made for revisions or alterations made to accommodate the specific equipment approved and supplied.
- 2.2 Component Compatibility
 - 2.2.1 Ensure all components of equipment systems including motor, drive, driven equipment and controls are compatible.
 - 2.2.2 Provide equipment systems comprised of two or more components as a unit by the responsible manufacturer. Unless otherwise specified, the *Supplier* of the driven unit is the responsible manufacturer.
 - 2.2.3 Prevent isolation or choose materials to prevent electrolytic action between dissimilar metals and materials.
 - 2.2.4 Choose and assemble all components of the equipment system to enhance compatibility, ease of construction, and efficient maintenance.
- 2.3 Bearings
 - 2.3.1 Design Criteria
 - .1 Provide equipment bearings with a minimum AFBMA L-10 rating life of 50,000 hours, as determined using the maximum equipment operating speed, unless otherwise specified.
 - .2 Provide easily accessible grease supply, flush, drain and relief fittings for grease lubricated bearings, using extension tubes where necessary to extend inaccessible lubrication points and drains to convenient locations. Provide standard hydraulic type grease supply fittings.
 - .3 Provide pressure lubricating or separate oil reservoir system for oil lubricated bearings. Provide a filler pipe and external level indicator gauge. System to be sized to absorb heat energy generated in the bearing at an ambient temperature of 40 °C.
 - .4 Provide ball or roller type equipment bearings unless otherwise specified, design to withstand the stresses of the service specified.
- 2.4 Motors

PROCESS EQUIPMENT SPECIFICATIONS

- 2.4.1 Refer to Division 26
- 2.5 CSA Approval
 - 2.5.1 All instrumentation, control and electrical devices to be CSA approved and to bear the CSA approvals sticker.
- 2.6 V-Belt Assemblies
 - 2.6.1 Acceptable manufacturers: Dodge, Woods or approved equal.
 - 2.6.2 Design Criteria
 - .1 Statically balance sheaves and bushings. Where sheaves and bushings are to operate a peripheral speeds greater than 1,650 m/min, dynamically balance the assembly.
 - 2.6.3 Equipment Components
 - .1 Belt to be selected for minimum 150 percent of rated drive power.
 - .2 Belts to be high capacity, oil and heat resistant.
 - .3 Provide anti-static type belts for explosion proof equipment.
 - .4 Provide sheaves with split, tapered, keyed hubs.
- 2.7 Guards
 - 2.7.1 Design Criteria
 - .1 On all moving parts, and on exposed equipment with operating surface temperatures exceeding 40°C, provide sheet expanded guards in accordance with workplace safety regulations.
 - .2 Guards to allow full movement of adjustable parts.
 - 2.7.2 Equipment Components
 - .1 Provide removable guards, expanded 14 gauge sheet carbon steel, or perforated sheet carbon steel. Paint guard after fabrication to protect against corrosion. Paint after fabrication to same standard as equipment, meeting OSHA requirements.
- 2.8 Piping Connections
 - 2.8.1 Provide piping connections compatible with piping systems to be connected. Refer and conform to quality standards in Section 40 05 23.24.
- 2.9 Couplings

PROCESS EQUIPMENT SPECIFICATIONS

2.9.1 Acceptable manufacturers: Dodge, Woods.

2.9.2 Design Criteria

- .1 Provide flexible couplings for equipment with drives greater than 0.5 hp.
- .2 Couplings to accommodate angular and parallel misalignment and end float and to cushion shock loads and dampen torsional vibrations. No metal to metal contact.
- .3 Size each coupling as recommended by the coupling manufacturer and install in conformance with the coupling manufacturer's instructions. Provide equivalent of shrunk-on fit.
- .4 Provide tire-type flexible member, attached to flanges by means of clamping rings and cap screws, with flanges attached to stub shaft by taperlock bushings.

2.10 Gauge Taps

2.10.1 Provide gauge taps on the suction and discharge side of pumps, blowers and compressors, complete with nipple, ball valve and cap.

2.10.2 Taps on air and clean water services to be 12 mm diameter.

2.10.3 Taps on wastewater services to be 25 mm diameter.

2.11 Housekeeping Pads

2.11.1 Design Criteria

- .1 Mount equipment and electrical cabinets located on concrete slabs on a concrete housekeeping pad.
- .2 Pad to be a minimum of 100 mm higher than finished floor elevation and extend 150 mm outside the equipment base or 10 bolt diameters from the outer edge of the outermost anchor bolt, whichever is greater. Pad to drain away from the equipment base.
- .3 Conduit, drains, piping etc. required for ancillary connections to the equipment are to rise through the pad unless shown otherwise.

2.12 Equipment Bases

2.12.1 Design Criteria

- .1 Provide rectangular bases, structural steel shapes with sufficient rigidity to maintain equipment alignment and resist forces and moments from the piping system.

PROCESS EQUIPMENT SPECIFICATIONS

- .2 Bases to be designed to withstand the design earthquake condition.
- .3 Provide bases sized for the next size larger motor. Baseplate to extend beyond all extremities of the driver and driven equipment.
- .4 Provide automatic alignment between the driver and driven end, or provide jacking screws between equipment frame and mounting feet, two screws at each end of equipment, one parallel and one perpendicular to the equipment axis.
- .5 Provide grout holes in equipment bases. Grout equipment bases using non-shrink, pour grade, non-metallic grout.

2.13 Anchor Bolts

2.13.1 Design Criteria

- .1 Equipment *Supplier* to provide anchor bolts, washers and nut sizing to *Contractor* for anchor bolts to be embedded in concrete for the equipment.
- .2 Equipment *Supplier* to provide all connecting bolts, washers and nuts required for attaching pieces of equipment and materials to base-plates.
- .3 The *Supplier* shall co-operate with the *Contractor* to provide details of the anchor bolts and shop drawings showing their installation details, length shape, and size, exact location and projection from the finished concrete are submitted to the *Contractor* in ample time to allow ordering and delivery prior to their being required on site.
- .4 The *Supplier* shall be responsible for the design and material specifications of all anchor bolts, and shall indicate clearly on the shop drawings any bolts whose location tolerance is less than normal.
- .5 For rotating equipment, drilled expansion or adhesive anchors for anchor bolts shall not be allowed unless designed and approved by a Structural Engineer. *Contractor* to provide shop drawings sealed by a professional engineer.
- .6 For rotating equipment provide anchor bolts with sleeves and washers to permit adjustment during installation of equipment.

2.13.2 Materials

- .1 Anchor bolts in the pumproom to be cadmium plated or galvanized.
- .2 Anchor bolts in all other areas to be 316 stainless steel.

PROCESS EQUIPMENT SPECIFICATIONS

2.14 Jacking Screws

- 2.14.1 For base mounted rotating equipment larger than 10 hp, provide jacking screws for the driver and the driven end to facilitate alignment, consisting of 12 mm nuts welded to the frame of the equipment, and a 12 mm bolt fitting through the nut and extending to the mounting feet. Provide two jacking screws at each end of the equipment, one each parallel and perpendicular to the equipment axis.

2.15 Pump Shaft Mechanical Seals

- 2.15.1 Acceptable manufacturers: John Crane

2.15.2 Design Criteria

- .1 See Division 43 for individual pump design criteria

2.15.3 Materials:

- .1 Metal parts; 316 or 316L stainless steel
.2 Non-clog, single coil spring; 316 stainless steel or Hastelloy C
.3 O-rings; Viton
.4 Faces; Silicon carbide on tungsten carbide

2.15.4 Equipment Components

- .1 Provide single mechanical seals where specified for equipment.
.2 Provide non-destructive, cartridge type, self-aligning stationary seals, requiring no shaft wearing sleeve, flexible stator.
.3 Provide flushless seals where specified.
.4 Drill and tap stuffing box for installation of seal water supply. Provide throat bushing to minimize sealwater flow.

2.16 Equipment Identification

- 2.16.1 Provide metal nameplate on each piece of equipment, mechanically fastened, complete with recessed letters.
- 2.16.2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle phase and power of motors.
- 2.16.3 Indicate design conditions (ie: flow, outlet pressure) in metric units, RPM, and equipment identification number as shown on process and instrumentation drawings.

PROCESS EQUIPMENT SPECIFICATIONS

2.16.4 Nameplate to be 304 stainless steel with 6 mm high indented letters.

2.17 Spare Parts

2.17.1 Provide two year supply of manufacturer's recommended lubricants for all equipment.

2.17.2 For all belt driven equipment, provide two V-belt sets.

2.17.3 For shop applied coatings, provide 1 unopened litre each of primer and finish coat.

2.17.4 For equipment that requires specialty tools for operations and maintenance, provide 1 set of specialty tools.

2.17.5 Tag and store spare parts as directed by the *Owner's* staff.

3.0 EXECUTION

3.1 General

3.1.1 Provide all necessary lifting and loading equipment, special tools, materials, supplies, lubricants, measuring devices, shims, gaskets, incidentals and other consumables as required to complete the installation and testing.

3.1.2 Inspect and field measure prior to equipment installation to ensure that previous work is not prejudicial to the proper installation for equipment.

3.1.3 Make all submissions required by the *Specifications* and local authorities and pay all fees required for the equipment installation.

3.1.4 Dimensions shown in the *Contract Documents* for equipment bases, piping connections, control panel locations, etc. are approximate and must be modified during equipment installation to suit the actual equipment provided. Review modifications with *Consultant* before proceeding.

3.1.5 Make all minor modifications to suit piping and other installed equipment and structural element locations and elevations. Review modifications with *Consultant* before proceeding.

3.2 Installation

3.2.1 Install all equipment specified or shown in the *Drawings*.

3.2.2 Provide for each piece of equipment a *supplier's* representative who shall instruct the *Contractor* in the proper installation of the *supplier's* equipment.

.1 The *supplier's* representative shall attend a preliminary site meeting to instruct the *Contractor* on the installation procedure. Allow for 1 day.

PROCESS EQUIPMENT SPECIFICATIONS

- .2 The *supplier's* representative shall also provide all necessary installation instructions to the *Contractor* in writing.
- 3.2.3 Install equipment as indicated in written instructions provided by the equipment manufacturer.
- 3.2.4 Level equipment using 304 stainless steel shims unless otherwise specified.
- 3.2.5 Grout equipment bases unless otherwise recommended by equipment manufacturer and agreed to by *Consultant*. Fill the entire void underneath the base. Provide full contact with equipment base unless otherwise recommended by equipment manufacturer and agreed to by *Consultant*. Neatly form and trim.
- 3.2.6 Remove storage lubricant and provide the initial fill of new lubricants for the equipment, grade as recommended by the equipment manufacturer.
- 3.2.7 Align rotating equipment in accordance with the more stringent requirements of either the equipment manufacturer or the following:
 - .1 Base to be level, using machinists level on all machined surfaces
 - .2 Align couplings to +/-0.05 mm
 - .3 Soft foot, maximum permissible 0.002 mm
 - .4 Where equipment undergoes a temperature differential rise of 30 °C or greater, provide precision benchmarks in foundation and perform alignment at operating temperatures.
- 3.2.8 Near the end of the equipment installation period, the *Contractor* shall notify the *Supplier* who shall send his representative to check over the installation when completed.
- 3.2.9 The *Supplier's* representative shall do a detailed check of the installation including, but not limited to, such items as: alignment, belt tension, bolt tension, running clearances, lubrication and workmanship.
- 3.2.10 The *Contractor* shall promptly remedy any defects to the satisfaction of the *Supplier's* Representative and the *Consultant*.
- 3.2.11 After the *Supplier's* Representative is satisfied that defects in installation have been remedied, alignment will be demonstrated to the *Consultant*, following which the equipment shall be given a brief test run in the presence of the representative, the *Contractor* and the *Consultant*. Provide a minimum of two weeks' notice to the *Consultant* that alignment and a brief test run will be demonstrated.

PROCESS EQUIPMENT SPECIFICATIONS

- 3.2.12 When the *Supplier's* representative is satisfied that installation is satisfactory in accordance with manufacturer's requirements and that the brief test run was successful, the representative shall complete Form 101 certifying that the installation is satisfactory in accordance with manufacturer requirements, and listing any minor defects requiring rectification.
- 3.2.13 Any defects in the installation shall be rectified by the *Contractor*.
- 3.3 Functional Testing
- 3.3.1 Equipment Functional Testing as described under this section is in addition to the brief test run described in Section 3.1.
- 3.3.2 Prior to equipment Functional Testing, pressure testing of all piping connected to the equipment must be completed as specified in Section 40 05 23.24
- 3.3.3 Equipment Functional Testing is to be performed with water to demonstrate to the satisfaction of the *Consultant* that:
- .1 All system components are fully operational
 - .2 Control and instrumentation components have been calibrated and properly adjusted
 - .3 All connecting piping is leak-proof and properly anchored
 - .4 The entire system is ready for continuous safe operation
- 3.3.4 The *Contractor* shall notify the *Supplier* and the *Consultant* 14 days ahead of the date when Functional Testing of the equipment furnished is to take place and the *Supplier* shall send his representative to the site to supervise and assist the *Contractor* in the testing of the equipment. The site visit may be concurrent with the check for the satisfactory installation of the equipment, if mutually agreed upon by the *Supplier* and the *Contractor*.
- 3.3.5 Before the *Consultant* witnesses the testing, the *Supplier's* representative shall recheck the installation and advise the *Contractor* as to any further installation, adjustments, checking, flushing or cleaning of the equipment required, and shall confirm that the equipment is ready to be operated.
- 3.3.6 The *Contractor* and the *Supplier's* representative shall operate the equipment for at least one hour to demonstrate to themselves the satisfactory operation of the equipment and controls, and shall take any remedial steps necessary to ensure the satisfactory operation of the equipment.

PROCESS EQUIPMENT SPECIFICATIONS

- 3.3.7 Following such remedial action, the *Contractor* shall notify the *Consultant* that the equipment operation is ready to be demonstrated, and the *Consultant* shall arrange to promptly attend such demonstration together with the *Owner's* representative.
- 3.3.8 The *Contractor* and the *Supplier's* representative shall then demonstrate to the *Consultant's* satisfaction the equipment operation, and shall prove out the satisfactory operation of all controls over several cycles and in all operating modes. The *Contractor* shall arrange to provide any supplies and water necessary to demonstrate the satisfactory operation of the equipment. Equipment shall be run continuously for a minimum of 24 hours as part of this demonstration, in automatic mode, without any alarms.
- 3.3.9 Should the demonstration reveal any defects, then they shall be promptly rectified by the *Contractor* and the demonstration of the equipment repeated to the satisfaction of the *Consultant*. Should such repeat demonstration require a second, or subsequent, visit to the site by the *Consultant*, the *Owner's* representative, the *Contractor*, or the *Supplier's* representative, then the additional costs, if any, incurred by each party shall be paid for by the *Contractor*.
- 3.3.10 During these tests instrument settings etc. shall be adjusted. Pressure, voltage, and amperage readings must be recorded. Each operating alarm condition must be simulated to ensure all controls and alarms are in good working order. The cost of any changes, adjustments or replacement of equipment that, in the opinion of the *Consultant*, are due to defective materials or errors or omissions on the part of the *Contractor* shall be made good by the *Contractor*.
- 3.3.11 Once testing has been completed to the satisfaction of the *Supplier's* representative and the *Contractor*, a Certificate of Satisfactory Testing Form 102 shall be completed and presented to the *Consultant*.
- 3.3.12 The *Consultant* shall sign the Certificate of Satisfactory Testing Form 102 completed by the *Supplier's* representative when testing has been completed to the satisfaction of the *Consultant*.
- 3.4 Operator Training
- 3.4.1 After successful completion of Equipment Testing, provide the services of the *Supplier's* Representative to train representatives of the *Owner* in process control and proper operation and maintenance of the equipment.
- 3.5 Start-Up and Commissioning
- 3.5.1 Refer to Section 01 91 00.

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PROCESS EQUIPMENT SPECIFICATIONS

END OF SECTION

TESTING AND DISINFECTION OF PIPING AND FACILITIES

1.0 GENERAL

1.1 Description

- 1.1.1 Section 46 80 00 refers to the portions of the *Work* that are unique to the pressure testing, leak testing and disinfection of piping and facilities as required prior to commissioning.

2.0 PRODUCTS

2.1 Not applicable

3.0 EXECUTION

3.1 General

- 3.1.1 *Contractor* to supply all water and chlorine as required for flushing, pressure or leak testing and disinfection.
- 3.1.2 *Contractor* responsible for completing chlorine residual and bacteriological tests as outlined in applicable AWWA standards.
- 3.1.3 *Contractor* to de-chlorinate and dispose of water used for disinfection process in location acceptable to the *Owner*.

3.2 Piping

- 3.2.1 Clean, pressure test and disinfect all raw water piping as identified in Section 33 11 01, 46 05 00 and per AWWA-C651.

3.3 Tanks and Channels –

- 3.3.1 Clean, leak test and disinfect the flash mixer tanks, flocculation tanks, DAF tanks, clarified channels, backwash holding tank, clearwell and raw water wet well in accordance with 3.5 and AWWA-652.

3.4 Leak Testing of Concrete Tanks

- 3.4.1 Contractor is responsible for ensuring that groundwater level is maintained below the bottom of the tanks at all times during construction and testing.
- 3.4.2 Prior to filling the tanks or channels with water, Contractor must receive approval from the Consultant. Internal inspection of the completed tank shall be completed by the Contractor and Consultant prior to filling the tank. Any visual defects

TESTING AND DISINFECTION OF PIPING AND FACILITIES

identified shall be repaired prior to proceeding with the leakage test specified below.

3.4.3 Contractor shall perform a leakage test of the tanks under the supervision of the Consultant. Contractor to provide 72hrs notice prior to commencing with the test. Leakage test will include:

- (a) Isolate tank as directed by the Consultant. Contractor responsible to supply and install any equipment required for isolation (e.g. pneumatic plugs)
- (b) Fill tank to the maximum water level
- (c) Let tank sit for 24hrs
- (d) Repair any obvious leaks during this period with sealing compound suitable for potable water
- (e) Check tank level after 24hr period and measure difference from initial depth. Any leakage volume greater than 0.05% of the total volume constitutes a failed test.
- (f) If test fails, the tank is considered unacceptable and the Contractor shall perform all necessary repairs to correct the Work. Once repairs have been completed, Contractor shall schedule another leakage test with the Consultant.
- (g) The tank must not be backfilled until a leak test has been passed and verified by the Consultant.

END OF SECTION