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END OF SECTION

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) The intake pump station site is located at the confluence of the Bow and Highwood Rivers. The site includes two pump station facilities. Both stations are designed to supply raw water for the FORWP to support growth over the next 25-50 years for the area. The “Primary Intake Pump Station” consists of a horizontal collector well (which includes a cylindrical concrete caisson and multiple lateral well screens), and multiple vertical turbine pumps along with associated controls equipment. The second pump station, referred to as “Well No. 2 Pump Station”, consists of a single raw water well with casing and deep well pump. The Well No. 2 Pump Station is located just south of the Primary Intake Pump Station. Both stations serve to deliver water to the Midline Pump Station and its adjacent raw water reservoirs located approximately 5.4 km southwest of the intake.
- (b) The Primary Intake Pump Station’s building will consist of the following components:
 - One 10.75 m x 10.75 m room that will house all pumps and electrical equipment.
 - A concrete floor slab constructed above the 1:200 year flood elevation. Slab to be installed on top
 - of the casing’s walls.
 - Galvanized metal stairs and railings for access into the building.
 - Wood-framed building with hardie board siding exterior finish.
 - Five vertical turbine pumps.
 - Roof access hatches for pump removal.
- (c) Three vertical turbine pumps will be installed as part of the initial phase with the fourth and fifth pump installed for ultimate build-out conditions. Stainless steel piping is provided off the pumps discharge that will transition to HDPE piping outside of the building. The discharge piping will run south towards the Well No. 2 Pump Station site. Electrical equipment will be installed adjacent to the pumps and will include the MCC, PLC, HMI, and other panels. No standby power is considered for the facility.

SUMMARY OF WORK

- (d) The Well No. 2 Pump Station will not include a building. The station will be of a simplistic design consisting of one deep well pump installed in a casing. Piping will be installed off the pump's discharge and will connect to the same forcemain as the Primary Intake Pump Station. Electrical equipment will be installed in a small weatherproof panel beside the casing. Panel to be supported by a wooden post and will be situated above the ground.

1.3 Work by Others

1.3.1 The following work is being completed by other contractors:

- (a) 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*.

SUBMITTALS PROCEDURES

- 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

SUBMITTALS PROCEDURES

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) SMACNA Sheet 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 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 Motor Control Center (MCC)

(a) The Owner is in the process of pre-purchasing a 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) **Motor Control Center, accessories, and equipment as specified.**

(b) Quantity: one (1) MCC

(c) Delivery Location: The *Vendor* will coordinate delivery of the equipment directly to the *Intake Pump 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 MCC will be available by October/November 2025.

(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

OWNER SUPPLIED EQUIPMENT

- 1.4.1 The *Contractor* shall take temporary ownership of the 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

Installing Contractor: _____

Comments: _____

[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

CERTIFICATE OF SATISFACTORY COMMISSIONING – FORM 103

Installing Contractor: _____

Comments: _____

[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

SELECTIVE SITE DEMOLITION

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for the location, use and placement of "Selective Site Demolition" requirements specified herein.

1.2 DEFINITIONS

- .1 For the purpose of construction in this Contract, the following definitions apply:
- .1 "Salvageable" is defined as all materials having salvage value.
- .2 "Non-salvageable" is defined as all material having no salvage value.

2. PRODUCTS

- .1 Not Applicable.

3. EXECUTION

3.1 INSPECTION

- .1 Inspect site and verify with the Owner's Representative items to be demolished, removed, and salvaged.

3.2 SALVAGEABLE MATERIALS

- .1 All materials having a salvage value will be excavated and removed in such a manner that no damage will be done to the material. Salvaged material will be removed, cleaned and stored at a location within the work area. At the completion of the project all salvage items will be transferred to the Owner's facility for storage. There will be no separate payment for salvaging or transferring to storage of these items.

3.3 DEMOLITION AND NON-SALVAGEABLE MATERIALS

- .1 Unless indicated otherwise, demolition and non-salvageable materials will be excavated, transported and disposed of at a licensed landfill. Burying of demolition and non-salvageable materials will not be allowed under any circumstances.
- .2 Asbestos cement pipe and materials are to be handled, removed and disposed of according to OH&S regulations and guidelines and the "*Alberta Asbestos Abatement Manual*", latest edition by Alberta Employment and Immigration.
- .3 The Contractor will bear the cost of all disposal fees.

3.4 REMOVAL OF CONCRETE MATERIALS

SELECTIVE SITE DEMOLITION

- .1 Saw cut the concrete as required for all concrete removal work and as indicated by the Owner's Representative. All cutting to be approved by Owner's Representative prior to cutting.
- .2 Re-cut concrete edges that are damaged or chipped due to the work, at no expense to the Owner.
- .3 Jack hammer, excavate, load, haul and dispose of the waste concrete materials at a licensed landfill, unless otherwise authorized by the Owner's Representative.
- .4 No separate payment will be made for saw cutting concrete, unless otherwise noted.

END OF SECTION

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- 23, 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 Waterstops: Ribbed extruded PVC of sizes indicated with shop welded corner and intersecting pieces with legs a minimum 150 mm long:
 - .1 Tensile strength: To ASTM D412, method A, Die "C", minimum 14 MPa.
 - .2 Elongation: To ASTM D412, method A, Die "C", minimum 275 %.
 - .3 Tear resistance: To ASTM D624, method A, Die "B", minimum 30 kN/m.
- .12 Pre-moulded Joint Fillers:
 - .1 Bituminous impregnated fibreboard: To ASTM D1751.
 - .2 Sponge rubber: To ASTM D1752, Type I, flexible grade.
 - .3 Standard cork: To ASTM D1752, Type II.
- .13 Dampproofing: Emulsified asphalt, mineral colloid type, unfilled: To Section 07 11 13 - Bituminous Dampproofing.

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.

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- .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.
 - .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.

CAST-IN-PLACE CONCRETE

- .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

- .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.

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- .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.
 - .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.

CAST-IN-PLACE CONCRETE

- .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.
 - .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.

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- .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

- .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

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:

STRUCTURAL STEEL FOR BUILDINGS

- .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:

STRUCTURAL STEEL FOR BUILDINGS

- .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

METAL FABRICATIONS

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 51 00 – Metal Stairs and Ladders.

1.3 Reference Standards

- .1 ASTM International (ASTM)
 - .1 ASTM A 53/A 53M-[12], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A269M-[15a], Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A307-[14], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM F3125-15, 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 CSA Group (CSA)
 - .1 CSA G40.20-[13]/G40.21-[13], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-[M92(R2003)], Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16-[14], Design of Steel Structures.
 - .4 CSA W48-[14], Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

METAL FABRICATIONS

- .5 CSA W59-[13], Welded Steel Construction (Metal Arc Welding) [Metric]
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - [current edition]
- .4 Underwriters Laboratories (UL)
 - .1 UL 2768-[11], Architectural Surface Coatings
- .5 NACE International
 - .1 NACE International
 - .1 ANSI/NACE No. 13/SSPC-ACS-1-[2016]-SG, Industrial Coating and Lining Application Specialist Qualification and Certification.
- 1.4 Action and Informational Submittals**
 - .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
 - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the province of the Work.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .4 Certificates:
 - .1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

METAL FABRICATIONS

1.5 Quality Assurance

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Qualifications:
 - .1 Ensure that 100% of industrial coating, lining applications, specialists, who perform concrete and steel surfaces preparation and coating applications, are certified by a recognized Applicator Certification Agency, in accordance with NACE 13 /SSPC ACS-I, Applicator Certification Standard (ACS).
 - .2 Maintain a current and valid ACS certification during project period.
 - .1 Application specialists who perform surface preparation and coating application work on this project must have a current ACS.
 - .3 Notify Consultant of any change in application specialist certification status.
 - .1 Any delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damages shall not be waived for any non-performance by Contractor.

1.6 Delivery, Storage And Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

METAL FABRICATIONS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade300W and/or 350W.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series
- .4 Bolts and anchor bolts: to ASTM F3125
- .5 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 Fabrication

- .1 Fabricate Work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Where possible, fit and shop assemble Work, ready for erection.
- .3 Exposed welds continuous for length of each joint: File or grind exposed welds smooth and flush.

2.3 Finishes

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164
- .2 Shop coat primer: MPI- EXT 5.1A and MPI-EXT 5.1B.
- .3 Zinc primer: zinc rich, ready mix to MPI-EXT 5.2C.

2.4 Isolation Coating

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

2.5 Shop Painting

- .1 Primer: VOC limit 250 g/L maximum.
- .2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.

METAL FABRICATIONS

- .4 Clean surfaces to be field welded; do not paint.

2.6 Pipe Railings

- .1 Steel HSS pipe: 64 mm nominal outside diameter, formed to shapes and sizes as indicated.
- .2 Galvanize exterior pipe railings after fabrication. Shop coat prime interior railings after fabrication.

2.7 Access Ladders

- .1 Stringers: 64 x 9.5 mm thick, Stainless steel.
- .2 Stainless steel Rungs: 20 mm diameter, welded to stringers at 300 mm on centre.
- .3 Brackets: sizes and shapes as indicated, weld to stringers at 3000 mm on centre, complete with fixing anchors.

2.8 Trench Covers and Frames

- .1 Stainless Steel fabricate from 6 mm thick raised pattern plate set in L55 x 55 x 6 frame. Include anchors at 1200 mm on centre for embedding in concrete. Supply trench covers in 1200 mm removable lengths.

2.9 Channel Frames

- .1 Fabricate frames from steel, sizes of channel as indicated.
- .2 Use full length channels to form frame, sizes as indicated.
- .3 Finish: prime coat painted.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications 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 remedied and after receipt of site inspection and written recommendations from Consultant.

METAL FABRICATIONS

3.2 Erection - General

- .1 Do welding work in accordance with CSA W59 unless specified otherwise
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S16 or Weld field connection.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up field welds, bolts and burnt or scratched surfaces with primer after completion of:
 - .1 Primer: maximum VOC limit 250 g/L.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250 g/L.

3.3 Pipe Railings

- .1 Install pipe railings to stairs, as indicated.

3.4 Access Ladders

- .1 Install access ladders in locations, as indicated.
- .2 Erect ladders 178 mm clear of wall on bracket supports.

3.5 Trench Covers

- .1 Install trench covers in locations, as indicated.

3.6 Channel Frames

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

METAL FABRICATIONS

3.7 Cleaning

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

3.8 Protection

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

END OF SECTION

METAL STAIRS AND LADDERS

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 50 00 – Metal Fabrications

1.3 Reference Standards

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
 - .1 ANSI/NAAMM MBG 531- [15], Metal Bar Grating Manual.
- .2 ASTM International (ASTM)
 - .1 ASTM A 53/A5 3M- [12], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 307- [14], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM F3125/F3125M- 15A, 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.
- .3 CSA Group (CSA)
 - .1 CSA G40.20- 13 /G40.21- 13, 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- 13, Welded Steel Construction (Metal Arc Welding).

METAL STAIRS AND LADDERS

- .4 Green Seal Environmental Standards (GS)
 - .1 GS-11-2011, 3rd Edition, Paints and Coatings.
- .5 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - [current edition].
- .6 The Society for Protective Coatings (SSPC)
 - .1 Systems and Specifications Manual, Volume 2, [2014] Edition
- .7 Underwriters Laboratories (UL)
 - .1 UL 2768- [11], Architectural Surface Coatings
- .8 NACE International
 - .1 NACE International
 - .1 ANSI/NACE No. 13/SSPC-ACS-1- 2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

1.4 Action and Informational Submittals

- .1 Submit in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for stairs, ladders and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the province of the Work.
 - .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.
- .4 Certificates:
 - .1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

METAL STAIRS AND LADDERS

1.5 Quality Assurance

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Qualifications:
 - .1 Ensure that 100% of industrial coating, lining applications specialists, who perform concrete and steel surfaces preparation and coating applications, are certified by a recognized Applicator Certification Agency, in accordance with NACE 13 /SSPC ACS-I, Applicator Certification Standard (ACS).
 - .2 Maintain a current and valid ACS certification during project period.
 - .1 Application specialists who perform surface preparation and coating application work on this project must have a current ACS.
 - .3 Notify Consultant of any change in application specialist certification status.
 - .1 Any delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damages shall not be waived for any non-performance by Contractor.

1.6 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect stairs, ladders from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2. PRODUCTS

METAL STAIRS AND LADDERS

2.1 System Description

- .1 Design Requirements:
- .2 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

2.2 Materials

- .1 Steel sections: to CSA G40.20/G40.21 Grade 350W.
- .2 Steel plate: to CSA G40.20/G40.21, Grade 300W pattern.
- .3 Floor plate: to CSA G40.20/G40.21, Grade 300 W.
 - .1 Thickness: 6 mm minimum.
 - .2 Width: [] mm.
 - .3 Design: [].
- .4 Steel tubing: to CSA G40.20/G40.21, Grade 350W, round, sizes and dimensions as indicated.
- .5 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with checkered plate nosings.
- .6 Welding materials: to CSA W59.
- .7 Bolts: to ASTM F3125
- .8 High strength bolts: to ASTM A F3125/F3125M

2.3 Fabrication

- .1 Fabricate in accordance with NAAMM, Metal Stair Manual
- .2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .3 Accurately form connections with exposed faces flush:
 - .1 Make mitres and joints tight.
 - .2 Make risers of equal height.
- .4 Grind or file exposed welds and steel sections smooth.

METAL STAIRS AND LADDERS

- .5 Shop fabricate stairs in sections as large and complete as practicable.

2.4 Grating Stairs

- .1 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of steel grating and reinforce as required.
- .2 Form stringers from C310.

2.5 Finishes

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2 to CAN/CSA-G164.
- .2 Shop coat primer: to MPI - EXT 5.1A and MPI - EXT 5.1B.
- .3 Zinc primer: zinc rich, ready mix to MPI - EXT 5.2C.

2.6 Shop Painting

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one coat of shop primer except interior surfaces of pans.
- .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease. Minimum temperature for painting 7 degrees C.
- .5 Do not paint surfaces to be field welded.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal stairs and ladders 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.

METAL STAIRS AND LADDERS

3.2 Installation of Stairs

- .1 Install in accordance with NAAMM, Metal Stair Manual
- .2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Do welding work in accordance with CSA W59 unless specified otherwise
- .5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

3.3 Installation of Plastic Handrail

- .1 Apply plastic handrails in accordance with manufacturer's printed instructions, using recommended tools.
- .2 Make joints and mitres neat, tight and inconspicuous. Remove surplus material from joint. Provide solid return at exposed ends of handrail.

3.4 Cleaning

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.5 Protection

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

END OF SECTION

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 .

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- .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:

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- .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.

MISCELLANEOUS ROUGH CARPENTRY

- .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

SHOP FABRICATED WOOD TRUSSES

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

SHOP FABRICATED WOOD TRUSSES

- .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:

SHOP FABRICATED WOOD TRUSSES

- .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.

SHOP FABRICATED WOOD TRUSSES

- .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

SHOP FABRICATED WOOD TRUSSES

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

SHOP FABRICATED WOOD TRUSSES

- .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

SHOP FABRICATED WOOD TRUSSES

- .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

SHOP FABRICATED WOOD TRUSSES

- .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

SHOP FABRICATED WOOD TRUSSES

- .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

SHOP FABRICATED WOOD TRUSSES

- .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.

SHOP FABRICATED WOOD TRUSSES

- .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

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

MODIFIED BITUMINUOUS MEMBRANE ROOFING

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 Alberta Roofing Contractors Association (ARCA):
 - .1 Roofing Application Standards Manual www.arcaonline.ca/manual/division-2-sbs-modified-bitumen-roofing [date of applicability], excluding the following sections:
 - .1 Part 2: Low-Slope Roofing – following sections only:
 - .1 Division 1 Built-up Roofing,
 - .2 Division 3: EPDM Roofing,
 - .3 Division 4: Thermoplastic Roofing
 - .2 Part 3: Steep Slope Roofing (entire part)
 - .3 Part 4: Metal Roofing (entire part)
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM D41 / D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - .2 ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
 - .3 ASTM D6162/D6162M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
 - .4 ASTM D6163/D6163M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
 - .5 ASTM D6164/ D6164M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
 - .6 ASTM F1667-13 - Driven Fasteners: Nails, Spikes and Staples.
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 37-GP-9Ma - Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing
 - .2 CAN/CGSB 51.33-M89 - Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction
 - .3 CGSB 19-GP-14M - Sealing Compound, One component, Butyl-Polyisobutylene, polymer base, solvent curing
- .4 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual, (current edition)
- .5 Canadian Standards Association
 - .1 CSA-A123.21 - Standard Test method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems
 - .2 CAN/CSA-A123.4 (R2023) - Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems
 - .3 CSA-A123.23 (R2020) - Product Specification for Polymer-Modified Bitumen Sheet, Prefabricated and Reinforced
- .6 Underwriters Laboratories of Canada

MODIFIED BITUMINUOUS MEMBRANE ROOFING

- .1 CAN/ULC S706.1 (R2016) - Standard for Wood Fibre Insulating Boards for Buildings

1.2 DEFINITIONS

- .1 "Roofing System" means: all materials contained within the roof assemblies installed by the Contractor, including all materials above the deck including membrane flashing up to and including 1067mm (42") above the surface of the primary membrane, and related sheet metal work.
- .2 Third Party Roofing Inspector" means: an individual engaged in commercial roofing inspections as a primary business, has a minimum of 5 years' experience as a roofer, has obtained a recognized Inspector Credential of a recognized Roofing Inspector program, can provide current Commercial General Liability Insurance coverage, annually inspects a minimum of 5,000 square metres of roofing systems, and is independent from roofing contractors, manufacturers, suppliers & distributors.
- .3 "Roofing Warranty" means: a written guarantee of the integrity of the Roofing System, the materials, labour, and the workmanship and provides for the repair or replacement of defects or deficiencies including the associated workmanship.
- .4 "Roofing Warranty Period" means: a Fifteen year period of time starting on the date of Interim Acceptance of the Work.
- .5 "Warrantor" means: the legal entity that provides the Roofing Warranty certificate.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
- .1 Deliver materials, handle and store in original packages and containers with manufacturer's seals and labels intact. The manufacturer's name, brand, mass, specification number and lot number shall be shown on the labels.
- .2 Storage and Handling Requirements:
- .1 Do not store materials on roof in concentrations which exceed design live loads.
- .2 Do not store gravel ballast on roofs. Haul gravel ballast to roof at rate of application.

1.4 QUALITY ASSURANCE

- .1 Qualifications: Engage a roofing company having documented experience with installation of specified roofing system having areas of 30,000 m² or greater, and that employ "Qualified Roofing Trades-people" that are skilled with installation of specified Products within Climate Zone 7a or colder as defined by the National Energy Code of Canada for Buildings, 2011 as follows:
- .2 "Qualified Roofing Trades-people" are defined as follows:
- .1 The onsite roofing foreman shall hold a Journeyman Certificate, Red Seal Journeyman certification, or equivalent from outside Alberta after obtaining prior written authorization from the Province, with documented evidence of the roofing foreman supervising two previous roofing projects, from start to completion, of similar size and complexity for public institutional buildings (each with at least a

MODIFIED BITUMINUOUS MEMBRANE ROOFING

30,000 m2 roof) of modified bituminous membrane roof type where construction was completed within the last 8 years.

- .2 The onsite roofing journeyman or apprentice trades-person shall hold a three year Alberta Roofer Apprentice Certificate, or equivalent from outside Alberta after obtaining prior written authorization from the Province, with documented evidence of the roofing trades-person completing two previous roofing projects, from start to completion, of similar size and complexity for a public building (each with at least a 30,000 m2 roof) of modified bituminous membrane roof type where construction was completed within the last 8 years.
- .3 Minimum of 50% of the balance of the onsite roofing persons to have completed some portion of a roofing apprenticeship program and shall have either: requested from Alberta's Apprenticeship and Industry Training Board certification as "Roofer", or equivalent after obtaining prior written authorization from the Province.

1.5 WARRANTY

- .1 The Contractor shall provide a Roofing Warranty certificate with a Twenty year Roofing Warranty Period, signed by both the Contractor and the Warrantor stating:
 - .1 The Roofing System has been constructed in accordance with the Contract Documents.
 - .2 The Roofing Warranty Period.
 - .3 Deficiencies including moisture leaks shall be corrected within a time-frame determined by the Province.
 - .4 The Owner as the warrantee, and stating that roofing work will remain in place and be free of any defects in materials and workmanship for the stated Roofing Warranty Period; and either:
 - .1 If a two-year Roofing Warranty Period is required: Contractor shall, at no additional expense to the Owner, repair any leaks (wherein moisture penetrates the waterproof/watershed component of the Roofing System) or other deficiencies in the Roofing System, occurring within two years of the date of Interim Acceptance of the Work; or
 - .2 If a 15-year Roofing Warranty Period is required: Warrantor shall, at no additional expense to the Owner, repair any leaks (wherein moisture penetrates the waterproof/watershed component of the Roofing System) or other deficiencies in the Roofing System, occurring between the date of Interim Acceptance of the Work and the end of the Roofing Warranty Period.
- .2 In addition to other Contractual requirements, the Contractor shall provide documents ensuring the performance of the Contractor's obligations under the Roofing Warranty in a form acceptable to the Province either:
 - .1 For a 2-year Roofing Warranty Period:
 - .1 Ensure that a Performance Bond is in place for a two 2-year period starting on Interim Acceptance of the Work; and
 - .2 Ensure the Warranty certificate, signed by the Contractor and the Roofing System manufacturer includes all roofing materials and assemblies installed by the Contractor including related sheet metal work. The Roofing System manufacturer's Warranty must be for a minimum Roofing Warranty Period of 5-years, starting on Interim Acceptance of the Work.
 - .2 For a 5, 10, or 20-year Roofing Warranty Period:

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- .1 Ensure that equivalent warranty provisions acceptable to the Owner, is in place for the Roofing Warranty Period starting on Interim Acceptance of the Work.

1.6 THIRD PARTY ROOFING INSPECTION

- .1 The Owner may engage third party roofing inspection. The Inspector will provide numerous inspections and reports to the Province during the progress of the roofing work, in accordance with the ARCA Roofing Applications Standards, to help ensure the roofing work is provided as set out in this Contract. Upon notice from the Province, the Contractor shall expediently perform all steps and make changes as identified by the roofing inspector, at no cost to the Province. The involvement of the roofing inspector does not relieve the Contractor of the responsibility to supervise, inspect and provide the roofing work as set out in this Contract.
- .2 The Construction schedule shall include roofing inspections. The number of roofing inspections and the frequency will be provided by the Province. The Owner, Consultant, roofing inspector(s), and Roofing System manufacturer, at reasonable times, shall have proper and safe access to the Work, including parts of the Work in preparation at locations other than the Place of the Work, for the purposes of observation, inspection and testing.
- .3 Provide copies of the manufacturer's site reports to the Owner, Consultant, and roofing inspector, prior to Interim Acceptance of the Work.

Part 2 Products

2.1 PRODUCTS

- .1 Except as specified otherwise, provide products from the Alberta Roofing Contractors Association ("ARCA") "Accepted Products Listing for S.B.S. Modified Bituminous Membrane Systems" or equivalent with prior written authorization from the Consultant.

2.2 AUXILIARY LEVELLING SURFACE

- .1 Gypsum Sheathing Board: water repellent surfacing, minimum 12.7 mm thick, conforming to one of the following standards:
 - .1 ASTM C1177
 - .2 ASTM C1278
 - .3 ASTM C1396

2.3 VAPOUR RETARDER

- .1 Provide the following:
 - .1 Isocyanurate Insulation: conforming to CAN/ULC-S704, rigid roof insulation board consisting of a polyisocyanurate foam core bonded chemically in the manufacturing process to glass fibre and other facings which are compatible to roofing membrane, aged RSI value of 0.99 per 25.4 mm thickness; thickness as indicated. Install in maximum 50 mm thick layers and maximum board size of 1200 mm x 1200 mm, to achieve RSI value as indicated on the drawings. Ensure that insulation is date stamp on date of manufacture, and that the insulation is not installed until 3 months after it has been manufactured.

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2.4 INSULATION COVER SHEATHING

- .1 As Substrate for Torch Application:
 - .1 Factory Laminated Support Panel/Base sheet: to CSA A123.21 composed of a 180 g/m² non-woven polyester reinforced SBS membrane with thermofusible surface, laminated on a semi-rigid asphaltic panel, 4.8 mm thick, 0.91 m x 2.44 m (3 ft x 8 ft). The membrane side lap is part self-adhesive and part thermofusible.
 - .2 Asphaltic core board comprised of mineral fortified asphalt sandwiched between a non woven glass reinforced mat, board size 1220 mm x 1524 mm x 3 mm (4'-0" x 5'-0" x 1/8").
- .2 As Substrate for Adhesive Application:
 - .1 Gypsum glass mat reinforced silicone treated board conforming to ASTM C1177/C1177M, non combustible according to ASTM E136/CAN/ULC-S114 thermal barrier as tested to UL 1256/CAN/ULC-S126, flame spread 0, smoke developed 0 to ASTM E84/CAN/ULC-S102 and ASTM D3273 with a rating of 10, no mould growth after 4 weeks exposure, minimum 6 mm (1/4") or for fire rating requirement 12 mm (1/2") thick gypsum board 1200 mm (4') wide, maximum practical length, tapered edge as required.
 - .2 Canadian Softwood Plywood: to CSA O151.
 - .3 Douglas Fir Plywood: to CSA O121.
 - .4 Waferboard or Oriented Strand Board (OSB): to CSA O437, top face non-waxed.

2.5 PRIMARY MEMBRANE AND MEMBRANE FLASHING

- .1 Provide two-ply SBS modified bitumen membrane, including SBS modified bitumen flashings, to manufacturer's recommendations conforming to "Accepted Products Listing for S.B.S. Modified Bituminous Membrane Systems" and as specified in this Section.
- .2 For membrane component types and reinforcement, refer to Primary Membrane Schedule at end of this Section.
- .3 Cap Sheet Finish: granules in colour selected by Consultant from manufacturer's standard range.
- .4 Membrane Flashing Finish: granules in colour selected by Consultant from manufacturer's standard range.

Part 3 Execution

3.1 INSTALLERS

- .1 Ensure a roofing foreman is on Site and supervising the roofing work at all times when roofing work is undertaken. Ensure that at least one other Qualified Roofing Tradesperson shall be on Site when roofing work is undertaken.
- .2 Roofing System application shall meet the following standards:
 - .1 The "Roofing Application Standards Manual", Alberta Roofing Contractors Association, current version, as amended from time to time.

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- .3 Ensure that all Qualified Roofing Trades-persons necessary to receive the manufacturer warranties, as set out within, are appropriately trained by the manufacturer and are on Site, at all relevant times.

- .4 Sub-Contracting

- .1 Contractor shall not sub-contract the roofing work and related sheet metal flashings. Sub-contracting of sheet metal fabrication is permitted.

3.2 APPLICATION OF AUXILIARY LEVELLING SURFACE

- .1 As specified in Section 07 50 10 - Bituminous Membrane Roofing General Requirements.

3.3 APPLICATION OF VAPOUR RETARDER

- .1 As specified in Section 07 50 10 - Bituminous Membrane Roofing General Requirements.

3.4 APPLICATION OF INSULATION

- .1 As specified in Section 07 50 10 - Bituminous Membrane Roofing General Requirements.
- .2 Before application of insulation ensure vapour retarder is not damaged, repair if necessary.
- .3 If Moulded Expanded Polystyrene insulation is used:
 - .1 Back mop the substrate receiving the insulation layer and embed insulation into asphalt to create a full bond.
- .4 Trim insulation to ensure no voids occur between the insulation and the insulation substrate. Where insulation butts a sloping surface, trim the insulation to profile that change in slope.
- .5 Trim insulation to ensure a tight fit at all vertical uprights.
- .6 Leave no insulation exposed at the end of the work day.

3.5 APPLICATION OF INSULATION COVER SHEATHING

- .1 As specified in Section 07 50 10

3.6 APPLICATION OF PRIMARY MEMBRANE

- .1 Install membrane components in accordance with requirements of "Roofing Application Standards Manual".
- .2 Use installation method as indicated on Primary Membrane Schedule at end of this Section.
- .3 Torch apply sheet materials for continuous fusion of sheets and adhesion to substrates.
- .4 Seal seams of nailed base sheets using cold or hot applied asphalt, or with torch heat application.
- .5 Limit cap sheet bleed-out at seams to 12 mm. Cover excessive bleed-out and replace missing mineral surfacing by embedding matching colour granules.

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- .6 Primary membrane deficiencies shall include, but not be limited to, ridges, tenting, buckles, wrinkles and voids.

3.7 MBM PRIMARY MEMBRANE SCHEDULE

Component Substrate	Installation Method	Reinforcement, Minimum, g/m ²
Base sheets on slopes up to 2:12		
Plywood, lumber and OSB	Mop or adhere	180 polyester
Gypsum sheathing	Mop or Adhere	95 glass fibre
Concrete	Mop or torch*	95 glass fibre
Base sheets on slopes over 2:12		
All Substrates	Mop or Adhere and Mechanically Fasten	180 polyester
Base sheet flashing		
All substrates	Self-adhered	180 polyester
Cap sheets		
Base sheet	Torch	250 polyester
Cap sheet flashing		
Base sheet flashing	Torch	180 polyester

*Base sheet installation method over concrete shall be either of the two methods specified, at Contractor's option.

END OF SECTION

METAL FLASHING FOR BITUMINOUS MEMBRANE ROOFING

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 D2822-05 - Asphalt Roof Cement.
 - .3 ASTM D3019 / D3019M-17 - Lap Cement Used with Asphalt Roll Roofing, Non-Fibred, Asbestos-Fibred, and Non-Asbestos-Fibred.
- .4 SCAQMD South Coast Air Quality Management District, California State (SCAQMD):
 - .1 SCAQMD Rule #1168, June 2006

1.2 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Galvanized Steel Sheet: commercial quality sheet to ASTM A653/A653M, with Z275 designation zinc coating.
- .2 Prepainted Galvanized Steel: commercial quality to ASTM A653/A653M with Z275 zinc coating prepainted with baked on enamel with colours of proven durability for exterior exposure, to CSSBI Technical Bulletin No. 7, 5000 series.
- .3 Solder: 50% pig and 50% block tin.
- .4 Flux: commercial quality as recommended by sheet metal manufacturer.
- .5 Flashing Nails: #12 hot dipped zinc coated, annular ringed.
- .6 Sheet Metal Screws: Cadmium plated, self-tapping, pan head.

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- .7 Plastic Cement: to ASTM D2822.
- .8 Lap Cement: to ASTM D3019.
- .9 Sealing Compound: to Section 07 57 13.
- .10 Recessed Reglet: preformed 0.70 mm thick galvanized steel channel with face and ends covered with plastic tape.
- .11 Flashing Anchor Clips: 0.80 mm thick galvanized steel.

2.2 FABRICATION, GENERALLY

- .1 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .2 Backpaint sheet metal with bituminous paint on surface in contact with concrete, masonry, cementitious materials or dissimilar metal.

2.3 FABRICATION, FLASHING

- .1 Maximum Joint Spacing:
 - .1 Parapet Face Flashings: 1200 mm.
 - .2 Cap Flashing 300 mm and Greater in Width: 1200 mm.
 - .3 All Other Flashings: 2400 mm.
- .2 Construct flashing joints to allow for flashing movement, using flat "S" lock seams.
- .3 Maintain minimum of 22 mm lap at all joints. Provide 25 mm anchor projection of "S" locks.
- .4 At inside and outside corners, mitre the joint, and use upstanding seams, 25 mm minimum height and 22 mm minimum lap.
- .5 Maintain minimum 1:5 slope on horizontal surfaces of flashings, parapets and control joints.
- .6 Hem exposed edges on underside of all flashings.
- .7 Fabricate cap flashing to have a drip leg minimum 110 mm high.
- .8 Fabricate cap and counter flashings to lap 100 mm over base flashings.

2.4 FABRICATION, ROOF ACCESSORIES

- .1 Form sheet steel roof drain sleeves, air stops etc. from 0.70 mm galvanized steel.
- .2 Form gum boxes from 0.70 mm galvanized steel, with 75 mm minimum upstand and 100 mm one piece flanges. Solder joints. Make pans wider than member passing through roof membrane by 50 mm minimum all sides.
- .3 Parapet flashings / copings 0.7mm, prepainted galvanized sheet steel.

METAL FLASHING FOR BITUMINOUS MEMBRANE ROOFING

- .4 Fabricate roof scuppers from 0.70 mm, prepainted galvanized sheet steel with one piece deck flange, minimum 150 mm. Contour scuppers to cant strips.
- .5 Fabricate splash pans from 0.70 mm galvanized steel.
- .6 Fabricate air/firestop below control joint box from 0.70 mm galvanized steel.

Part 3 Execution

3.1 EXAMINATION OF SURFACES

- .1 Examine surfaces to receive flashings. Notify the Construction Manager of surfaces which are considered unacceptable to receive the work of this Section.
- .2 The commencement of flashing work will imply unconditional acceptance of the surfaces and substrates to which the flashing is to be fastened.
- .3 Verify that the following are located and installed as detailed on drawings:
 - .1 Plywood and lumber nailer plates to walls and parapets.
 - .2 Control joints.

3.2 PROTECTION OF EXISTING WORK

- .1 Protect the work of other Sections from damage by the work of this Section.
- .2 Place protection to the requirements and satisfaction of this Section before performing the work of other Sections.

3.3 FLASHING INSTALLATION, GENERALLY

- .1 Install flashings not later than seven days after installation of the membrane on any particular section of the roof.
- .2 Use 0.80 mm thick x 150 mm long anchor clips on fascia faces, and screws or annular ringed nails on the opposite face.
- .3 Use exposed fastenings in approved locations. Install anchors using annular ringed nails.
- .4 Fasten flashings of 1.2 m length and shorter, through the extended "S" locks. Fasten flashings over 1.2 m length, through the extended "s" locks, and at mid length with a 150 mm long, 0.80 mm thick galvanized steel clip.
- .5 Fasten flashings at maximum 600 mm O.C.
- .6 Where possible, do not set base flashing screws less than 200 mm from top of roof membrane.

3.4 INSTALLATION OF FLASHING JOINTS

- .1 Fit flashings together so that one end of each section is free to move in the joint. Do not use sealant at joints.

METAL FLASHING FOR BITUMINOUS MEMBRANE ROOFING

- .2 Wipe and wash clean, soldered joints to remove traces of flux, immediately after soldering.

3.5 INSTALLATION AT REGLETS

- .1 Assist in locating and installing recessed reglets, as required.
- .2 Confirm reglet installation and report defects to the Construction Manager.
- .3 Insert metal flashing into reglets to form tight fit.
- .4 Seal flashing into reglet with sealant.

3.6 GUM BOX INSTALLATION

- .1 Fill gum boxes with plastic cement in two equal lifts. Separate lifts with one ply of organic felt, precision cut to fit the box.
- .2 Built-up Roofing Membranes: apply two plies of organic felt stripping over flange and extend up face of box curb. Reinforce stripping with 2 layers of woven glass cloth.
- .3 Modified Bituminous Roofing: apply roofing and flashing to membrane manufacturer's printed instructions.

3.7 VENT STACK INSTALLATION

- .1 Install vent stacks to same elevation as top of curb.
- .2 Size flashings to extend minimum 150 mm down curb base flashing and screw to base flashing.

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

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

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.

HARDWARE

- .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

HARDWARE

- 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.

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- .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

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- 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			

HARDWARE

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.

HARDWARE

- .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

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.

GYPSUM BOARD

- .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

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

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

END OF SECTION

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 B79-08, Commercial and Residential Drains and Cleanouts.

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.
 - .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.

PLUMBING SPECIALTIES AND ACCESSORIES

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.
- .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.

Part 3 Execution

3.1 EXAMINATION

PLUMBING SPECIALTIES AND ACCESSORIES

- .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.

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 TRAP SEAL PRIMERS

- .1 Install mechanical trap seals for running traps.

3.6 START-UP

- .1 General:
 - .1 In accordance with Division 01 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.7 TESTING AND ADJUSTING

- .1 Floor drains:
 - .1 Check operations of flushing features.
 - .2 Check security, accessibility, removability of strainer.
 - .3 Clean out baskets.

PLUMBING SPECIALTIES AND ACCESSORIES

- .2 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.

3.8 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.

3.9 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

SANITARY WASTE AND VENT PIPING - PLASTIC

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 - PLASTIC

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 - PLASTIC

- .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

OPERATION AND MAINTANANCE OF HVAC SYSTEM 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 time.

COMMON WORK RESULTS FOR HVAC

- .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.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.

COMMON WORK RESULTS FOR HVAC

- .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.
- .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

COMMON WORK RESULTS FOR HVAC

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 Requirements.

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- .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

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.

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- .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

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- .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.
- .3 Where concrete slabs form the finished ceiling, finish inserts flush with slab surface.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

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.
 - .2 640 to 900 mm wide: 25 x 25 x 3 mm.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

- .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.
- .4 Install chrome plated escutcheons where piping passes through finished surfaces.

HANGERS AND SUPPORTS FOR HVAC, PIPING AND EQUIPMENT

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

TEASTING, 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.

TEASTING, 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.

TEASTING, 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.

TEASTING, 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 CONTROL 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 CONTROL 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

FACILITY NATURAL GAS PIPING

Part 1 General

1.1 SUMMARY

- .1 Section Includes: materials and installation for piping, valves and fittings for gas fired equipment.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.5-2020, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24, Metric/Inch Standard
 - .2 ASME B18.2.1-2012 (R2021), Square and Hex Bolts and Screws Inch Series
- .2 ASTM International (ASTM):
 - .1 ASTM A47/A47M-99(2022)E01, Standard Specification for Ferritic Malleable Iron Castings
 - .2 ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
- .3 CSA Group (CSA):
 - .1 CAN/CSA B149.1:20, Natural Gas and Propane Installation Code Handbook
 - .2 CSA W47.1:19 (R2024), Certification of Companies for Fusion Welding of Steel
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Division 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Indicate on manufacturers catalogue literature for the following: valves and regulators.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .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 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Division 01 - Closeout Submittals.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:

FACILITY NATURAL GAS PIPING

- .1 Convene pre-installation meeting one week before beginning work of this Section and on-site installations in accordance with Division 01 - Project Meetings.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: Teflon tape to CAN/CSA B149.1.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: non-metallic flat.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M
 - .5 Bolts and nuts: to ASME B18.2.1
 - .6 Nipples: schedule 40, to ASTM A53/A53M
 - .7 Hose: stainless steel hose to CAN/CSA B149.1

2.4 VALVES

- .1 Provincial Code approved, lubricated plug type.

Part 3 Execution

3.1 PIPING

- .1 Install in accordance with applicable Provincial/Territorial Codes, and CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points and dirt legs:
 - .1 At low points in piping system.

FACILITY NATURAL GAS PIPING

- .2 At connections to equipment.

3.2 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.3 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Obtain reports within 3 days of review and submit immediately to Consultant.
- .3 Performance Verification:
 - .1 Measure gas pressure at gas meter outlet and at burner manifold.
 - .2 Verify details of temperature and pressure compensation at meter.
 - .3 Verify settings, operation, venting of high and low pressure cut-outs, and alarms.
 - .4 Check terminals of vents for gas pressure regulators.
- .4 PV procedures:
 - .1 Test performance of components.

3.4 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.5 CLEANING

- .1 Cleaning: in accordance with CAN/CSA B149.1, supplemented as specified.
- .2 Perform cleaning operations as specified in Division 01 - Cleaning and in accordance with manufacturer's recommendations.

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.

AIR DUCT ACCESSORIES

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors:
 - .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.

1.5 DELIVERY, STORAGE, AND HANDLING

HVAC FANS

- .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.

2.3 UTILITY SETS

HVAC FANS

- .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 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

- .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 louvres, 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

UNIT HEATERS

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

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C916-20, Standard Specification for Adhesives for Duct Thermal Insulation
 - .2 ASTM C1071-19, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .4 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Equipment, capacity and piping connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

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.

UNIT HEATERS

- .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 unit heaters from nicks, scratches, and blemishes.

Part 2 Products

2.1 UNIT HEATERS

- .1 Cabinet: type as indicated, 1.6 mm thick steel with rounded exposed corners and edges, removable panels, glass fibre insulation and integral air outlet and inlet.
 - .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-developed index of 50 maximum to CAN/ULC-S102
 - .2 Finish with factory applied primer coat.
 - .3 Special cabinets: as indicated.
 - .4 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.
 - .5 Motor: tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.
 - .1 Include spark free non-ferrous fan construction and explosion proof motor construction in bracket.
 - .2 Motor Speed: single.
 - .6 Filters: removable 25 mm thick permanent washable type.
 - .7 Capacity: as indicated.
 - .8 Control:
 - .1 Wall mounted thermostats: type low voltage electronic, to Section 23 09 33 - Electric and Electronic Control System for HVAC.
 - .9 Connections:
 - .1 NPS 1/2 threaded natural gas with shut-off valve and dirt leg in accordance with Section 23 11 23 – Facility Natural Gas Piping.
 - .2 100 mm diameter vent and combustion air complete concentric vent adapter.

UNIT HEATERS

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 Install in accordance with manufacturer's instructions.
- .2 Check final location with Consultant if different from that indicated prior to installation.
 - .1 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .3 Clean finned tubes and comb straight.
- .4 Provide supplementary suspension steel as required.
- .5 Install thermostats in locations indicated.
- .6 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 - Cleaning.
 - .1 Remove surplus materials, rubbish, tools and equipment.

END OF SECTION

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.
- .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.

GROUNDING

- .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

ELECGTRICAL 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.

ELECGTRICAL 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

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

CLEARING AND GRUBBING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Clearing and Grubbing" specified herein.

1.2 PROTECTION

- .1 Protect trees, shrubs and other vegetation to remain in place, against unnecessary cutting, breaking and any other damage.
- .2 Protect from damage to fences, roadways and other existing site improvements that are to remain.
- .3 Protect bench marks and reference points from damage.

2. PRODUCTS

- .1 Not applicable.

3. EXECUTION

3.1 INSPECTION

- .1 Inspect site and verify with the Owner's Representative clearing and grubbing limits and items designated to remain.

3.2 GENERAL

- .1 Confirm clearing and grubbing procedures with Owner's Representative.
- .2 Locate and protect underground and service utilities.
- .3 Notify utility agencies before starting site clearing and grubbing.
- .4 Remove all concrete, logs, trees, brush, stumps, roots and all objectionable material above the ground or on the ground surface.
- .5 Remove all stumps, roots and other deleterious materials to 0.3 m below the ground surface.
- .6 Remove visible rock fragments and boulders greater than 300 mm in greatest dimension, but less than 0.25 m³.
- .7 Temporarily stockpile material within the site until conditions are suitable for disposal.

CLEARING AND GRUBBING

3.3 DISPOSAL

- .1 Dispose of cleared and grubbed material by hauling to disposal off-site, or on-site to a designated licensed waste area as indicated in the Contract Documents.

END OF SECTION

SOIL STRIPPING AND STOCKPILING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Soil Stripping and Stockpiling" specified herein.

1.2 DEFINITIONS

- .1 For the purpose of construction in this Contract, the following definitions apply:
- .1 "Topsoil" is defined as the uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils, normally ranging in depth from 50 mm to 450 mm, capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 "Subsoil" is defined as material that lies immediately beneath the Topsoil and extending to root depth. Subsoil may be up to 1.5 m in depth.
 - .3 "Overburden" is defined as soil material that lies between the Subsoil and the material that is designated to be utilized for construction.
 - .4 "Stripping" is defined as the excavation of Topsoil, Subsoil, and Overburden, including materials in frozen condition.

2. PRODUCTS

- .1 Not applicable.

3. EXECUTION

3.1 PROTECTION OF EXISTING FACILITIES

- .1 Locate utility lines, fencing, survey reference points, instrumentation, culverts, and all other existing facilities before commencement of Work. Protect these items from damage.

3.2 EXCAVATION

- .1 Do not strip any area without prior approval of the Owner.
- .2 Stay on designated haul roads and do not disturb grassed or natural areas not part of the Work. Do not drive on undisturbed areas except for the performance of stripping operation.
- .3 In stripping areas, strip topsoil to top of subsoil levels, then strip the subsoil to top of overburden levels, then strip the overburden. Avoid mixing Topsoil, Subsoil and Overburden.
- .4 Strip and stockpile materials separately to prevent contamination.

SOIL STRIPPING AND STOCKPILING

- .5 Strip and stockpile materials from temporary construction access roads, borrow areas and waste fill areas required for performance of the Work.
- .6 Conduct the stripping operation far enough in advance of excavation to ensure that undesirable material does not become mixed with the Topsoil.
- .7 Suspend stripping operations during rain or wet ground conditions.
- .8 Suspend stripping operations during high winds greater than 80 km/hr, which may result in contamination or loss of Topsoil.
- .9 Provide proper drainage of surface water from stripped area to prevent ponding and infiltration in areas where fill is to be placed.
- .10 Use equipment with precise depth control such as a grader when stripping shallow depth topsoil.
- .11 If the stripping area soils are frozen, rip the area to a depth of 300 mm and stockpile separately.
- .12 Excavate all initial frozen material. Subsequent frost removal will not be paid.

3.3 STOCKPILES

- .1 Unless otherwise designated in the Contract Documents, stockpile stripped material adjacent to borrow areas, waste areas or along the road right of way. Choose stockpile locations such that they will not interfere with construction.
- .2 Stockpile topsoil separately from other materials.
- .3 Maintain a minimum separation of 1 m between stockpiles.
- .4 Stockpile frozen stripped material separately from other materials.
- .5 Adopt measures to prevent drifting of topsoil.
- .6 Keep drainage courses clear of stockpiled material.
- .7 Stockpile material at slopes lower than 2H:1V.

3.4 DISPOSAL OF STRIPPING MATERIAL

- .1 The Contractor will assume ownership of the different waste stripping materials, not incorporated in the work. The Contractor is encouraged to recycle the waste material where practical. Dispose of non-recycled topsoil material at a licensed landfill, unless otherwise approved by Owner's Representative.

END OF SECTION

EXCAVATING TRENCHING AND BACKFILLING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Excavating, Trenching and Backfilling" specified herein.
- .2 This Section is intended to be used as a reference section for excavating, backfilling of trenching required for installation of underground services which may include pipes, fittings, valves, manholes, vaults, catch basins, ducts, duct banks, conduits, cable, wire, etc.

2. PRODUCTS

2.1 FILL MATERIALS

.1 General

- .1 Do not use frozen fill materials.
- .2 Remove cobble, stones and rock fragments have maximum dimension greater than 75 mm from fill material or other object other objects which could be detrimental to the pipe or the embedment materials.

.2 Native Backfill Material

- .1 Native backfill containing no debris; tree roots, sod or other organic materials.

.3 Granular Materials

Restore all existing granular materials for access roads and parking lots to preconstruction conditions.

.4 Non-shrink Backfill

Non-shrink Backfill is a very weak mixture of Portland Cement or Lime/Fly Ash, concrete aggregates and water that resists settlement when placed in a utility trenches and is capable of being readily excavated.

- .1 Compressive Strength – 0.2 to 0.5 Mpa with a maximum 56 day strength of 0.5 Mpa.
- .2 Aggregate consisting of washed sand conforming to the requirement of C.S.A. Standard CAN#-A23.1-M77. Aggregate gradation to be within the following limits:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
10 mm	100%
5 mm	95 - 100%
2.5 mm	80 - 100%
1.25 mm	50 - 100%
0.630 mm	25 - 65%
0.315 mm	10 - 35%
0.160 mm	2 - 15%
0.080 mm	0 - 10%

EXCAVATING TRENCHING AND BACKFILLING

- .3 Minimum slump - 75 mm. Maximum slump - 125mm.
- .4 Calcium chloride admixture may be used. Air entrainment admixture may be used to improve workability.
- .5 Cold Weather Requirements: Non shrink backfill delivered in cold weather will conform to the requirement specified in Section 18 of C.S.A Standard CAN3-A23.1-M77.

.5 Concrete

Concrete mix will satisfy the requirements of Exposure Classification C-2 of Table 1 in the latest revision of CAN/CSA A23, and will be in accordance with the following minimum requirements unless shown in the Contract Documents:

- 28 day compressive strength – 25 MPa
- Maximum nominal size of coarse aggregate – 25 mm
- Slump – maximum 75 mm
- Air Content – 4% to 7%
- Maximum water cementing materials ratio – 0.45
- Portland Cement – Type 50 or HS, Sulfate Resistant
- Minimum cement content – 300 kg/m³
- Fly Ash Content – 20% max.

2.2 RIGID FROST SHIELD

- .1 Rigid frost shield material to be extruded polystyrene insulation 50 mm thick with a minimum resistance to heat transfer of 1.76 RSI (R-value of 10) as determined by ASTM C518 and a minimum comprehensive strength of 275 kPa (40 psi) as determined by ASTM D1621.
- .2 Approved products:
 - Dow STYROFOAM HIGHLOAD 40
 - Owens Corning Foamular 400
 - or approved equal

2.3 GRANULAR FROST INSULATION

- .1 Processed lightweight aggregates (LWA) used as granular frost insulation material in pipe bedding and insulating cover due to high thermal insulation value and low thermal conductivity compared to natural soils.
- .2 Approved products:
 - Granulite
 - Aggrelite by Atrium Lightweight Materials Inc.
 - Liteweight 730
 - or approved equal

2.4 CELLULAR CONCRETE INSULATION

EXCAVATING TRENCHING AND BACKFILLING

- .1 Insulating material will be precast cellular concrete blocks with wet density equal to 475 kg/m³.
- .2 Approved products:
 - Cematrix CMI-475
 - Or approved equal

3. EXECUTION

3.1 EXCAVATION

- .1 Excavate trenches to the lines, grades and elevations shown on the Contract Documents. For pipe trenches, comply with Pipe Trench Width Schedule.
- .2 Where a trench box and/or cage will be employed for a trench excavation refer to Uni-Bell's latest edition of "Handbook of PVC Pipe – Design and Construction" for the trench design and method of installation.
- .3 Where shoring will be employed for trenching and/or protection of utilities and structures the Contractor must engage the services of qualified professional engineer who is registered or licensed in province of the project to design and inspect shoring and anchoring required for work.
- .4 Grade and shape pipe trench to give uniform and even bearing for each length of pipe. Dig bell holes at each joint as required.

3.2 MOISTURE CONTENT CONTROL OF BACKFILL MATERIAL

- .1 Uniform moisture content of each layer of fill to be within the Optimum Moisture Content limits specified in Backfilling Schedule, as determined by ASTM D698 test procedures.
- .2 When the moisture content in the fill material is lower than that specified for placement, add water and mix with the material to achieve uniform moisture content in the material to conform to the requirements.
- .3 When the moisture content in the fill material is higher than that specified for placement, dry the material by scarifying, disking, mixing and harrowing to achieve uniform moisture content in the material that conforms to the requirements.

3.3 PLACEMENT AND COMPACTION OF BACKFILL MATERIAL

- .1 Backfill trenches using fill materials as specified in Backfilling Schedule.
- .2 Place fill materials in layers not exceeding loose thickness specified in Backfilling Schedule.
- .3 Uniformly compact each layer of fill to minimum percentages of Standard Proctor Density specified in Backfilling Schedule, as determined by ASTM D698 test procedures.
- .4 Uniform moisture content of each layer of fill to be within the Optimum Moisture Content limits specified in Backfilling Schedule.

EXCAVATING TRENCHING AND BACKFILLING

- .5 Where a trench box and/or cage is employed, ensure that the pipe installation and pipe zone compaction requirements are met. Refer to Uni-Bell's, latest edition of "Handbook of PVC Pipe - Design and Construction" for trench box/ cage design and methods of installation. The installed pipe and its embedment will not be disturbed when using movable trench boxes and/or cages. Movable supports will not be used below the top of the pipe zone unless an approved method is used to maintain the integrity of the embedment material. Before moving supports, place and compact embedment to sufficient depths to ensure protection of the pipe. As supports are moved, finish placing and compaction of embedment material.
- .6 Where shoring is employed, the shoring professional will provide the Contractor instructions how the backfill schedule requirements will be achieved. Provide instructions to the Owner's Representative for review and comment at least 7 days prior to commencing backfilling
- .7 When there is granular material placed in the pipe zone, install a compacted earth plug at a maximum interval of 50 m. The intent of the earth plug is to minimize water from piping through the granular material. Contractor to record the location of earth plugs and provide this information to the Owner's Representative.
- .8 When compacting in the pipe zone, care should be taken to avoid contact between the pipe and the compaction equipment (mechanical tampers, tamping bars, etc.).
- .9 Compaction in the haunch area is to be obtained by use of mechanical tampers and tamping bars. Care should be taken to ensure that the pipe does not "float" due to the compacting methods.
- .10 When compacting initial backfill, mechanical tampers are to be used adjacent to the pipe. Mechanical tampers shall not be used directly above the pipe until a minimum of 300 mm of backfill material is in place above the pipe.
- .11 When compacting backfill in the intermediate zone, roller compacting equipment is not to be used until a minimum of 500 mm of backfill material has been placed above the top of pipe.
- .12 The use of hydro-hammer in the pipe zone is not be permitted.
- .13 When compacting backfill above the pipe zone, hydro-hammer is not to be used until a minimum of 1,000 mm of backfill material has been placed above the top of pipe.

3.4 UTILITY CROSSINGS

- .1 Install crossings to the lines, grades and elevations shown on the Contract Documents.
- .2 Comply with requirements of crossing agreement, permit or other crossing requirements issued by utility company.

3.5 PIPE TRENCH WIDTH

- .1 Except as otherwise specified, minimum and maximum trench widths, up to a point 300 mm above top of pipe, will be as specified in Pipe Trench Width Schedule.

EXCAVATING TRENCHING AND BACKFILLING

- .2 Maximum trench widths indicated in Pipe Trench Width Schedule exclude an allowance for shoring.
- .3 Trench width at any point will not be less than trench width at any depth below such point.

3.6 PIPE TRENCH WIDTH SCHEDULE

Pipe Size (Outside Diameter)	Minimum Trench Width	Maximum Trench Width
850 mm diameter or less	300 mm greater than external pipe diameter	600 mm greater than external pipe diameter or 750 mm total trench width, whichever is greater
Greater than 850 mm diameter	300 mm greater than external pipe diameter	600 mm greater than external pipe diameter

3.7 BACKFILLING SCHEDULE

Location	Fill Material	Max. Lift Thickness	Minimum Compaction	Moisture Content Variance from Optimum
Pipe Zone (Bedding and haunching)				
Type 1	Suitable Native Material	150 mm	95%	-3% to +3%
Type 2	Zone 4 Granular Material	150 mm	95%	-3% to +3%
Pipe Zone (Initial backfill)				
Type 1	Suitable Native Material	150 mm	95%	-1% to +2%
Type 2	Suitable Native Material	150 mm	95%	-1% to +2%
Intermediate Zone				
Type 1	Suitable Native Material	150 mm	98%	-1% to +2%
Type 2	Suitable Native Material	150 mm	98%	-1% to +2%
Final Zone to 1.0m below subgrade				
Type 1	Suitable Native Material	150 mm	98%	-1% to +2%
Type 2	Suitable Native Material	150 mm	98%	-1% to +2%

EXCAVATING TRENCHING AND BACKFILLING

END OF SECTION

ROCK REMOVAL

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location of “Rock Excavation” specified herein.

1.2 DEFINITIONS

- .1 Rock Excavation includes:
 - .1 Removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with a Group 10 hydraulic excavator or Group 6 track type loader (defined in the current Alberta Roadbuilders and Heavy Construction Association Equipment Rental Rates Guide).
 - .2 Boulders encountered during excavation which are larger than 1.5 m³ will be classified as rock.
 - .3 Frozen soil materials will not be classified as rock excavation.

2. PRODUCTS

- .1 Not applicable.

3. EXECUTION

3.1 PROTECTION OF EXISTING FACILITIES

- .1 Locate utility lines, fencing, survey reference points, instrumentation, culverts, and all other existing facilities before commencement of Work. Protect these items from damage.

3.2 EXCAVATION

- .1 Excavate rock by mechanical methods in accordance with the excavation plan.
- .2 Conform to Regulatory Requirements when using explosives.
- .3 Remove shattered layers to provide sound and unshattered base for structure and pipe foundations.
- .4 Remove boulders and fragments that may slide or roll into excavated areas.
- .5 Scale and remove loose rock from excavated faces immediately following excavation, and at any time during the Contract. Remove rock which is unsafe or appears to endanger persons, work or property.

ROCK REMOVAL

- .6 Use methods and techniques that will reduce overbreak. Prevent shattering or splitting of rock, or the opening up of seams in rock not required to be excavated.
- .7 Thoroughly clean the rock surface with brooms and carefully apply compressed air to remove disturbed material. During cleanup of the rock surface, control the air pressure to ensure high pressures are not directed into the bedrock joints which will lift or break out fragments of sound competent bedrock.

3.3 OVER EXCAVATION

- .1 Excavation outside the required lines and grades and elevations that is not specifically authorized by the Owner will be considered as unauthorized over excavation and will not be paid.
- .2 Correct any over excavation made in the construction areas, without authorization by the Owner, by backfilling with compacted impervious fill or tamped impervious fill materials and compacting to 95% Standard Proctor Maximum Dry Density in accordance with ASTM D698. Backfilling of unauthorized excavation will not be paid for.

3.4 DISPOSAL OF EXCAVATED MATERIAL

- .1 Load, haul, and dispose of excavated materials in designated waste fill areas or random embankments.
- .2 Maintain waste fills and random embankments in a neat, sightly, free-draining condition with leveled off surfaces.
- .3 Ensure side slopes for waste fills and random embankments are as shown in the Contract Documents.

3.5 TOLERANCE

- .1 Excavate rock surfaces against which concrete is placed, to a maximum of 50 mm inside the lines, grades and elevations shown in the Contract Documents. Excavate rock surfaces outside the limits of the structures and where concrete will not be placed to a maximum of 100 mm inside the lines, grades and elevations shown in the Contract Documents.
- .2 Excavation outside the lines, grades and elevations required is not restricted, however, excavation and backfill beyond the lines, grades and elevations will not be paid.

END OF SECTION

EXCAVATION

1. GENERAL

1.1 INTENT

- .1 Read this section in conjunction with other sections for location, use and placement of "Excavation" specified herein.

1.2 DEFINITIONS

- .1 "Common Excavation" is defined as all excavation, hauling, placement and compaction of materials within the project work area excluding materials classified under topsoil stripping, rock excavation, borrow excavation or other specified excavation operations as shown in the Contract Documents or as designated by the Owner's Representative.
- .2 "Borrow Excavation" is defined as all imported excavation from borrow areas excluding materials classified under topsoil stripping, excavation of frozen material or other specified excavation operations as shown in the Contract Documents or as designated by the Owner's Representative.
- .3 "Waste Excavation" is defined as all excavation, hauling, and placement of materials, within the project work area and at designated waste areas, that are not suitable for use or are surplus to requirements for the completion of the project work excluding materials classified under topsoil stripping, rock excavation or other specified excavation operations as shown in the Contract Documents or as designated by the Owner's Representative.

2. PRODUCTS

- .1 Not applicable.

3. EXECUTION

3.1 PREPARATION

- .1 Notify Owner's Representative at least 2 days prior to beginning excavating operations.
- .2 Prior to commencing excavation:
 - .1 Contact all appropriate utility companies and establish exact location and current status of all utilities, voltage of underground and overhead power lines and pressure of natural gas lines.
 - .2 Notify Owner if any utility lines have been omitted from or incorrectly indicated in the Contract Documents.

EXCAVATION

3.2 PROTECTION OF EXISTING FACILITIES

- .1 Locate utility lines, fencing, survey reference points, instrumentation, culverts, and all other existing facilities before commencement of Work. Protect these items from damage.

3.3 UNAUTHORIZED EXCAVATION

- .1 Unauthorized excavation is any excavation beyond lines, elevations and dimensions indicated in the Contract Documents without specific authorization by the Owner.
- .2 Fill unauthorized excavation to lines, elevations and dimensions indicated, as directed by the Owner's Representative.
- .3 Unauthorized excavation and remedial work will be at Contractor's expense.

3.4 EXCAVATION LINES

- .1 Excavate to the lines, grades and elevations indicated in the Contract Documents or as determined by the Owner's Representative
- .2 The Owner's Representative will determine if unsuitable bearing materials are encountered at indicated foundation elevations. Carry excavation deeper to remove unsuitable bearing materials and replace excavated material with suitable materials.
- .3 The Owner's Representative will determine if bearing conditions are fulfilled at elevations above those indicated in the Contract Documents. Adjust excavation elevations to accommodate raised foundation level.

3.5 SHORING AND BRACING

- .1 If required to provide safe working conditions and to prevent cave-ins and loose soil from falling into excavations, protect excavations by temporary shoring, bracing, or other suitable methods.
- .2 Where the excavation is made to accommodate structures, remove sufficient material to allow for the proper placing and bracing of forms.
- .3 No extra payment will be made for supplying, placing, maintaining and removing sheeting, bracing, shoring, or other means of temporary support.

3.6 EXCAVATION

- .1 Strip Topsoil and Subsoil and stockpile in the designated areas.
- .2 Remove and dispose of all water, snow and surface ice prior to excavation.
- .3 Schedule and coordinate the work such that excavations are trimmed to grade prior to becoming frozen.

EXCAVATION

- .4 Excavate to the required lines, grades and elevations.
- .5 Immediately notify the Owner's Representative of unsuitable organic soils or other unsuitable or unstable materials encountered during excavation and remove unsuitable materials to the depth and extent directed.
- .6 Prevent loss of soil and sloughing of slopes if springs or seepage are encountered within excavation.
- .7 Remove boulders, loose bedrock, soil blocks and other fragments that may slide or roll into excavated areas, which, in the opinion of the Owner's Representative or the Contractor, are unsafe or appear to endanger persons, work or property. The fact that such removal may enlarge an excavation beyond the required excavation lines will not relieve the Contractor from the necessity of doing such scaling and removal.

3.8 COBBLES AND BOULDERS

- .1 The Contractor is advised that cobbles and boulders too large to be left in fill materials are anticipated to be encountered in materials excavated from all areas of the site including Borrow Areas. These cobbles and boulders must be removed from the fill prior to compaction. In some cases the cobbles and boulders can be too large to be reasonably moved by hand and must be removed by machinery. When cobbles and boulders are removed by machinery, reasonable care, satisfactory to the Owner's Representative, must be taken to limit the quantity of suitable fill removed with the cobble or boulder.
- .2 The Contractor is encouraged to make appropriate use of cobbles and boulders materials where suitable and acceptable to the Owner. Stockpile excess cobbles and boulders at locations within the Site limits designated by the Owner's Representative.
- .3 No separate payment will be made for removal, handling, transporting and/or disposing of cobbles and boulders.

3.9 DISPOSAL OF EXCAVATED MATERIAL

- .1 General
 - .1 Obtain prior approval by Owner for stockpile areas. Strip topsoil from stockpile areas except do not strip topsoil stockpile areas.
 - .2 If stockpiling is required, stockpile materials meeting the classifications of different zones in separate stockpiles.
 - .3 Prepare stockpile sites and construct stockpiles taking every precaution necessary to prevent segregation of particle sizes and contamination with other materials.

EXCAVATION

- .4 Finish the surfaces in stockpiles to safe, stable lines and slopes 3H:1V or flatter or as directed by the Owner's Representative and leave the surfaces in a neat and workmanlike manner.
- .5 Maintain stockpiles in a condition acceptable to Owner.
- .6 Do not block drainage courses with stockpiled material.
- .7 Space all stockpiles at least three metres from adjacent material stockpiles with a different classification.
- .8 Remove all stockpiled materials from stockpiles and incorporate into the Work of the Contract.
- .2 Suitable Materials
 - .1 Load, haul and place, suitable materials from common and borrow excavations where placement of compacted and tamped fills are designated.
- .3 Unsuitable Materials
 - .1 Load, haul and place unsuitable waste excavation materials in designated waste fills and waste sites.
 - .2 Load, haul and place unsuitable materials from borrow excavations in borrow areas, after the removal of all suitable materials.
- .4 Excavated Material Disposal Sites
 - .1 The Contractor will assume ownership of the different excavated materials, not incorporated into the work. The Contractor is encouraged to recycle this waste material where practical. The Contractor will dispose of non-recycled waste material at a licensed landfill.

3.10 TOLERANCE

- .1 Excavate all surfaces to within + 20 mm and - 20 mm of the lines, grades and elevations shown in the Contract Documents.

END OF SECTION

SUBGRADE PREPARATION

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location and requirement of "Subgrade Preparation" specified herein.

2. DEFINITIONS

- .1 "Scarification" is defined as loosing or breaking up of surface of soils with a disk, cultivator, shanks, or ripper teeth to a depth of 150 mm unless specified otherwise in the Contract Documents.

3. PRODUCTS

- .1 Not Applicable.

4. EXECUTION

4.1 SUBGRADE PREPARATION

- .1 Subgrade preparation includes the following work:
 - .1 Excavate the upper 300 mm of subgrade earth materials allowing for the lower 300 mm to 600 mm zone of subgrade earth material to be shaped, scarified, conditioned and compacted. The lower zone subgrade earth materials to be compacted to a minimum of 98% Standard Proctor Maximum Dry Density and moisture conditioned to within + 2% to - 2% of optimum moisture content.
 - .2 Place, scarify, moisture condition, shape and compact the upper 300 mm of subgrade earth materials to 100% Standard Proctor Density, moisture conditioned to within -1% to +2% of optimum moisture content and to design subgrade elevation.
- .2 When the moisture content in the subgrade material is lower than that specified, add water and mixed with the material to achieve uniform moisture content in the material to conform to the requirements.
- .3 When the moisture content in the subgrade material is higher than that specified, dry the material by scarifying, disking, mixing and harrowing to achieve uniform moisture content in the material that conforms to the requirements.
- .4 Remove and dispose of unsuitable materials as authorized by the Owner's Representative. Replace with an approved suitable material and compact as specified herein.
- .5 Maintain the subgrade to the specified section, grades and condition required for filter fabric and/or granular material placement. Provide interim drainage to prevent damage

SUBGRADE PREPARATION

to the work and unstable conditions due to high moisture contents. No separate payment will be made for these items.

- .6 The subgrade will pass density and proof rolling requirements prior to the placement of filter fabric and/or granular materials.

4.2 TOLERANCES

- .1 Shape and compact subgrade to the required cross-section and grade to within -10 mm and +10 mm of design elevations but not uniformly high or low, and maintain surface drainage as required to protect the work.

END OF SECTION

BUILDING AND STRUCTURE BACKFILLING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Building and Structure Backfilling" specified herein.
- .2 This section includes requirements for backfilling, filling, and compaction inside the perimeters of each building or structure and outside the perimeters of each building or structure, adjacent to foundations.

4. EXECUTION

4.1 PLACEMENT AND COMPACTION OF FILL MATERIALS

- .1 Backfill excavations and fill to required subgrade elevations using fill materials specified in Backfilling and Filling Schedule.
- .2 Place fill materials in layers not exceeding loose thickness specified in Backfilling and Filling Schedule.
- .3 Moisture condition each layer of fill to within the Optimum Moisture Content range specified in Backfilling and Filling Schedule
- .4 Compact each layer of fill to the minimum percentages of Standard Proctor Density specified in Backfilling and Filling Schedule.
- .5 Ensure that adequate permanent or temporary horizontal bracing of the building or structure is in place prior to backfilling against walls.
- .6 Take care to prevent damage to or displacement of waterproofing, insulation, weeping tile installation, pipe, conduit and other work.

4.2 GRANULAR BASE CONSTRUCTION UNDER SLABS

- .1 Directly under floor slabs supported on grade, provide a minimum of 150 mm compacted depth of Road Gravel.
- .2 Where slab is to be directly underlain by a sheet moisture/vapour barrier, provide a uniform top dressing of coarse sand, applied and compacted to produce a smooth surface to receive sheet and slab.

4.3 BACKFILLING AND FILLING SCHEDULE

BACKFILLING AND FILLING SCHEDULE

BUILDING AND STRUCTURE BACKFILLING

Location	Fill Material	Max. Lift Thickness	Minimum Compaction
Under structural slabs and exterior slab-on-grade	Native	150 mm	98%
Landscaped Areas	Native	150 mm	98%
Within 1m of side of caisson walls	Native	150 mm	95 %

END OF SECTION

COMPACTED EARTH FILL

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Compacted Earth Fill" specified herein.

1.2 TYPES OF FILL

- .1 Compacted Fill.
- .2 Tamped Fill.
- .3 Waste Fill.

1.3 DEFINITIONS

- .1 "Suitable Material" is defined as material obtained from common or borrow excavations, free of organic or frozen materials, that is suitable for compacted embankment construction.
- .2 "Unsuitable Material" is defined as organic or frozen material from common or borrow excavations, that is not suitable for compacted embankment construction.
- .3 "Compacted Fill" or "Tamped Fill" is defined as suitable material obtained from common or borrow excavations, free of organic, wet or frozen materials, and placed on site, road or embankment construction.
- .4 "Waste Fill" is defined as organic or frozen material from common or borrow excavation that is not suitable for site, road, embankment, liner or structural construction.

2. PRODUCTS

2.1 FILL MATERIALS

- .1 Compacted and tamped fill material is fine grained materials having a minimum of 50% passing the 0.075 mm sieve size and classified as a low to medium plastic clay based on the unified classification system as modified by PFRA.
- .2 Remove tree roots, sod or other organic materials.
- .3 Do not use frozen material in the fill.
- .4 Remove cobbles and rock fragments having maximum dimensions greater *than* 100 mm

COMPACTED EARTH FILL

3. EXECUTION

3.1 GENERAL

- .1 Do not proceed with fill placement until the Owner has inspected and approved foundation areas designated for fill placement.
- .2 Scarify the foundation to obtain a suitable bond with the earthfill immediately prior to placing the first layer of earthfill.
- .3 Construct earthfills to the lines, grades and elevations shown in the Contract Documents.
- .4 Suspend all earthwork operations at any time when satisfactory work cannot be conducted on account of rain, floods, cold weather or other unsatisfactory conditions.

3.2 DENSITY CONTROL

- .1 Compacted Fill material to be compacted to a dry density equal to or greater than 98% of the maximum dry density obtained in the Standard Proctor Compaction Test performed in accordance with ASTM D698.
- .2 Tamped Fill material to be compacted to a minimum 98% of the maximum dry density obtained in the Standard Proctor Compaction Test performed in accordance with ASTM D698.
- .3 Waste Fill material to be compacted to 85% of Standard Proctor Maximum Dry Density Test performed in accordance with ASTM D698.
- .4 Fill material within 150 mm of finished grade to be compacted to 100% of Standard Proctor Maximum Dry Density Test performed in accordance with ASTM D698.

3.3 MOISTURE CONTROL

- .1 Maintain moisture content for Tamped Fill materials within -2% to +2% of optimum moisture content as determined by ASTM D698 test procedures.
- .2 When the moisture content in the fill material is lower than that specified for placement, add water and mix with the material to achieve uniform moisture content in the material to conform to the requirements.
- .3 When the moisture content in the fill material is higher than that specified for placement, dry the material by scarifying, disking, mixing and harrowing to achieve uniform moisture content in the material to conform to the requirements.
- .4 Moisture content control on waste fill will not be required.
- .5 Do not apply water to fill material in a manner that causes segregation or the finer materials to be washed out.
- .6 Water added to fill material for moisture control purposes will be free of deleterious materials.

COMPACTED EARTH FILL

3.4 PLACEMENT AND COMPACTION

- .1 Drain and clean all earth foundations of loose, thawed, frozen, soft, or other deleterious material including ice, snow and organic materials and topsoil.
- .2 Work the surface to obtain a suitable bond with the earth fill immediately prior to placing the first layer. Scarify the top 300 mm of the surface and compact to 95% of the maximum dry density obtained in the Standard Proctor Compaction Test performed in accordance with ASTM D698.
- .3 When the surface of the prepared foundations or the compacted fill material is too dry or too smooth to bond properly with the layer of fill material to be placed thereon, moisten the surface and work with a disc, scarifier, or other equipment, to provide a satisfactory bonding surface before the succeeding layer of fill material is placed.
- .4 When the surface of the prepared foundations or the compacted fill material is too wet for proper compaction, remove it and allow it to dry, or work it with a harrow, disc or other equipment to reduce the moisture content to the required amount; then compact the fill material before the succeeding layer of fill material is placed thereon.
- .5 Maintain slopes at less than 1V:1H for earth foundations on which fill is to be placed.
- .6 Place compacted fill material in continuous horizontal layers not exceeding 150 mm in thickness when compacted. Spread, blend, disc, blade, smooth and compact each lift to provide a homogeneous fill without stratification. Commence placement of fill at the lowest elevation of foundation. Use sheepfoot type compaction equipment.
- .7 Place waste fill materials in continuous horizontal lifts not exceeding 300 mm in thickness such that there will be no voids or bridging of material. Spread and compact each lift by complete coverage of tracked equipment. Blade the compacted waste fill embankment to a smooth, uniform, free-draining shape.
- .8 Join new fill to existing slopes by terracing or excavating into slopes to remove all dried and loose material.
- .9 Schedule fill placement operations such that the foundation areas or previously compacted earthfill does not freeze and that compacted earthfill is not placed on frozen subgrade. Remove and replace any such frozen layers of compacted earthfill at no cost to the Owner.
- .10 Scarify each lift of fill to a minimum depth of 70 mm following compaction, using a disc or other Owner approved equipment to ensure complete bond between that lift and the overlying lift.
- .11 Reroute construction traffic or increase fill thickness over soft foundations in areas where fill surface starts rutting. If rutting has occurred, scarify, regrade and moisture condition the fill surface prior to placement of overlying fill.
- .12 Re-compact or remove any portion of the fill, which has suffered a reduction in density due to frost, rain or any other reason before placing succeeding layers. Protect compacted fill material and foundations prepared for the fill from freezing.

COMPACTED EARTH FILL

- .13 Remove any non-conforming materials, which accumulate on the surface of any layer, or prepared foundation before any material is placed for the succeeding layer.
- .14 Maintain adequate grading during construction to protect the work from surface drainage damage.

3.5 COMPACTION EQUIPMENT

- .1 Supply necessary compaction equipment capable of meeting the specified compaction requirements.
- .2 Hauling equipment is not acceptable for compaction.
- .3 The Owner's Representative reserves the right to order the discontinuation of any compaction equipment that does not produce the specified compaction requirements or causes excessive breakage around structures or is not capable of compacting the fill material to the required density in a reasonable time.

3.6 TOLERANCE

- .1 Make changes in grade natural. Blend slopes into level areas.
- .2 Compact all surfaces to within -50 mm and + 50 mm from the lines, grades and elevations shown in the Contract Documents.

3.7 COMPACTION SCHEDULE

Location	Maximum Loose Lift Thickness (mm)	Moisture Content Limits ⁽¹⁾	Density Limits ⁽²⁾
Compacted Clay	150	Optimum to +2%	≥98% SPMDD
Compacted Embankment	150	Optimum to +2%	≥98% SPMDD
Landscape Fill/Stockpile Areas	300	N/A	≥95% SPMDD

⁽¹⁾ Moisture content range above (+) or below (-) Optimum Moisture Content (ASTM D698).

⁽²⁾ Density relative to indicated reference value, Standard Proctor Maximum Dry Density (SPMDD), as determined by test method ASTM D698, or Maximum Vibrated Density (MVD), as determined by test method ASTM D4253.

END OF SECTION

RESTORATION OF SITEWORK

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Restoration of Sitework" specified herein.

2. PRODUCTS

- .1 Not Applicable.

3. EXECUTION

3.1 RESTORATION - GENERAL

- .1 Restore all existing areas and sitework damaged or disturbed due to earthwork or other work of this Contract, back to their original condition or better.

3.2 LANDSCAPE WORK

- .1 Protect the integrity of the existing landscape features by implementing construction procedures that will minimize damages.
- .2 Restore all landscape features damaged or disturbed by the work, back to their original condition or better. All costs associated with this work will be borne by the Contractor.
- .3 Maintain all trees within the work site.
- .4 Minimize damage to trees, plants and shrubs during the course of construction.
- .5 Attend to damaged trees, plants or shrubs by qualified personnel.
- .6 All grassed areas along Sunset Blvd. will be restored with topsoil and sod.
- .7 Topsoil and sod reconstruction limits will be laid out by the Owner's Representative when rough grading has been completed.
- .8 All landscape work will be completed to the satisfaction to the Owner.

3.3 IRRIGATION WORK

- .1 Maintain all irrigation system works, unless otherwise noted.
- .2 Restore all irrigation system components damaged or disturbed by the work, back to their original condition or better. All costs associated with this work will be borne by the Contractor.
- .3 All irrigation repair work will be constructed in accordance with the latest edition of the Town of Turner Valley Construction Standards.

RESTORATION OF SITEWORK

- .4 All irrigation work will be completed to the satisfaction to the Owner.

3.4 CONCRETE STRUCTURE WORK

- .1 Protect the integrity of existing concrete structures. This includes utilizing suitably sized equipment and implementing construction procedures that will minimize concrete damage.
- .2 Replace any concrete structures damaged or disturbed, outside of the construction limits. All costs associated with this work will be borne by the Contractor.

3.5 ASPHALT WORK

- .1 Protect the integrity of existing road, lane and driveway structures. This includes utilizing suitably sized equipment and implementing construction procedures that will minimize pavement damage.
- .2 Replace any asphalt pavement damaged or disturbed, outside of the construction limits. All costs associated with this work will be borne by the Contractor.
- .3 All paved road restoration and reconstruction work along {description of area}, will consist of subgrade preparation; 250mm sub-base granular material; 100mm base granular material; prime coat; 60mm Type 1 hot mix asphalt, tack coat and 60mm Type 2 hot mix asphalt.
- .4 All paved lane restoration and reconstruction work along {description of area}, will consist of subgrade preparation; 200mm base granular material; prime coat and 80mm Type 3 hot mix asphalt.
- .5 All paved driveway restoration and reconstruction along {description of area}, will consist of subgrade preparation; 200mm base granular material; prime coat and 80mm Type 3 hot mix asphalt.

3.6 GRAVEL WORK

- .1 Restore any gravel damaged or disturbed outside of the construction limits, back to their original condition or better. All costs associated with this work will be borne by the Contractor.
- .2 All gravel lane restoration and reconstruction work along Sunset Blvd. will consist of subgrade preparation and 300mm base granular material.
- .3 All gravel driveway restoration and reconstruction work along Sunset Blvd. will consist of subgrade preparation and 300mm base granular material.

END OF SECTION

DUST CONTROL

1. GENERAL

1.1 INTENT

- .1 Read this section in conjunction with other Sections for the location, use and placement of "Erosion and Sediment Control" requirements specified herein.

1.2 REFERENCES

- .1 Undertake Erosion and Sediment Control installation in accordance with the latest edition of Alberta Transportation's "Field Guide for Erosion and Sediment Control for Highways" City of Calgary Water Services "Guidelines for Erosion & Sediment Control" 2011.

1.3 SUBMITTALS

- .1 Submit the Erosion and Sediment Control Plan to the Owner's Representative for review and comment at least five (5) working days prior to commencing construction activities.
- .2 Submit all proposed erosion and sediment control products to the Owner's Representative for review and comment at least two weeks prior to commencing construction activities.

2. PRODUCTS

2.1 ROLLED EROSION CONTROL PRODUCTS

- .1 Approved products:
- If required: North American Green - V Max SC 250 rolled erosion control matting and staples or approved equal.

2.2 SILT FENCE

- .1 Fence fabric consisting of a woven polypropylene fabric having the following minimum physical properties:

Property	Requirement	Test Method
Mass Per Unit Area	100 g/m ²	N/A
Tensile Strength	550 N	ASTM D4632
Elongation	15%	ASTM D4632
Trapezoidal Tear Strengths	290 N	ASTM D4533
Puncture Strength	290 N	ASTM D4833
Apparent Opening Size	600 microns	ASTM D4751

- .2 Approved products:
- Brock White – AGES 600G or approved equal.

2.3 FIBER FILTRATION TUBES

DUST CONTROL

- .1 Engineered composites of wood fibers, man-made fibers, and performance-enhancing polymers encased in heavy-duty, knitted cylindrical tubes.
- .2 Approved products:
 - GPEC / PROFILE Products LLC – Terra-Tubes® or approved equal

2.4 VARIOUS

- .1 Gabions, gabion mats, rock check dams, synthetic permeable (ditch) barriers, seed, mulch, and other E&SC products will be reviewed upon E&SC Plan submission.

3. EXECUTION

3.1 GENERAL – EROSION AND SEDIMENT CONTROLS

- .1 Provide all equipment, materials, and labour for the supply, installation, and maintenance of erosion and sediment control measures. The measures may include, but are not limited to, silt fencing, storm inlet sediment barriers, synthetic permeable (ditch) barriers, sediment traps seeding, surface roughening and texturing, and other best management practices for sediment and erosion control.
- .2 Modify the erosion and sediment control measures as required by changes in the construction activities and the weather conditions.
- .3 Install erosion and sediment control products as per manufacturers' recommendations.
- .4 Undertake a site inspection and complete a sedimentation report after any significant rainfall event, and at least every seven calendar days.
- .5 Roughen the prepared topsoil slope surfaces by slope texturing employing the surface tracking method prior to seeding and/or hydro mulching.
- .6 Maintain erosion and sediment control measures until revegetation has established and risk of erosion no longer exists.

END OF SECTION

1. GENERAL

1.1 INTENT

- .1 Read this section in conjunction with other Sections for the location, use and placement of "Erosion and Sediment Control" requirements specified herein.

1.2 REFERENCES

DUST CONTROL

- .1 Prepare an Erosion and Sediment Control Plan in accordance with the latest edition of Alberta Transportation's "Design Guidelines for Erosion and Sediment Control for Highways". The plan is required to be prepared by certified CPESC personnel.
- .2 Undertake Erosion and Sediment Control installation in accordance with the latest edition of Alberta Transportation's "Field Guide for Erosion and Sediment Control for Highways" City of Calgary Water Services "Guidelines for Erosion & Sediment Control" 2011.

1.3 SUBMITTALS

- .1 Submit the Erosion and Sediment Control Plan to the Owner's Representative for review and comment at least five (5) working days prior to commencing construction activities.
- .2 Submit all proposed erosion and sediment control products to the Owner's Representative for review and comment at least two weeks prior to commencing construction activities.

2. PRODUCTS

2.1 ROLLED EROSION CONTROL PRODUCTS

- .1 Approved products:
 - If required: North American Green - V Max SC 250 rolled erosion control matting and staples or approved equal.

2.2 SILT FENCE

- .1 Fence fabric consisting of a woven polypropylene fabric having the following minimum physical properties:

Property	Requirement	Test Method
Mass Per Unit Area	100 g/m ²	N/A
Tensile Strength	550 N	ASTM D4632
Elongation	15%	ASTM D4632
Trapezoidal Tear Strengths	290 N	ASTM D4533
Puncture Strength	290 N	ASTM D4833
Apparent Opening Size	600 microns	ASTM D4751

- .2 Approved products:
 - Brock White – AGES 600G or approved equal.

2.3 FIBER FILTRATION TUBES

- .1 Engineered composites of wood fibers, man-made fibers, and performance-enhancing polymers encased in heavy-duty, knitted cylindrical tubes.
- .2 Approved products:

DUST CONTROL

- GPEC / PROFILE Products LLC – Terra-Tubes® or approved equal

2.4 VARIOUS

- .1 Gabions, gabion mats, rock check dams, synthetic permeable (ditch) barriers, seed, mulch, and other E&SC products will be reviewed upon E&SC Plan submission.

3. EXECUTION

3.1 GENERAL – EROSION AND SEDIMENT CONTROLS

- .1 Provide all equipment, materials, and labour for the supply, installation, and maintenance of erosion and sediment control measures. The measures may include, but are not limited to, silt fencing, storm inlet sediment barriers, synthetic permeable (ditch) barriers, sediment traps seeding, surface roughening and texturing, and other best management practices for sediment and erosion control.
- .2 Modify the erosion and sediment control measures as required by changes in the construction activities and the weather conditions.
- .3 Install erosion and sediment control products as per manufacturers' recommendations.
- .4 Undertake a site inspection and complete a sedimentation report after any significant rainfall event, and at least every seven calendar days.
- .5 Roughen the prepared topsoil slope surfaces by slope texturing employing the surface tracking method prior to seeding and/or hydro mulching.
- .6 Maintain erosion and sediment control measures until revegetation has established and risk of erosion no longer exists.

END OF SECTION

TOPSOIL REMOVAL AND FINISHED GRADING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Topsoil Placement and Grading" specified herein.

1.2 TOPSOIL TESTING

- .1 Contractor will arrange and pay for services of accredited testing laboratory, approved by the Owner's Representative, to perform complete soil quality analysis on topsoil. Provide adequate tests from all sources of topsoil and submit original copy of analysis to the Owner's Representative.
- .2 Soil analysis will include results for: existing soil nutrients; soil salinity expressed as electrical conductivity; pH value; organic matter; soil texture; fertility recommendations; and recommended soil conditioning amendments.

1.3 SOURCE TOPSOIL

- .1 Use native topsoil materials from designated topsoil stockpiles provided it meets specified requirements.
- .2 If native topsoil is inadequate in quantity, quality or both, use imported topsoil meeting specified requirements for balance of topsoil required.

2. PRODUCTS

2.1 TOPSOIL MATERIALS

- .1 Topsoil materials to be a mixture of mineral particulates, microorganisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Soil texture to be based on the *Canadian System of Soil Classification*, to consist of 20% to 70% sand and contain 2% to 10% organic matter by weight.
 - .2 Topsoil PH value to be between 6.5 to 8.0.
 - .3 Topsoil to contain no toxic elements or growth inhibiting materials.
 - .4 Topsoil to be free from debris and stones over 50 mm diameter.
 - .5 Topsoil consistency to be friable when moist.
- .2 Major soil nutrients required for topsoil fertility to be present in following ratios:
 - .1 Nitrogen (N): 20 to 40 microgram of available N per gram of topsoil.
 - .2 Phosphorus (P): 10 to 20 micrograms of phosphate per gram of topsoil.
 - .3 Potassium (K): 80 to 120 micrograms of potash per gram of topsoil.

TOPSOIL REMOVAL AND FINISHED GRADING

- .4 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
- .5 Coarse vegetative material: 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

2.2 SOIL AMENDMENTS

- .1 Specify quality of material for required soil amendments. Include additional soil amendments for special turf and plant material requirements.
 - .1 Peatmoss:
 - Derived from partially decomposed species of Sphagnum Mosses.
 - Elastic and homogeneous, brown in colour.
 - Free of wood and deleterious material which could prohibit growth.
 - Shredded particle minimum size: 5 mm.
 - Sand: washed coarse silica sand, medium to coarse textured.
 - .2 Limestone:
 - Ground agricultural limestone containing minimum calcium carbonate equivalent of 85%.
 - Graduation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.124 mm sieve.
 - .3 Fertilizer:
 - Complete, commercial with 35% soluble nitrogen.

3. EXECUTION

3.1 DESIGNATED TOPSOIL MATERIALS

- .1 Control and eliminate perennial grass and noxious weeds including their root systems until stockpile topsoil is required for landscape use. Stockpile topsoil will be reasonably free of all weed growth before placement on site.
- .2 Perform weed control, when necessary, in accordance with relevant government chemical pesticide application legislation. Obtain Owner's approval for all pesticide applications.
- .3 Submit detailed pesticide applicator's log for verification after each application of approved pesticide.

3.3 PREPARATION OF SUBGRADE

- .1 Remove debris, roots, branches, foreign material, undesirable plants, visible stones in excess of 50 mm diameter, contaminated soil and other deleterious materials. Dispose of waste materials at a licensed landfill.
- .2 Grade areas to be reclaimed to finish subgrade. Eliminate uneven areas and low spots and ensure proper drainage.

TOPSOIL REMOVAL AND FINISHED GRADING

- .3 Scarify all areas designated for topsoil placement to a depth of 150 mm, except in areas where considered impractical by the Owner's Representative. Scarify entire subgrade area once in the longitudinal direction and once in the perpendicular direction. Disc area when large clay lumps are prevalent.
- .4 Compact finished subgrade to 95% Standard Proctor Density unless noted elsewhere.

3.4 TOPSOIL PLACEMENT

- .1 Place and spread subsoil and topsoil materials in uniform layers not exceeding 150 mm, in dry weather on dry unfrozen subgrade.
- .2 Manually spread and rake topsoil around structures, trees, fences or other obstructions.
- .3 Spread topsoil to obtain minimum depth after settlement of:
 - 150 mm for seeded areas
 - 125 mm for sodded areas
 - 450 mm for flower beds
 - 600 mm for shrub beds

3.5 FINISH GRADING

- .1 Remove all stones in excess of 50 mm diameter, soil lumps, roots, grass, weeds, construction materials, debris and foreign non-organic materials that may surface after preparation. Dispose of waste materials at a licensed landfill.
- .2 Thoroughly cultivate topsoil to minimum depth of 100 mm by rototilling or hand methods where compaction has occurred and to break all soil lumps.
- .3 Float until surface is smooth. Cut smooth falls to catch basin rims, finish flush.
- .4 Fine grade to eliminate rough or low areas and to ensure positive drainage on slopes and away from buildings, sidewalks and other structures. Maintain levels, profiles and contours of subgrade.
- .5 Leave surface smooth, uniform and sufficiently firm to prevent settlement or sinkage pockets when watered. Finished surface to be even and free from irregular surface changes.
- .6 Rake, chain drag and lightly roll topsoil areas, remove all ridges and fill all depressions. On larger areas, use hydraulic power box rake or similar mechanical equipment to: remove soil lumps, rocks and debris; fill and level low areas; and correct other grading deficiencies in preparation of seed or sod bed.
- .7 When topsoil will abut existing turf, cut turf to form a straight joint with the new seeded or sodded areas.
- .8 Where topsoil will be receiving sod, leave final grade 15 mm below finish grade of adjacent pavement, edging, curbs and crown of adjacent turf area.
- .9 Do not cover catch basins, manholes, valve covers, irrigation boxes or any other surface accesses.

TOPSOIL REMOVAL AND FINISHED GRADING

- .10 Use water trucks and sprinklers to control all airborne dust caused by topsoil placement and grading operations when necessary.
- .11 Immediately clean up any soil or debris spilled onto roadway, walks and mulched areas.

3.6 TOLERANCES

- .1 The finished topsoil surface to be even, uniformly shaped and compacted to within ± 15 mm of design grade, but not uniformly high or low, while maintaining surface drainage.

END OF SECTION

GRASS SEEDING

1. GENERAL

1.1 INTENT

- .1 Read this section in conjunction with other sections for location, use and placement of "Grass Seeding" specified herein.

1.2 DELIVERY STORAGE AND HANDLING

- .1 Provide seed in standard containers clearly labeled with the following information:
- .1 Supplier's name and address
 - .2 Lot Number
 - .3 Net Mass
 - .4 Names and percentages of individual seed species
- .2 Protect seed from moisture, mould and damage while in transit and storage.
- .3 Provide fertilizer in standard containers clearly labeled with the following information:
- .1 Supplier's name and address
 - .2 Specified Composition
 - .3 Net Mass

2. PRODUCTS

2.1 MATERIALS

- .1 Provide seed mixture to the following composition:
- | | |
|---------------------|---------------|
| <u>Seed Mixture</u> | |
| Brome Grass | 80% by weight |
| Creeping Red Fescue | 20% by weight |
- .2 Seed mix to be blended by a qualified seed processor. Contractor to provide a copy of the certification of the seed mix to the Owner.
- .3 Provide seed and seed mixture that are free of all prohibited noxious weed seeds.
- .4 All seed to be stored in a dry weatherproof storage place and to be protected from damage by heat, rodents and other causes.
- .5 Provide Canada No. 1 Grade seed in accordance with the Government of Canada Seeds Act and Seeds Regulations. Do not provide seeds which are wet, mouldy, or otherwise damaged.

GRASS SEEDING

- .6 Provide fertilizer in accordance with Government of Canada Fertilizer Act and Fertilizers Regulations. Fertilizer is to be compatible with the seed mixture and the soil conditions.

3. EXECUTION

3.1 GENERAL

- .1 Prepare topsoil surface for seeding as specified in Section 02201.
- .2 Apply materials during calm weather and on ground free of frost and standing water.
- .3 Measure the quantities of materials by weight.

3.2 APPLICATION OF SEEDS

- .1 Apply seed mixture using a "Brillion" Seeder in two (2) perpendicular directions at the total application rates of 110 kg per hectare. Riverbank areas are to be seeded by a hand broadcast seeder followed by raking.
- .2 Apply seed mixture during calm weather (less than 8 km/hr wind) and on ground free of frost and standing water.
- .3 Perform seeding operations at such a time of the year when climatic conditions are suitable for establishing grass stands.
- .4 Fine grade and loosen the surface to plow depth to obtain a proper seed bed without undue loss from high winds or ordinary rainfall.
- .5 Where the work adjoins existing vegetation, blend the application at least 300 mm into adjacent vegetated areas.
- .6 Protect seeded areas against damage.
- .7 Regulate the drill so that the seed is properly placed in the soil to a depth of 20 to 32 mm.
- .8 Where seeded areas are not hydro mulched, apply 16-20-00 fertilizer uniformly at the rate of 78.5 kg per hectare using a fertilizer attachment.

3.3 MAINTENANCE

- .1 Watering to be carried out when the seed is first applied to prevent grass and the underlying soil from drying out.
- .2 Provide maintenance of turf areas including all measures necessary to establish and maintain grass in healthy and vigorous growing condition.
- .3 Irrigated Areas - Re-apply seed to all areas that do not show a uniform stand of grass. Perform such reapplication to allow for establishment prior to Substantial Performance of the Work. For irrigated areas, a uniform stand of grass will be considered growth that shows no bare spots greater than 50mm by 50mm in size and provides a minimum of ninety-five percent ground cover.

GRASS SEEDING

- .4 Non-Irrigated Areas - Re-apply seed to all areas that do not show a uniform stand of grass. Perform such reapplication to allow for establishment prior to Substantial Performance of the Work. For non-irrigated areas, a uniform stand of grass will be considered growth that shows no bare spots greater than 150mm by 150mm in size and provides a minimum of ninety percent ground cover.
- .5 Re-apply seed to all areas that do not show a uniform stand of grass. Perform such reapplication to allow for establishment prior to Substantial Performance of the Work. A uniform stand of grass will be considered growth that shows no bare spots greater than 0.25 square metres in size and provides a minimum of eighty percent ground cover.

END OF SECTION

EARTHWORK AND GRANULAR MATERIAL TESTING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for requirements for “Earthwork and Granular Material Testing” specified herein.

1.2 TESTING

- .1 Contractor is responsible for performance testing in performance of the Work. Materials testing performed by the Contractor includes all sieve analysis, proctors, and compaction testing to complete the project.
- .2 The Owner's Representative will perform quality assurance testing and related functions.
- .3 The Owner's Representative will perform quality assurance testing according to the testing standards listed in the Contract Documents as selected by the Owner.
- .4 Provide samples requested by Owner's Representative for testing.
- .5 Cooperate with the Owner's Representative in site sampling for testing.

2. PRODUCTS

- .1 Not applicable.

3. EXECUTION

3.1 FILL MATERIAL TESTING

- .1 Fill materials may be tested, before and after placement, for conformance with specified requirements and to confirm suitability for intended uses.
- .2 Acceptance of fill material will be made only after the material has been dumped, spread and compacted in place. Owner may reject fill material in the borrow areas, in the stockpiles, in the transporting vehicle or in place. Cooperate with the Owner to ensure only acceptable fill material will be placed in the Work.
- .3 If requested by the Owner's Representative, provide 1 m³ of each type of imported granular fill material for testing purposes.

3.2 COMPACTION AND MOISTURE CONTENT TESTING

- .1 Compaction and moisture content testing will be performed during fill material placement operations to ensure that specified requirements are met.
- .2 The frequency of compaction and moisture content testing will be determined by the Owner.

3.3 GRAVEL TESTING

EARTHWORK AND GRANULAR MATERIAL TESTING

- .1 The Owner's Representative may carry out testing of the gravel material while it is being processed.

END OF SECTION

CARE OF WATER

1. GENERAL

1.1 INTENT

- .1 Read this section in conjunction with other sections for the location, use and placement for “Care of Water” specified herein.

1.2 SITE CONDITIONS

- .1 Be aware that the project area is located where rapid temperature, and weather changes occur in all four seasons. Prepare the site for sudden rainfalls and quick snow melts due to Chinook winds.

2. PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- .1 Provide all pumps, hoses and related equipment and power sources required for “Care of Water”.
- .2 Maintain pumps in good operating condition at all times. Have at least one standby pump for each category of pump required for care of water on site at all times.
- .3 Install a replacement pump or pumps of equal capacity before removing a pump or pumps for maintenance.

3. EXECUTION

3.1 GENERAL

- .1 Design, construct and maintain Temporary Works, construct and maintain related Permanent Works, as required for care of water, including all necessary cofferdams, channels, flumes, drains, sandpoints, wells and sumps and other temporary diversion and protective works and furnish all materials required therefore. Furnish, install, maintain and operate all necessary pumping and other equipment, for dewatering the various parts of the work and for maintaining the foundation and other parts of the work free of water, ice and snow from whatever source.
- .2 Maintain all sumps, trenches and discharge lines to ensure proper containment and free flow of water to and from the pumps and other diversions and protective works at all times.
- .3 Obtain permits, in addition to those obtained by the Owner.
- .4 Ensure that “Care of Water” procedures do not interfere with the excavated work areas, operation of road surface drainage courses, natural watercourses, utilities or the flow of traffic.
- .5 Repair damage to any part of the work caused by water or failure of protective works at no extra cost to the Owner.

CARE OF WATER

- .6 Be responsible for additional excavation and subsequent backfill made necessary by water, snow, or ice.
- .7 Ensure procedures for "Care of Water" do not cause pollution in the area. Locate and control discharge of water to avoid causing damage to property, pollution of watercourses, nuisances on roads, or injury to the public or wildlife.
- .8 Remove or level all cofferdams, drainage ditches or other Temporary Works after having served their purpose so as not to interfere in any way with adjacent facilities or with adjacent landowners.
- .9 Make provisions for handling residual water, storm runoff and snowmelt that may enter the work area or excavations from time to time.
- .10 Make arrangements with the Owner, landowners and agencies, which may be affected by disposal of water, snow and ice. Written permission is required before any water may be disposed of through sewer of a municipality.
- .11 Remove and dispose of all water, snow and ice from the work areas in a manner not detrimental to public or private property, or any portion of the work completed or under construction.
- .12 Excavations are to be kept free of water while work is in progress.
- .13 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .14 Protect open excavations against flooding and damage due to surface runoff.
- .15 Provide the Owner's Representative written details of the proposed dewatering and/or heave prevention measures and methods such as dikes, well points, and sheet pile cut-offs.

3.2 CONSTRUCTION ACCESS CROSSING

- .1 Provide construction access to crossings, as required.
- .2 Design crossings to accommodate the drainage of runoff water.
- .3 Design crossings for the maximum load of the construction equipment to be used.
- .4 Do not use existing on-site public and private bridges and culvert crossings for construction equipment without prior written approval.

END OF SECTION

UTILITIES HDPE PIPE AND FITTINGS

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other sections for location use and placement of "Utilities HDPE Pipe and Fittings" specified herein.

2. PRODUCTS

2.1 MATERIAL

- .1 The pipe will be made from polyethylene resin compound qualified as Type III, Category 5, Class C, Grade P34 in ASTM D1248-84. This material will have a long term hydrostatic strength of 1600 psi, when tested and analyzed by ASTM D2837.
- .2 The raw material will contain a minimum of 2% carbon black, well dispersed.
- .3 The pipe will contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material supplier.
- .4 Compliance with the requirements of this paragraph will be certified in writing by the pipe supplier upon request.
- .5 The cell classification will be PE 345434C for PE 4710 materials per latest revision of ASTM D3350.

2.2 PIPE

- .1 Ensure pipe is cylindrical and straight, with ends cut square to the longitudinal axis and having a smooth finish free from imperfections such as grooves or ripples.
- .2 Provide pipe and fittings in outside diameter based iron pipe sizes up to 75 mm diameter certified to CSA B 137.1 and AWWA 901 latest revisions and meeting ASTM material specification PE 4710 for hydrostatic design stress of 800 psi.
- .3 Provide pipe and fittings in outside diameter based iron pipe sizes 100 mm diameter and larger certified to CSA B 137.1 and AWWA 906 latest revisions and meeting ASTM material specification PE 4710 for hydrostatic design stress of 800 psi.
- .4 Gravity Sewer pipe will have a light color interior surface that will allow for video inspection of pipe.
- .5 The following information will be continuously indent printed on the pipe, or spaced at intervals not exceeding 1.5 m.
 - .1 Name and/or trademark of the pipe.
 - .2 Nominal pipe size.
 - .3 Pressure rating and/or DR number.
 - .4 The letters "PE" followed by the polyethylene type and category, as specified by ASTM D-1248, followed by the hydrostatic design basis.

UTILITIES HDPE PIPE AND FITTINGS

- .5 Manufactured standard design basis.
- .6 A production code from which the date and place of manufacture can be determined.

2.3 FITTINGS

- .1 Polyethylene fittings will be made from material meeting the same requirements as the pipe.
- .2 Where applicable, fittings will meet the requirements of AWWA C906.
- .3 Molded fittings will be manufactured in accordance with either the latest version of ASTM D2683 (socket fused) or the latest version of ASTM F2620 (butt fused) and will be so marked.
- .4 Mitred fusion and mitred flanged fittings will be FRP reinforced.
- .5 Molded fittings will be constructed of polyethylene pipe with a wall thickness 25% greater than the system design. If molded fittings are to be butt fused, each end of the fitting will be the same thickness as the pipe to which the fitting is to be fused.
- .6 Mechanical Fittings used with polyethylene pipe will be specifically designed for, or tested and found to be acceptable for use with, polyethylene pipe. Mechanical Fittings designed for other materials will not be used unless authorized by the Mechanical Fitting Manufacturer. Special precautions may exist with certain mechanical fittings or additional components may be required. Consult the manufacturer of the fitting and submit shop drawings to the Owner's Representative for review prior to its use.

2.4 TRACER WIRE

- .1 Tracer wire will be a 3.26 mm (8 AWG – American Wire Gauge) Copper Clad Steel (CCS) Extra High Strength (EHS) with purple insulation colour, such as:
 - Pro-Trace HDD-CCS PE45, Pro-Line Safety Products.
 - or approved equivalent.

Conductor shall be hard-drawn, 21% IACS, copper clad steel, utilizing an ANSI 1065 high carbon steel core (required to meet break load), with rated break load of 2,785 lbs (215,000 psi). Conductor will be extruded with 45 mil, high-density, high molecular weight polyethylene (HMW-HDPE) exterior insulation as per ASTM D1248. Tracer wire will be rated for direct burial use at 600 volts and RoHS compliant.

Splice the tracer wire, where and as required, with waterproof connections in such a way so as to maintain wire continuity after backfill and compaction. Install tracer wire through all crossings. Install tracer wire electrical junction boxes as specified in the drawings or at a maximum 2,000 metre interval. Install junction boxes at fence lines and/or beside isolation valves, where possible. Use waterproof electrical conduits at each junction box location where the wire is rising out of the ground. Embed wire conduit a minimum 500 mm into ground. Complete a continuity check on tracer wire prior to final approval.

UTILITIES HDPE PIPE AND FITTINGS

3. EXECUTION

3.1 PIPE INSTALLATION

- .1 Installation and handling of pipe will be according to the manufacturer's recommendations and applicable AWWA Specification for the type of pipe selected or as specified herein.
- .2 Unless otherwise shown on the drawings, HDPE pipe and fittings to be installed with at least a minimum cover of 2.5 m above the crown of the pipe. Pipe and fittings with less than 2.5 m cover will be installed with an insulating frost shield unless otherwise directed by Owner's Representative.
- .3 Install pipe to the lines, grades, and elevations shown on the Contract Documents. Pipe bedding as specified. Lay the pipes on the prepared bed, true to line and grade, with pipe invert smooth and free of sag or high points. Ensure barrel of each pipe is in contact with shaped bed throughout the full length of pipe.
- .4 Lower pipe into the trench by hand or by mechanical equipment. Lift pipe by means of slings and lower into the trench. By no means will the pipe be lifted with equipment that gouges or scars the pipe. Do not roll pipe into the trench. If the Contractor elects to use a narrow trench, the method of lowering the pipe into the trench will be such that no rocks or lumps of earth fall into the trench beneath the pipe. Lumps of earth and rock greater than 25 mm will not be permitted beneath the pipe and must be removed prior to pipe placement.
- .5 The assembly of thermally butt-fused or electro-fused HDPE pipe will be performed as recommended by the pipe manufacturer and applicable AWWA Specification for the type of pipe selected.
- .6 Employ the services of a certified HDPE fusing technician to perform all butt-fusion and electro-fusion.
- .7 All transitions from HDPE to PVC pipe will require a system with HDPE anchor-fitting concrete anchorblock; HDPE flange with metal backup ring; stainless steel nuts, bolts, and washers; PVC bell by flange fitting and mechanical piperestrainers necessary to prevent the PVC pipe pulling out of the bell fittings when HDPE pipe shrinkage occurs.
- .8 Handle pipe in a manner to prevent damage to the pipe walls. Pipe strung along the trench will, if necessary, be supported on timber skids sufficiently protected to prevent injury. Securely close the open end of pipe at the end of each day's work to prevent the entrance of small animals, or the introduction of foreign matter of any nature, and do not reopen the ends until work is resumed. Exercise care in joining sections of the pipe, in order to minimize any possibility of foreign matter whatsoever being inside the pipeline after the completion. Any obstructions remaining in the line after the completion thereof are to be removed.
- .9 When installing the pipe bedding/haunching material ensure that the pipe is adequately secured to prevent the pipe from lifting or moving laterally while the pipe bedding/haunching material is being placed and compacted around the pipe.
- .10 For special fittings and tie-ins, cut the pipe to the length required as recommended by the pipe manufacturer without damaging the pipe or its coating. The end will be cut smooth at right angles to the axis of the pipe.

UTILITIES HDPE PIPE AND FITTINGS

- .11 Do not install pipe on frozen bedding.
- .12 All HPDE pipe joints must be connected by fusion or flanges. No couplers are acceptable.

3.2 TRACER WIRE INSTALLATION

- .1 The Contractor must ensure that the tracer wire is not cut, scraped, or nicked during installation. Termination access points will be installed at each air release (manual and automatic), stubs, buried vault and each side of highway and railway crossings.
- .2 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, and without distortion of signal caused by more than one wire being installed in close proximity to one another.
- .3 Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- .4 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.
- .5 Tracer wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5-foot intervals.
- .6 Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end ground using an approved waterproof connector to a Ground Rod driven into virgin soil beneath and in line with the utility.
- .7 All service lateral tracer wire shall be a single wire, connected to the mainline tracer wire using a three-way mainline-to-service connector, installed without cutting/splicing the mainline tracer wire.
- .8 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 be connected using approved connectors.
- .9 Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access point located directly above the utility, at the edge of the road right-of-way, but out of the roadway.
- .10 One foot of excess/slack wire is required in all tracer wire access points after meeting final elevation.
- .11 Tracer wire must be properly grounded as specified.
- .12 At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a 1.5-lb., drive-in, magnesium ground rod.
- .13 When grounding the tracer wire at dead-ends/stubs, the Ground Rod shall be driven into virgin soil directly beneath and in line with the utility.

UTILITIES HDPE PIPE AND FITTINGS

- .14 Ground rod wire shall be connected to the ground rod terminal.
- .15 Where the Ground Rod wire will be connected to a tracer wire access point, one foot of excess/slack wire is required after meeting final elevation.
- .16 The Contractor will test and the Owner's Representative will check the tracer wire. The Contractor is responsible to locate and repair any malfunctions discovered.

3.3 TOLERANCE

- .1 Maintain constructed grade to within -150 mm to +150 mm from the lines, grades and elevations shown in the Contract Documents. Where departures occur, return to established grade gradually over a distance of not less than 25 m or reinstall the pipe to within grade tolerances.

3.4 TESTING AND INSPECTIONS

- .1 Contractor will inform the Owner's Representative 48 hours before all testing and inspections are to begin.
- .2 The Owner's Representative may request random samples of fused joints for testing. The sample will be requested following the completion of the fusion process, but before the next fuse is begun.
- .3 The Contractor will do all work necessary to provide the requested joint and re-fuse the two pieces of pipe. No extra payment will be made for this work.
- .4 The number of fused joints requested for testing will not exceed an average of one joint per 800 metres of HDPE pipe installed.
- .5 All pipe and fittings installed during the Work will be pressure tested.
- .6 All pipe and fittings on a potable water system affected by installation Work will be flushed and disinfected including bacteriological testing.

END OF SECTION

COUPLINGS

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Couplings" specified herein.

2. PRODUCTS

2.1 COUPLINGS

- .1 Stainless Steel Couplings:
- .1 Designed for joining plain end pipes of equal outside diameter. To be flexible, all stainless steel construction. All welded stainless steel to be "passivated" after welding to eliminate sensitizing of the stainless steel.
 - .2 Shell, Sidebars, Nuts, and Bolts to be Type 304 fully passivated stainless steel. Gasket to be continuous ringed S.B.R. rubber conforming to latest revision AWWA C-111 / ANSI A21.11.
 - .3 Approved Products:
 - Robar 1606 Style 2 - for sizes 100 mm to 350 mm
 - Robar 1606 Style 3 - for sizes 400 mm to 600 mm
- .2 Epoxy Coated Couplings:
- .1 To be cathodically fitted and protected by cap type anodes. Anodes to be 300-gram zinc alloy caps meeting latest revision ASTM B418, Type 1, threaded onto the coupling bolts. Electrical continuity between bolts and end plates to be achieved by removing the epoxy coating from the end plates, under the nut bearing area or with a factory installed anode strap.
 - .2 Epoxy Coated couplings are supplied in the four following configurations:
 - Standard Couplings: designed for joining plain end pipes of equal outside diameter.
 - Transition Couplings: designed for connecting pipes of the same nominal size, which have great differences in outside diameter. Transition to be made by "stepped-down" centre ring, c/w special end plate.
 - Reducing Couplings: designed for connecting pipes of different nominal sizes. Reduction to be made by "stepped-down" centre ring, c/w special end plate.
 - Multi Range Couplings: Straight and transition couplings are used to make a non restrained connection between two pipes of the same nominal size but with same or different outside diameters. One range fits all pipe outside diameters, IPS PVC to rough barrel AC.
 - .3 Centre ring to be cast ductile iron to latest revision ASTM A536, factory coated with corrosion protective epoxy. Coating thickness to be 0.30 mm (12 mils) minimum, 0.50 mm (20 mils) maximum.
 - .4 End plates to be heat-treated cast ductile iron to latest revision ASTM A536, factory coated with corrosion protective epoxy. Coating thickness to be 0.30 mm

COUPLINGS

(12 mils) minimum, 0.50 mm (20 mils) maximum. End plates will be provided with one 6 mm (1/4") SAE J429 Grade 5, NC cadmium plated setscrew to provide electrical conductivity between the end plates and the sleeves.

- .5 Gasket to be S.B.R. rubber conforming to latest revision AWWA C-111 / ANSI A21.11.
- .6 Bolts to be 15.875 mm (5/8") NC trackhead, c/w heavy-duty hex nuts. Material to be low alloy steel conforming to latest revision AWWA C-111 / ANSI A21.11. All bolts (except threaded area) to be factory coated with corrosion protective epoxy. Coating thickness to be 0.30 mm (12 mils) minimum, 0.50 mm (20 mils) maximum.
- .7 Coupling components to be marked as follows:
Centre Ring: Nominal size and manufacturers' name.
End-Plate: O.D. range and manufacturers' name.
Gaskets: O.D. range and manufacturers' name.
- .8 Approved Coupling Products
 - Robar 1529
 - TPS Hymax 2000
 - Romac 501
- .9 Approved Anode Products:
 - "Protecto-Caps" 300 P60W

2.2 TAPPING SLEEVES

- .1 Sleeves will be split body type designed to allow tightening of the sleeve bolts from the opposite side of the flange outlet.
- .2 Sleeves will be constructed of stainless steel or corrosion protected mild steel material. Corrosion protected sleeves will be epoxy coated and lined. All welded stainless steel to be "passivated" after welding to eliminate sensitizing of the stainless steel.
- .3 Sleeves to include a 6.35 mm (3/4") NPT test plug for pressure testing of sleeve and installed tapping valve.
- .4 Sleeves to have permanent identification marking to identify the manufacturer's name, nominal size, and O.D. range. All sleeves to be packaged and delivered as a complete unit (i.e. sleeves, gaskets, nuts, and bolts).
- .5 Sleeves to have Class D flanges conforming to the latest revision of AWWA C207, 150 lb. drilling. Flanges to be fixed, not floating.
- .6 Flange materials for stainless steel tapping sleeves to be stainless steel. Flange materials for epoxy coated tapping sleeves to be cast ductile iron.
- .7 Gasket materials as follows:
Flange- Virgin SBR compounded for water service use.
Ring Seal - Buna N, or virgin SBR compounded for water service use.
Liner-3.18 mm (1/8") Neoprene, or virgin SBR compounded for water service use.

COUPLINGS

- .8 Bolts to be 19 mm (3/4") NC stainless steel c/w heavy hex nuts and washers, lubricated to prevent galling.
- .9 Approved Products:
- | <u>Stainless Steel</u> | <u>Epoxy Coated Mild Steel</u> |
|------------------------|--------------------------------|
| - Robar 6606 | - Robar 6506, 6906 |
| - Romac "SST" | - Smith Blair 622 |
| - Ford FTSS | - Romac FTS 420 |
| - Smith Blair 663 | |

2.3 RESTRAINERS

- .1 Restrain PVC pipe back to nearest fitting. Use cast iron fittings when restrainers are required.
- .2 Approved Products:
Ford Meter Box Co. – Uniflange Restrainers 1300 Series

3. EXECUTION

- .1 Install all couplings, tapping sleeves and restrainers in accordance with manufacturer recommendations.
- .2 Backfill for couplings, tapping sleeves and restrainers will be consistent with the connecting pipe.
- .3 Install sacrificial anodes and corrosion protective tape on all epoxy coated couplings, tapping sleeves and restrainers.

END OF SECTION

CATHODIC PROTECTION

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Cathodic Protection" specified herein.

2. PRODUCTS

2.1 CORROSION PROTECTIVE TAPES AND WRAPS

- .1 Field installed corrosion protective coatings to be two part paste & tape systems.

- .2 Approved Products:

- **Polyken 900 system:**
No. 930 Joint Wrap Tape
No. 931 Filler Tape
- **Denso of Canada Ltd:**
Denso Paste
Denso Tape
- **Canada Pipeline Accessories Corp.:**
Petro Primer Paste
Petro 40 Tape
Petro Overwrap Tape
- **Polyguard Products Inc.**
Polyguard 600 Primer
Polyguard 600 Series Coating Tape
Polyguard 606 Filler System
- **The Trenton Corporation**
Trenton Tec-Tape Primer
Trenton Tec-Tape Wrapper
Trenton Glas-Wrap
Trenton Fill-Putty

2.2 CATHODIC PROTECTION

- .1 General

- .1 Prior to backfilling, arrange for the Owner's Representative to witness the installation of the sacrificial anode, wires, cadwelding, etc., and the necessary continuity check. Location of anode packs to be reviewed by the Owner's Representative.

- .2 Sacrificial Anodes

Anode lead wires will be 3 metres in length and will consist of AWG#10/7 stranded copper wire with RWU-90 insulation. Zinc anodes are to be supplied with a white lead wire and magnesium anodes with a blue lead wire. The lead wire will be connected to

CATHODIC PROTECTION

the core with silver solder. The entire connection will be insulated by filling the recess with an electrical potting compound.

The anode will be packaged in a water permeable cardboard containing a backfill mixture of the following composition:

Ground Hydrated Gypsum	75%
Powdered Wyoming Bentonite	20%
Anhydrous Sodium Sulphate	5%

Backfill will have a grain size so that 100% is capable of passing through a 20 mesh screen and 50% will be retained by a 100 mesh screen. The mixture will be firmly packaged around the anode within the cardboard tube by means of adequate vibration. Cardboard tube size and backfill material volume will be sufficient to provide a maximum thickness of 25 mm of backfill between all parts of the anode and the anode packaging.

All anodes will carry a label identifying the manufacturer's name, type of anode and the net weight. Cardboard tubes used to package anodes will have sufficient strength to permit normal shipping and handling without failure.

Zinc Anodes

Zinc anodes will conform to ASTM B418 Type II. All anodes will have a minimum open circuit potential of -1.10 volts referenced to Cu/CuSO₄. Zinc anodes will have the following composition:

Aluminum	0.005%	maximum
Cadmium	0.003%	maximum
Iron	0.0014%	maximum
Lead	0.003%	maximum
Copper	0.002%	maximum
Zinc	remainder	

Magnesium Anodes

Magnesium anodes will conform to ASTM B843 grade M1C. Anodes will have a minimum open circuit potential of -1.70 volts referenced to Cu/CuSO₄. Minimum acceptable current efficiency is 48%. Testing of these properties will be in accordance with ASTM G97. These anodes will be cast with a perforated galvanized steel core. The weight of the core will not exceed 0.15 kg per meter. One end of the anode will be recessed so that the core is accessible for the lead wire connection.

Magnesium anodes will conform to the following composition (limits are given as maximum weight percent unless shown as a range):

Aluminum	0.01
Manganese	0.50 to 1.3
Silicon	0.05
Copper	0.02
Nickel	0.001
Iron	0.03
Other metallic Impurities	0.05 ea
Magnesium	remainder

CATHODIC PROTECTION

3. EXECUTION

3.1 INSTALLATION OF CORROSION PROTECTIVE COATINGS

- .1 Install corrosion protective coatings as per manufacturer's recommendations.
- .2 Ensure steel to be coated is clean so that coating adheres to the surface.
- .3 Allow cadwelds to cool before placing coating over the cadweld.

3.2 INSTALLATION OF SACRIFICIAL ANODES

- .1 Remove the plastic bag from the anodes, leaving the cloth bag or cardboard casing intact.
- .2 Place the anodes a minimum distance of 1.0 m from the main in a horizontal position at approximately the same elevation and parallel to the main.
- .3 Ensure that soil is packed uniformly around the anodes to eliminate voids or air pockets adjacent to the anodes.
- .4 Wet the installed anode and surrounding soil prior to backfilling
- .5 Cadweld anode lead wire to the buried metal item to be cathodically protected.
- .6 Provide one (1) 5.4 kg anode for:
 - .1 each buried valve 200mm valve.
 - .2 each buried steel or cast iron fitting
 - .3 each buried steel coupling, topping, sleeve or restrainer
 - .4 each fire hydrant
 - .5 each 6.1 m length of buried steel pipe.
- .7 Provide one (2) 5.4 kg anode for:
 - .1 Each buried 600mm valve.
- .8 Provide two (2) 5.4 kg anodes on each end of a steel casing installed by Auger/bore on directional drill method.

3.3 CADWELDING

- .1 Remove a small portion of coating on the metal item to receive the anode lead wire.
- .2 Thoroughly clean area to be cadwelded and file metal until a shiny, roughened surface is obtained approximately 75 mm square.
- .3 Crimp a copper sleeve onto the bared end of the wire to be cadwelded.
- .4 Use a cadweld mold M108 or equal and powder CA-15 or equal.
- .5 Knock any slag off of the completed cadweld and file smooth any sharp edges.

CATHODIC PROTECTION

- .6 Thoroughly coat and cover the cadweld and any area adjacent that has had the coating removed with an adhesive moulded plastic patch.

END OF SECTION

HYDROSTATIC PRESSURE TESTING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for the location, use, and placement of "Hydrostatic Pressure Testing" specified herein.
- .2 HDPE Hydrostatic Pressure Testing conforming to ASTM F2164 Standard.

2. PRODUCTS

- .1 Potable water system: test water must be potable water.
- .2 Non-potable water or sanitary forcemain system: test water must be either potable water or clean, non-potable water.
- .3 Purchase all necessary water for hydrostatic pressure testing from the owner of the utility, unless otherwise approved by the Owner's Representative.

3. EXECUTION

3.1 PRESSURE TESTING

- .1 Subject the newly laid pipe to hydrostatic tests after backfilling.
- .2 The Contractor shall provide all labour, water, materials, equipment and fittings required for pipe hydrostatic and leakage tests. Equipment shall include a pump, pipe connections, pressure gauges with adequate pressure range, and all other necessary equipment.
- .3 Notify the Owner's Representative at least 24 hours prior to starting the tests. The tests are to be performed in the presence of the Owner's Representative. Submit written procedures and schedule of pressure testing to Owner's Representative for review prior to any pressure testing.
- .4 Do not conduct tests until at least 5 days after placing concrete or 2 days if high early strength concrete is used for thrust blocks.
- .5 Open or close all valves necessary to test section of pipe.
- .6 Test pipeline up to stub as indicated on construction drawings unless otherwise authorized by Owner's Representative.
- .7 Expel air from main by slowly filling main with potable water. Install corporation stops at high points in main where no air-vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs. To compensate for initial pipe stretch and to expel all entrapped air, the pipe shall be pressurized until pressure is maintained before the test period is started.
- .8 Thoroughly examine exposed parts and correct for leakage as necessary.

HYDROSTATIC PRESSURE TESTING

- .9 Any leaks, breaks, failures, or blockages, which are a result of faulty material and/or workmanship are the sole responsibility of the Contractor to correct at his expense.

3.2 HDPE PIPE

- .1 For fused polyethylene pipe the hydrostatic test consists of two phases: the initial expansion phase and the test period phase.
- .2 Fill test section with clean water. Take care to bleed off all trapped air. While the test section is filling, venting at high points may be necessary to purge air pockets. Venting may be provided by using equipment vents.
- .3 The line shall initially be pressured up to 1.5 times the system design pressure of the Pipe with pressure measured at the lowest elevation in the section being tested. Pipes with different pressure ratings shall be tested separately or as specified by the Owner's representative. The maximum test pressure is not to exceed the pressure rating of the lowest pressure-rated component in the test section, where lower pressure-rated components or devices cannot be removed or isolated from the test section. Consult the component manufacturer for pressure ratings.
- .4 Water shall be added throughout the initial expansion period to maintain the pressure, thereby compensating for the expansion of the pipe. The initial expansion period shall be no less than 4 hours. At the end of the four hour initial period, there could be a noticeable drop in the amount of make-up water required.
- .5 Following the expansion period, a 2 hour test phase will commence. The pressure during the test phase should be 10 psi (69 kPa) lower than during the expansion period. Do not increase pressure or add make-up water during this phase.
- .6 If no visual leakage is observed and pressure during the test phase remains steady (within 5% of the test pressure) for the 2 hour test phase period, a passing test is indicated. There is no leakage allowance for a section of heat-fusion joined polyethylene piping.
- .7 If the test is not completed within the time period for whatever reason, the test section should be permitted to "relax" for an additional eight hour period prior to starting the next test sequence.
- .8 After testing, locate and repair defects.
- .9 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .10 Repeat hydrostatic test until all defects have been corrected.
- .11 Repeat test until the pressure is within the allowable test range.

END OF SECTION

THRUST BLOCKING

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunctions with other Sections for the location, use, and placement of "Thrust Blocking" specified herein

2. PRODUCTS

2.1 CONCRETE

- .1 Concrete mix will satisfy the requirements of Exposure Classification C-2 of Table 1 in the latest revision of CAN/CSA A23, and will be in accordance with the following minimum requirements unless shown in the Contract Documents:
- 28 day compressive strength – 25 MPa
 - Maximum nominal size of coarse aggregate – 25 mm
 - Slump – maximum 75 mm
 - Air Content – 4% to 7%
 - Maximum water cementing materials ratio – 0.45
 - Portland Cement – Type 50 or HS, Sulfate Resistant
 - Minimum cement content – 300 kg/m³
 - Fly Ash Content – 20% max.
- .2 Two layers of 6 mil polyethylene to be placed between all fittings, valve, and pipe and the concrete.

3. EXECUTION

- .1 All bends, fittings, valves and all points where there is thrust will be anchored to prevent movement by providing suitable thrust blocking, as shown on the Contract Documents.
- .2 Thrust-blocking material will be purchased from a reputable concrete supplier and will not be manufactured on site.
- .3 Thrust blocking will be placed between solid ground and the fitting to be anchored; the area of bearing between the pipe and the ground in each instance will be that shown on the Contract Documents. The blocking will be so placed that the pipe and fitting joints will be accessible for repair.
- .4 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants, and fittings and undisturbed ground as indicated or as directed by the Owner's Representative.
- .5 Bearing areas will be inspected by the Owner's Representative prior to placing concrete.
- .6 Keep joints and couplings free from concrete.
- .7 Do not backfill over concrete for a minimum of 24 hours after concrete is placed.
- .8 Backfill for thrust blocking to be consistent with connecting pipe .

END OF SECTION

SITE SURVEYING

1. GENERAL

1.1 SURVEY REFERENCE POINTS

- .1 Primary horizontal and vertical survey reference points have been established by the Owner as specified in the Contract Documents. The Owner is responsible for the accuracy of the primary survey reference points.
- .2 Locate, confirm, and protect primary reference points prior to starting Work on the Site. Preserve permanent reference points during construction.
- .3 Make no changes to or relocations of the primary survey reference points without prior written authorization of the Owner.
- .4 Report to the Owner when a reference point is lost or damaged, or requires relocation because of the Work.
- .5 Replace damaged reference points in accordance with the original survey control.

1.2 CONTRACTOR'S SURVEY REQUIREMENTS

- .1 Provide and pay all costs for qualified survey rodman to jointly survey with Owner's Representative for cross-sections, grades, elevations and field measurements.
- .2 Carry horizontal and vertical surveys from primary survey points and establish secondary survey points to facilitate setting out the work. Be solely responsible for the accuracy of the secondary survey reference points and the layout, staking, and checking of the work. Any errors caused by the inaccurate surveys of these secondary points shall be corrected by the Contractor at his own cost.

1.3 OWNER'S REPRESENTATIVE'S SURVEY REQUIREMENTS

- .1 All work to be performed under this contract will be laid out by the Owner's Representative by means of stakes and hubs and the Contractor shall be required to make the completed work conform to the lines and grades in accordance with the Contract Drawings and Specifications. The Contractor shall verify all stakes and marks provided by the Owner's Representative. Once grade stakes are established, it is the responsibility of the Contractor to safeguard the stakes. If survey stakes are lost or damaged after the primary survey is complete, the Contractor will pay for the services of a survey company to re-establish the survey points and stakes. It is the intent of the Owner's Representative, if possible, to discuss the layout of the work with the contractor prior to commencement. Only one layout survey will be completed by the Owner. If a second survey is requested by the contractor, the contractor will pay for all additional surveys. The Owner's Representative will provide the following surveys and information for each individual aspect of the project:
 - .1 Structures:
 - .1 Four hubs offset from the centreline of the structure. Each hub will indicate station, elevation and offset to centreline.
 - .2 Pipelines:

SITE SURVEYING

- .1 Construction easement stakes - to be located on both sides of the pipeline at approximately 100-metre spacing.
 - .2 Hubs on one side of the proposed pipeline at approximately 100 metre spacing. Each hub will indicate station offset to centreline and elevation.
 - .3 Slope stakes for settling pond at 25-metre spacing. Each slope stake will indicate the cut or fill required.
 - .4 Grade sheet showing centreline cut at 25-metre spacing and hub cuts at 100-metre spacing.
- .3 Earthworks:
- .1 Construction easement stakes - to be located on both sides of the earthwork project at approximately 100-metre spacing.
 - .2 Hubs on one side of the earthwork project at approximately 100-metre spacing. Each hub will indicate station, offset to centreline and elevation.
 - .3 One set of slope stakes at approximately 50-metre spacing. Each slope stake will indicate station and the required cut or fill.
- .2 All elevations will be Geodetic unless otherwise noted.
- .3 Keep the Owner's Representative advised on a regular basis of construction survey requirements so that the survey work may be co-ordinated with the Contractor's sequence of operation. In any event, a minimum of 48 hours' notice will be required prior to commencement of surveys.
- .4 The Owner's Representative's stakes or other marks to be carefully preserved by the Contractor until they have served their purpose. Suspend all work at such points and for such reasonable time as the Owner's Representative may require to check the lines and grades. No additional compensation will be paid to the Contractor for required assistance in performing all on site surveys or for loss of time on account of such necessary suspension of work or otherwise on account of the requirements of this section.

1.4 ELECTRONIC DESIGN DATA

- .1 Electronic design data is available from the Owner's Representative upon request. This information is intended as an aid for construction layout. The Owner's Representative does not guarantee its accuracy. Any discrepancies between the electronic design data and the drawings must be brought to the attention of the Owner's Representative immediately. Information provided on the drawings will take precedence over electronic design data.

1.5 GLOBAL POSITIONING SYSTEMS (GPS)

- .1 If GPS controlled excavation and trimming equipment is utilized in conjunction with GPS final grade checking, the Owner may waive the requirement for final grade

SITE SURVEYING

stakes if the accuracy and consistency of the final grade check can be demonstrated.

- .2 If the final grade stake requirement is waived, provide a surface grade sheet in electronic and hard copy of the electronic survey data in a format acceptable to the Owner.
- .3 The surface grade sheet to include the following minimum information.
 - .1 Station.
 - .2 Offset left or right of the centerline.
 - .3 Design elevation at the grade line break point.
 - .4 Actual elevation at the grade line break point.
 - .5 Deviation of the actual elevation from the design elevation.
 - .6 Indication if deviation is within specified tolerances.

- 2. **PRODUCTS** – **NOT USED**
- 3. **EXECUTION** – **NOT USED**

END OF SECTION

VALVES

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location, use and placement of "Valves – Cast Iron" specified herein.

2. PRODUCTS

2.1 VALVES

- .1 Resilient Wedge Gate Valves (150 – 300 mm diameter):
- .1 100 mm diameter valves are not permitted.
 - .2 Valves sized 150 to 300 mm diameter shall be resilient wedge gate valves, conforming to latest revision AWWA C515 250 PSI, UL/FM Approved 200 PSI, NSF 61 Certified, Full Water Way, c/w fully rubber encapsulated solid wedge, non-rising stem, suitable for direct bury.
 - .3 Valves to open counter clockwise. (Turn left to open).
 - .4 Valve body to be constructed of cast iron, in accordance with ASTM A126, Class "B". All nuts, bolts conform to SAE J429 Grade 8 Zinc Dichromate coated to 610g/m² (2oz/ft²).
 - .5 Interior and exterior of valve to be epoxy coated, as per latest revision AWWA C550-81.
 - .6 Bronze valve stem to be operated by a 50 x 50 mm square operating nut. The valve stem (stuffing box) shall contain a double "O" ring seal.
 - .7 Valve ends to be flanged conforming to latest revision of ANSI B16.1, Class 125.
 - .8 Approved Products:
 - Mueller 2360 Series
 - Clow Model 2638
 - AVK Co. Series 65
 - or as Approved.
- .2 Resilient Wedge Gate Valves (600 mm diameter):
- .1 100mm diameter valves are not permitted.
 - .2 Valves sized 600mm diameter shall be resilient wedge gate valves, conforming to latest revision AWWA C515 250 PSI, UL/FM Approved 200

VALVES

PSI, NSF 61 Certified, Full Water Way, c/w fully rubber encapsulated solid wedge, non-rising stem, bevel gear, suitable for direct bury.

- .3 Valves to open counter clockwise. (Turn left to open).
- .4 Valve body to be constructed of cast iron, in accordance with ASTM A126, Class "B". All nuts, bolts conform to SAE J429 Grade 8 Zinc Dichromate coated to 610g/m² (2oz/ft²).
- .5 Interior and exterior of valve to be epoxy coated, as per latest revision AWWA C550-81.
- .6 Bronze valve stem to be operated by a 50 x 50 mm square operating nut. The valve stem (stuffing box) shall contain a double "O" ring seal.
- .7 Valve ends to be flanged conforming to latest revision of ANSI B16.1, Class 125.
- .8 600mm gate valves to be full port to allow for pig launch through a 600mm HDPE DR 11 pipeline.
- .8 Approved Products:
 - Clow Model 2638
 - Mueller 2361 Series
 - AVK Co. Series 65
 - or as Approved

2.2 CAST IRON VALVE BOXES

- .1 To be completely bituminous coated sliding type, adjustable over a minimum of 450 mm. Bottom casing to be large round type with minimum inside diameter of 240 mm. All castings will clearly have the manufacturer's identification cast on them.
- .2 Depth of bury to be 2.7 m (9') to 3.05m (10').
 - .1 Valve operating extension spindle to be 25 x 25 mm square. Spindle length will be such that the operating nut will not be more than 300 mm below the cover when set on the valve-operating nut.
 - .2 Bottom of spindle to fit 50 x 50 mm square valve operating nut and will be riveted to spindle.
 - .3 Top of spindle will have removable 50 x 50 mm square operating nut c/w stonecatcher flange.
 - .4 Top casing to fit over 133 mm (5.25") inside diameter bottom casing.

VALVES

- .5 Lid to be 11.35-kg (25-lbs.) minimum, marked "WATER".
- .6 Approved Products:
 - Norwood "Type A"
 - Trojan Industries "Type A"
 - Sovereign Castings Ltd. "Type A"

3. EXECUTION

3.1 VALVE INSTALLATION

- .1 Set and joint all valves in accordance with the manufacturer's recommendations and applicable AWWA Specifications.
- .2 Ensure that the stuffing glands are properly packed with a high-grade packing and tighten gland bolts prior to installation.
- .3 Install concrete base for valves and anchors as per the drawings.
- .4 Provide sacrificial anodes and corrosion protective tape on all valves.
- .5 Set the valve accurately in position and place the valve box carefully over the bonnet with the valve casing perpendicular to the axis of the pipe, and adjust the top box to the grades specified.
- .6 Secure the extension rod to the valve nut. Install extension rod and valve Box Riser plumb over the valve.
- .7 Backfill for valves and valve boxes shall be consistent with the connecting pipe backfill.
- .8 Install wooden markers as per Contract Drawings.

END OF SECTION

MECHANICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 INTENT

- .1 This section of the specifications refers to the piping, fittings, valves and all piping specialties and supporting devices to be installed under this contract. Also included are the equipment, valve and commodity identification legends for all piping systems to be installed.
- .2 Control valves and other in-line equipment, such as flow meters, pumps, flow control valves, flow switches, pressure switches, solenoid valves, pressure gauges, etc., supplied under Divisions 11 and 13, are to be installed under this Section.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittals Procedures
- .2 Section 40 05 70 - Operation and Maintenance Manuals
- .3 Section 26 27 26 - Instrumentation – Wiring
- .4 Section 40 90 05 - Instrumentation – Field Instruments
- .5 Section 40 05 01 - Mechanical General Requirements
- .6 Section 40 05 23 - Detailed Piping Specifications
- .7 Section 40 05 51 - Valves
- .8 Section 40 05 65 - Hydrostatic and Pressure Testing

1.3 REFERENCE STANDARDS

- .1 Conform to the following reference standards:
 - .1 ANSI A13.1, Scheme for the Identification of Piping Systems
 - .2 ANSI B1.20.1, Pipe Threads, General Purpose
 - .3 ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
 - .4 ANSI B16.3, Malleable Iron threaded Fittings Class 150 and 300
 - .5 ANSI B16.5 Steel Pipe Flanges and Flanged Fittings
 - .6 ANSI B16.9, Factory-Made Wrought Steel Butt Welding Fittings
 - .7 ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded
 - .8 ANSI B16.12, Cast Iron Threaded Drainage Fittings
 - .9 ANSI B16.15, Pipe Flanges and Flanged Fittings, Classes 150 and 300
 - .10 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings
 - .11 ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - .12 ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes
 - .13 ASME B31.1, Power Piping
 - .14 ASME B31.3, Process Piping
 - .15 ASME B31.9, Building Services Piping
 - .16 ANSI B32, Solder Metal
 - .17 ANSI B36.10M, Welded and Seamless Wrought Steel Pipe
 - .18 ANSI B36.19M, Stainless Steel Pipe
 - .19 ASME Section IX, Boiler and Pressure Vessel Code; Welding and Brazing Requirements

MECHANICAL GENERAL REQUIREMENTS

- .20 ASTM A47, Malleable Iron Castings
- .21 ASTM A53, Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
- .22 ASTM A74, Cast Iron Soil Pipe and Fittings
- .23 ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components
- .24 ASTM A106, Seamless Carbon Steel Pipe for High Temperature Service
- .25 ASTM A126, Grey-Iron Castings for Valves, Flanges, and Pipe Fittings
- .26 ASTM A135, Electric-Resistance-Welded Steel Pipe
- .27 ASTM A139, Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over)
- .28 ASTM A167, Stainless Steel and Heat-Resisting Chromium- Nickel Steel Plate
- .29 ASTM A181/181M, Forgings, Carbon Steel, for General Purpose Piping
- .30 ASTM A182/182M, Forged or Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- .31 ASTM A193/193M, Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
- .32 ASTM A194/194M, Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
- .33 ASTM A197, Cupola Malleable Iron
- .34 ASTM A234/A234M, Pipe Fittings of Wrought Carbon Steel and Alloy steel for Moderate and Elevated Temperatures
- .35 ASTM A240, Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- .36 ASTM A269, Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- .37 ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes
- .38 ASTM A307, Carbon steel Bolts and Studs, 60,000 psi Tensile Strength
- .39 ASTM A312/312M, Seamless and Welded Austenitic Stainless Steel Pipe
- .40 ASTM A320/320M, Alloy Steel Bolting Materials for Low-Temperature Service
- .41 ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings
- .42 ASTM A409/A409M, Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service
- .43 ASTM A480/A480M, General Requirements for Flat-Rolled Stainless for Heat-Resisting Steel Plate, Sheet and Strip
- .44 ASTM A536, Ductile Iron Castings
- .45 ASTM A563, Carbon and Alloy Steel Nuts
- .46 ASTM A570/A570M, Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- .47 ASTM A774/A744M, As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
- .48 ASTM A778, Welded, Unannealed Austenitic Stainless Steel Tubular Products
- .49 ASTM B88, Seamless Copper Water Tube
- .50 ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- .51 ASTM C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- .52 ASTM D638, Test Method for Tensile Properties of Plastics
- .53 ASTM D792, Test Method for Specific Gravity and Density of Plastics by Displacement
- .54 ASTM D1248, Polyethylene Plastics Moulding and Extrusion Materials
- .55 ASTM D1457, PTFE Moulding and Extrusion Materials
- .56 ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- .57 ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- .58 ASTM D2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- .59 ASTM D2466, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- .60 ASTM D2467, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- .61 ASTM D2513, Thermoplastic Gas Pressure Pipe, Tubing and Fittings

MECHANICAL GENERAL REQUIREMENTS

- .62 ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- .63 ASTM D2665, Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- .64 ASTM D2996, Filament-Wound Reinforced Thermosetting Resin Pipe
- .65 ASTM D3212, Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals
- .66 ASTM D3261, Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings
- .67 ASTM D4101, Polypropylene Plastic Injection and Extrusion Materials
- .68 ASTM D4174, Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
- .69 ASTM F441, Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- .70 ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- .71 AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
- .72 AWWA C110, Ductile-Iron and Grey-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
- .73 AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Grey-Iron Pipe and Fittings
- .74 AWWA C115, Flanged Ductile-Iron and Grey-Iron Pipe with Threaded Flanges
- .75 AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Moulds or Sand-Lined Moulds, for Water and Other Liquids
- .76 AWWA C200, Steel Water Pipe, 6 Inches and Larger
- .77 AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot Applied
- .78 AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 Inches through 144 Inches
- .79 AWWA C206, Field Welding of Steel Water Pipe
- .80 AWWA C207, Steel Pipe Flanges for Waterworks Services – Sizes 4 Inch Through 144 Inch
- .81 AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings
- .82 AWWA C209, Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
- .83 AWWA C210, Coal-Tar Epoxy Coating System for the Interior and Exterior of Steel Water Pipe
- .84 AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines
- .85 AWWA C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
- .86 AWWA C303, Reinforced Concrete Pressure Pipe – Steel Cylinder Type, Pretensioned, for Water and Other Liquids
- .87 AWWA C600, Installation of Ductile-Iron Water Mains and their Appurtenances
- .88 AWWA C606, Grooved and Shouldered Joints
- .89 AWWA C651, Disinfecting Water Mains
- .90 AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water
- .91 AWWA M11; Steel Pipe – A Guide for Design and Installation
- .92 CGA, Canadian Gas Association Standards
- .93 CAN/CGA B105 – Installation Code for Digester Gas Systems
- .94 CISPI 301, Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings
- .95 CPC, Canadian Plumbing Code
- .96 CSA B52, Mechanical Refrigeration Code

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- .97 CSA B64 Series CSA Standards on Vacuum Breakers and Backflow
- .98 CAN3-B70, Cast Iron Soil Pipe, Fittings, and Means of Joining
- .99 CSA B137.3, Rigid PVC Pipe for Pressure Applications
- .100 CSA B139, Installation Code for Oil Burning Equipment
- .101 CSA B140.0 General Requirements for Oil Burning Equipment
- .102 CSA B158.1 Cast Brass Solder Joint Drainage, Waste and Vent Fittings
- .103 CAN3-B181.2 PVC Drain, Waste and Vent Pipe and Pipe Fittings
- .104 CSA CAN3-Z299.3, Quality Verification Program Requirements
- .105 CSA CAN-Z183, Oil Pipeline Systems
- .106 CSA Z184 Gas Pipeline Systems
- .107 CSA B242 Groove and Shoulder Type Mechanical Pipe Couplings
- .108 EJMA STDS, Standards of Expansion Joint Manufacturers' Association, Edition No. 6
- .109 Fluid Sealing Association Technical Handbook, Rubber Expansion Joint Division
- .110 FEDSPEC, L-C530B(1), Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy
- .111 MIL-H-13528B, Hydrochloric Acid, Inhibited, Rust Removing
- .112 MIL-S-8660C, Silicone Compound
- .113 MIL-STD-810C, Environmental Test Methods
- .114 MSS SP25, Standard Marking System for Valves, Fittings, Flanges and Unions
- .115 MSS SP43, Wrought Stainless Steel Butt Welding Fittings
- .116 SAE J1227, Assessing Cleanliness of Hydraulic Fluid Power Components and Systems
- .117 SSPC-P3, Canadian Government Standards Board
- .118 SSPC-SP6, Canadian Government Standards Board
- .119 SSPC-SP10, Canadian Government Standards Board
- .120 Plumbing and Drainage Regulations of Province of Saskatchewan
- .121 Gas Protection Regulations of the Province of Saskatchewan
- .122 Pressure Vessel Act of the Province of Saskatchewan
- .123 The American Society of Mechanical Engineers. (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, Part I – Power Boilers
 - .2 ASME Boiler and Pressure Vessel Code, Part IV – Heating Boilers
 - .3 ASME Boiler and Pressure Vessel Code, Part VIII – Pressure Vessels
 - .4 ASME Boiler and Pressure Vessel Code, Part IX – Welding and Brazing Qualifications
- .124 The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- .125 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- .126 Department of Environment of the Province of Saskatchewan
- .127 Air-Conditioning and Refrigeration Institute (ARI)
- .128 National Fire Protection Association (NFPA)
- .129 Air Movement and Control Association (AMCA)
- .130 Canadian Gas Association
 - .1 CAN/CGA B149.1 Natural Gas Installation Code
 - .2 CAN/CGA-B149.2 Propane Installation Code
- .131 National Building Code
- .132 National Sanitation Foundation (NSF)
- .133 American Petroleum Institute (API)
- .134 CSA B214-07 Installation code for hydronic heating systems

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data.
- .2 Shop drawings and product data to include the following:

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- .1 Performance curves, which include differential head, efficiency, water NPSHR, and brake horsepower (where applicable).
- .2 Outline and arrangement drawings.
- .3 Cross-section drawings.
- .4 Materials of construction.

1.5 UNIFORMITY OF EQUIPMENT

- .1 All valves, gauges and other equipment to be supplied by one manufacturer throughout to the extent practical. Variations will be permitted only where the major supplier cannot supply a particular piece of equipment as specified.

1.6 DRAWINGS AND DESIGN

- .1 The drawings are intended to show the major details of the mechanical 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.

1.7 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into the manual specified in Section 01790 - Operation and Maintenance Manuals.
- .2 Include the reviewed tag lists.

1.8 PIPE MATERIALS – GENERAL

- .1 All pipe materials to be new, free from defects and conforming to applicable reference standards.
- .2 All materials, linings and coatings in contact with water to be NSF approved for potable water.
- .3 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

1.9 PIPE SIZES

- .1 Where the pipe size is not specified, provide pipe with the sizes required by the Plumbing Code. Small piping not described by the Plumbing Code or otherwise specified herein shall be 12 mm nominal diameter.

1.10 JOINTS – GENERAL

- .1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which maybe disassembled at the minimum, within 1.0 metre of any connection to equipment, on both sides of structural penetrations, within 0.6 metres of all threaded end valves, and at the spacing specified in the detailed piping specification sheets.
- .2 For carbon steel piping less than 75 mm in diameter, butt-weld or use threaded couplings. Use unions where disassembly is required.

MECHANICAL GENERAL REQUIREMENTS

- .3 For steel piping equal to or greater than 75 mm in diameter, where not specified or shown otherwise, butt-weld according to ASME Boiler and Pressure Vessel Code or furnish slip-on flanges, conforming to ANSI B16.5, Class 150. Unless indicated otherwise on the drawings or detail specifications, where disassembly is required, use flanges.
- .4 For stainless steel tubing use stainless steel compression fittings.
- .5 For schedule rated stainless steel pipe smaller than 75 mm in diameter, socket-weld pipe. Where disassembly is required, use threaded unions.
- .6 For thin wall or schedule rated stainless steel pipe equal to or greater than 75 mm in diameter, butt-weld pipe unless otherwise shown or specified.
- .7 For copper or brass piping, use soldered couplings. Where disassembly is required, use compression unions.
- .8 For ductile iron piping, where not shown or otherwise specified, and for other piping where specified or shown, use grooved joints in accordance with AWWA C606.
- .9 Where not shown or otherwise specified, use solvent weld joints for PVC and FRP piping. Provide flanges or unions where disassembly is required.

1.11 TAGGING

- .1 Provide each piece of equipment with a tag stamped or engraved with the appropriate equipment number, as listed in this Specification.
- .2 Tags to be 20 mm high, 75 mm long, and 1.5 mm thick Lamecoid with 10 mm high alphanumeric characters, Helvetica font, reverse engraved. Characters to be white on coloured background. Background colour to be red.
- .3 The code lettering and number system shall be as shown on the P & I drawings or as directed by the Engineer.
- .4 Affix tags to equipment securely.

2. PRODUCTS

2.1 PIPE, FITTINGS AND VALVES

- .1 All, fittings and standard valves to be in accordance with the line code sheet accompanying this section. All piping materials to be in accordance with the line code sheet accompanying section 15020.

2.2 FLANGES

- .1 Unless otherwise noted, make flanges on steel pipe Class 300, conforming to ANSI B16.5. Companion flanges for connection to cast iron or ductile iron equipment flanges shall be refaced to be flush with the companion flange.
- .2 Make flanges on stainless steel piping stainless steel slip-on, rolled-angle Van-Stone type, with a stainless steel back-up ring drilled to ANSI B 16.1, Class 250. Make the angle ring thickness equal or greater than the pipe or fitting to which it is welded. For digester gas services, make the flanges Lap-joint type with galvanized steel Lap-joint

MECHANICAL GENERAL REQUIREMENTS

flange and in accordance with CGA B105. For instrument air services, make the flanges Lap-joint type with a stainless steel Lap-joint flange.

- .3 Provide Class 250 flanges on cast or ductile pipe, conforming to ANSI B 16. 1.
- .4 General requirements for flanges are as follows:
 - .1 Compatible flanges for mating to equipment or valves.
 - .2 Provide flat-faced flanges on each side of butterfly valves.
 - .3 For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.
- .5 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets.

2.3 LINK SEALS

- .1 Seal pipes passing through concrete walls as indicated on drawings, in a watertight manner, with link type expanding rubber seals as manufactured by the Thunderline Corporation.
- .2 Link seals shall have EPDM seal element, composite pressure plates, and steel bolts with zinc chromate treatment.
- .3 Size to suit cored hole or sleeved hole as required.
- .4 Support pipe on either side of seal so that seal is not load bearing.

2.4 DIELECTRIC COUPLINGS

- .1 Wherever pipes of dissimilar metals are joined use dielectric couplings.
- .2 Use insulating unions for pipe sizes 50 mm and smaller and insulating flanges for pipe sizes larger than 50 mm.

2.5 UNIONS

- .1 Provide unions at all locations for all pipe materials so that the Operator can easily perform required maintenance of all equipment.

2.6 SOLDERED COUPLINGS

- .1 Soldered couplings for copper pipe conform to ANSI B16.26. Solder to be lead free conforming to ASTM B32 and the Plumbing Code.

2.7 THREADED COUPLINGS

- .1 Make screwed joints using American Standard threads to ANSI B1.20.1.
- .2 Use paste as thread lubricant for threaded joints, Loctite or approved equal.
- .3 Conform to ASTM A182 or ASTM A276, **Class 300**, for threaded connections to stainless steel pipe, threadolet to be shop welded to the pipe at the locations specified.
- .4 Provide threaded-end to flanged-end adaptors where required to connect to flanges.

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2.8 COMPRESSION COUPLINGS

- .1 Furnish compression couplings for stainless steel tubing of the same material as the pipe, capable of withstanding the maximum pressure to which the pipe is subjected.
- .2 Furnish compression couplings for copper and brass tubing of copper, suitable for the maximum pressure of the pipe, conforming to ANSI B16.26.

2.9 GROOVED JOINT COUPLINGS

- .1 Fabricate grooved joint couplings of ductile iron to ASTM A536, and in accordance with AWWA C606. Provide cut grooves in pipe and fittings in accordance with AWWA C606. Rolled grooves and roll-groove type joints are not acceptable.
- .2 Steel Pipe: Use flexible style couplings for all buried service pipe, all pipe greater than 300 mm in diameter, for pipe less than 300 mm in diameter in rack mounted piping assemblies, and for grooved joints adjacent to pump or blower suction and discharge where grooved joints are used for noise and vibration control. Use rigid style couplings in all other applications.
- .3 Where grooved joint piping systems connect to equipment or to flanged valves, meters, or other sensing devices; use grooved joint flanges or flange adapters. Acceptable products are: Tyler Groove to Flange Fittings or Victaulic Flange adapters. Where the Contractor chooses to use grooved joint flanges rather than the indicated adapters, piping modifications required to suit this change are the responsibility of the Contractor. Make full allowance for piping disassembly and access to the face of equipment.
- .4 All couplings to be internally and externally epoxy coated.

2.10 FLEXIBLE COUPLINGS

- .1 Flexible Couplings for non-buried to be Brico D-0-L
 - .1 Stainless steel construction with stainless steel bolts, nuts and washers.
 - .2 Gaskets: fabricated of material suitable to the service conditions.

2.11 FITTINGS

- .1 For steel pipelines 75 mm in diameter or greater, fittings to conform to ANSI B16.9, ANSI B16.11 or ANSI B16.5. Provide fittings with a wall thickness equal to or greater than the pipe. In steel pipelines less than 75 mm in diameter provide threaded malleable iron fittings, conforming to ANSI B16.3.
- .2 Provide long radius steel grooved-joint fittings conforming to ANSI B16.9 in steel grooved-joint pipeline systems. Grooved joint adapters may be welded to fitting ends; dimension and cut the groove of the adapter in accordance with the coupling manufacturer's recommendations; materials and inside diameter to be the same as the pipe; grind the interior weld smooth and meet the lining manufacturer's recommendations.
- .3 For steel grooved-joint pipe of diameters of 150 mm and less, the Contractor may provide ductile iron grooved-joint fittings which have an outside diameter equal to the steel pipe diameter. Provide ductile iron to ASTM A536, dimensioned to 1.5 diameter radius bends, and cut grooving dimensions to AWWA C606 EPS dimensions. The lining and coating of the ductile iron fittings must equal the lining and coating of the steel pipeline system.

MECHANICAL GENERAL REQUIREMENTS

- .4 Standard radius elbows to dimensions of ANSI B16.5 may be provided on clean water grooved-joint piping systems only.
- .5 Provide butt welding fittings in stainless steel pipelines less than 75 mm of the same class as the pipe, conforming to ASTM A403 and ANSI B16.11. Provide socket welding fittings in stainless steel pipelines less than 75 mm to Cl. 3000, same material as the pipe, and ANSI B16.1 1. Fabricate fittings in stainless steel pipelines equal to or greater than 75 mm in diameter using similar materials and classes as the pipe and conform to ASTM A774.
- .6 Provide fittings in flanged ductile iron pipelines that conform to ANSI B16.1 and in grooved end or mechanical joint ductile iron pipelines to AWWA C110.
- .7 Provide ductile iron fittings in PVC pipelines that conform to AWWA C110 or provide PVC to CSA B137.3, of the same material and class as the pipe.
- .8 Provide fittings in FRP pipelines of the same material and class as the pipe.
- .9 Provide copper fittings in copper pipelines conforming to ANSI B16.26.
- .10 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.
- .11 Provide concentric reducers in vertical lines unless indicated otherwise.
- .12 Provide long radius elbows unless otherwise shown. Provide smooth flow carbon or stainless steel elbows 350 mm and less, to ANSI B16.9. Provide mitred elbows greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use 3 piece construction unless otherwise shown or specified.
- .13 Provide fittings in concrete cylinder pipe fabricated from metal plate, cement lined and coated, and in accordance with AWWA C301. Dimensions to AWWA C208.

2.12 GASKETS

- .1 For flat faced flanges, use full-face gaskets. For raised-face flanges, use ring type gaskets. Conform to ASTM B16.21.
- .2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline. Refer to detailed pipe specifications for recommended gasket material. Material designations used in the detailed pipe specification sheets are as follows:
 - .1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer.
 - .2 Bl. Neoprene: neoprene (black) 70 durometer.
 - .3 Nitrile: nitrile (Buna N).
 - .4 SBR: Styrene-butadiene (red).
 - .5 Natural rubber: natural rubber.
 - .6 Compressed synthetic fibres (Kevlar): ASTM F104 (F7712400), and neoprene binder: 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37).
 - .7 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder: 1.7 MPa (ASTM F1 52), 0.1 mL/h Leakage Fuel A (ASTM F37).
 - .8 Gylon - Type 1: Garlock Style 3500, 1.35 MPa (ASTM F152), 0.22 mL/h Leakage Fuel A (ASTM F37).
 - .9 Gylon-Type2: Garlock Style 3510, 1.35 MPa (ASTM F152), 0.04 mL/h Leakage Fuel A (ASTM F37).

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- .10 CPE - Chlorinated Polyethylene.
- .3 Unless otherwise specified, minimum Gasket Material Thickness for full face gaskets:
 - .1 75 to 250 mm pipe diameter; 1.6 mm thick.
 - .2 Greater than 250 mm pipe diameter; 3.2 mm. thick.
- .4 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:
 - .1 75 to 100 mm pipe diameter; 1.6 mm thick.
 - .2 Greater than 100 mm. pipe diameter; 3.2 mm thick.
- .5 Grooved joint gasket materials to be as recommended by the manufacturer for the service conditions indicated. Unless otherwise specified, provide flush seal type gaskets for all grooved joint systems. Acceptable products: Gustin-Bacon Rigidrip, Victaulic Flush-Seal.

2.13 BOLTS AND NUTS

- .1 Provide hex head bolts and nuts. Threads to be ANSI B1.1, standard coarse thread series.
- .2 For general interior service, use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.
- .3 For exposed (exterior), submerged, buried, installed below the main floor slab and concrete encased service, provide stainless steel bolts, nuts and washers; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8.
- .4 Provide hot dip galvanized bolts, nuts and washers for use with hot dip galvanized Van Stone flange back-up rings and Lap-joint flange back-up rings.
- .5 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

2.14 ANCHOR BOLTS

- .1 Provide hot dip galvanized, L – type anchor bolts, nuts and washers for use with concrete support blocks.
- .2 Use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Grade A.
- .3 Refer to the standard drawings at the end of this section.

2.15 EPOXY COATING (INTERIOR/EXTERIOR PIPING & VALVE SURFACES)

- .1 General
 - .1 All coatings shall be to AWWA C210, ANSI/NSF 60/61 suitable for use in potable water applications.
 - .2 All coatings shall be factory applied by the fitting, piping or valve manufacturer or by a specialized coating firm approved by the Owner's Representative.
 - .3 Coat all non-galvanized/non-stainless steel surfaces in contact with water.
- .2 Coating Materials and Applications
 - .1 Coating Material: The coating material shall be a two component, epoxy liquid coating suitable for use in potable water applications.

MECHANICAL GENERAL REQUIREMENTS

- .2 Application: The coating shall be cold applied and holiday free in accordance with the coating manufacturer's specifications.
- .3 Surface Preparations
 - .1 All surfaces shall be blast cleaned to SSPC-SP5 prior to and within 4 hours of coating. Newly cast objects need not to be sandblasted if not contaminated with soil, oil, grease etc. and if coating takes place within 4 hours after casting.
- .4 Field Applied Coatings
 - .1 Apply to damaged areas of shop coated surfaces and at field welds.
 - .2 Clean and prepare surfaces in accordance with the manufacturers recommendations.
 - .3 Repair coating with an epoxy compatible with the factory-applied epoxy and finish in accordance with the coating manufacturers specifications.
- .5 Inspection
 - .1 The coating shall be pinhole free.
 - .2 The Owner reserves the right to obtain independent coating testing.
 - .3 The cost of independent coating testing shall be born by the Owner unless the inspection was requested by the Contractor.
 - .4 If the independent test shows that the coating is unacceptable, the Contractor shall bear the full cost of all testing and reapplication to the satisfaction of the Owner.
- .6 Color Schedule
 - .1 All piping, valves, and equipment shall be color coded and the finish colors shall be as shown on the color schedule in Section 9907 or as directed by the Engineer.
- .7 Acceptable product
 - .1 Devoe BAR-RUST 233H (NSF approved) Multi-Purpose Epoxy Coating, DFT 12 - 16 mils.
 - .2 Or approved alternate.

2.16 FIELD APPLIED COATING AND WRAPPING

- .1 Buried steel piping shall have an external protective wrapping to protect against corrosion. The wrapping shall consist of a primer followed by a polyken tape covering and then a polyethylene rock shield. The system of primer and tape shall conform to AWWA C209.
- .2 The tape shall be a polyken tape with butyl rubber backing.
- .3 Primer shall have a base of rubber and synthetic resins, compatible with tape, and suitable for hand application.
- .4 The rock shield shall be black polyethylene, 40-mil thickness, supplied in rolls 1050-mm wide, Renfrew 350-40 or as approved.
- .5 Buried steel flanges shall have an external protective wrapping to protect against corrosion. The wrapping shall consist of a primer followed by a Denso tape covering.

2.17 GALVANIZING

MECHANICAL GENERAL REQUIREMENTS

- .1 Where piping is to be galvanized, hot dip zinc coat to CSA G164 with a minimum coating of 550 g/m².

2.18 RPVC CONDUIT

- .1 Tubing shall be installed in RPVC conduit where indicated on Contract Drawings.
- .2 Tubing of 10 mm diameter and smaller is to be installed in 25 mm diameter RPVC conduit complete with long radius elbows.
- .3 Tubing of 12 mm diameter to be installed in 50 mm diameter RPVC conduit complete with long radius elbows.

2.19 TRACER WIRE

- .1 Buried nonmetallic piping shall be installed with insulated tracer wire.
- .2 Insulated tracer wire; 2.0mm (14 gauge) shall be placed above the pipeline and directly over the centre of the pipeline. The Contractor must ensure that the tracer wire is not cut, scraped, or nicked during installation. Termination points shall be installed on Pipeline Warning Sign Posts at approximately 2 km spacing.
- .3 The Contractor shall test and the Engineer shall check the tracer wire. It shall be the Contractor's responsibility to locate and repair any malfunctions discovered by either the Contractor or the Engineer.

2.20 PIPE HANGERS AND SUPPORTS

- .1 General:
 - .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 1983 and MSS-SP58-1983.
 - .2 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
 - .3 Dielectrically isolate all piping from dissimilar metal supports.
- .2 Upper Attachments:
 - .1 Concrete:
 - .1 Inserts for cast-in-place concrete: galvanized steel wedge to MSS-SP58-1983, type 18. ULC listed for pipe 20 mm size through 200 mm.
 - .1 Acceptable product: Anvil Fig. 281; Myatt.
 - .2 Carbon steel plate with clevis, for surface mount - malleable iron socket, expansion case and bolt. Minimum two expansion cases and bolts for each hanger.
 - .1 Acceptable product: Anvil - Fig. 49, Socket Fig. 290, Expansion Case Fig. 117; Myatt.
 - .2 Steel Beam (bottom flange):

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- .1 Cold piping 50 mm size or smaller: malleable iron C clamp to MSS-SP58-198 type 19, ULC listed.
 - .1 Acceptable product: Anvil Fig. 61; Myatt.
- .2 Cold piping 65 mm size and larger and all hot piping: malleable iron beam clamp to MSS-SP58-1983 type 28 or 29, ULC listed.
 - .1 Acceptable product: Anvil Fig. 229; Myatt.
- .3 Steel Beam (top):
 - .1 Cold piping 50 mm size or smaller: malleable iron "top of beam" clamp to MSS-SP58-1983 type 19, ULC listed.
 - .1 Acceptable product: Anvil Fig. 61; Myatt.
 - .2 Cold piping 65 mm size and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP58-1983 type 25, ULC listed.
 - .1 Acceptable product: Anvil Fig. 227; Myatt.
- .4 Steel Joist:
 - .1 Cold piping 50 mm size and smaller: steel washer plate with double locking nuts.
 - .1 Acceptable product: Anvil Fig. 60; Myatt.
 - .2 Cold piping 65 mm size and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.
 - .1 Acceptable product: Anvil - washer plate Fig. 60, clevis Fig. 66, socket Fig. 290, Myatt.
- .5 Steel Channel or Angle (bottom):
 - .1 Cold piping 50 mm size and smaller: malleable iron C clamp to MSS-Sp58-1983 type 23, ULC listed.
 - .1 Acceptable product: Anvil Fig. 86; Myatt.
 - .2 Cold piping 65 mm size and larger and all hot piping: universal channel clamp, ULC listed.
 - .1 Acceptable product: Anvil 226; Myatt.
- .6 Steel Channel or Angle (top):
 - .1 Cold piping 50 mm size or smaller: malleable iron "top of beam" C clamp to MSS-SP58-1983 type 19 ULC listed.
 - .1 Acceptable product: Anvil Fig. 61; Myatt.

MECHANICAL GENERAL REQUIREMENTS

- .2 Cold piping 65 mm size and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP58-1983 type 25, ULC listed.
 - .1 Acceptable product: Anvil Fig. 227; Myatt.
- .3 Middle Attachment (rod):
 - .1 Carbon steel threaded rod, electro-galvanized for finish.
 - .1 Acceptable product: Anvil Fig. 146; Myatt.
- .4 Pipe Attachment:
 - .1 Cold piping, steel or cast iron: hot piping, steel with less than 25 mm horizontal movement: hot piping, steel with more than 300 mm middle attachment rod length: adjustable clevis to MSS-SP58-1983 type 1, ULC listed.
 - .1 Acceptable product: Anvil Fig. 260; Myatt.
 - .2 Cold piping, hot copper with less than 25 mm horizontal movement; hot copper with more than 300 mm middle attachment rod length: adjustable clevis to MSS-SP58-1983 type 1, copper plated.
 - .1 Acceptable product: Anvil Fig. CT-65; Myatt.
 - .3 Suspended hot piping, steel and copper with horizontal movement in excess of 25 mm; hot steel with middle attachment rod 300 mm or less: pipe roller to MSS-1983 type 43.
 - .1 Acceptable product: Anvil Fig. 181; Myatt.
 - .4 Bottom supported hot piping, steel or copper: pipe roller stand to MSS-SP58-1983 type 45.
 - .1 Acceptable product: Anvil Fig. 271; Myatt.
- .7 Riser Clamps:
 - .1 Steel or cast iron pipe: galvanized carbon steel to MSS-SP58-1983 type 42, ULC listed.
 - .1 Acceptable product: Anvil Fig. 261; Myatt.
 - .2 Copper pipe: carbon steel copper finished to MSS-SP58-1983 type 42.
 - .1 Acceptable product: Anvil Fig. CT-121; Myatt.
- .8 Strut Mounted (galvanized carbon steel):
 - .1 Copper piping: cushion clamp c/w thermoplastic rubber.
 - .1 Acceptable product: Anvil PS1400; Hydra-Zorb.

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.9 Saddles and Shields:

- .1 Cold piping 30 mm and larger: protection shield with high density insulation under shield with interrupted vapour barrier.

- .1 Acceptable product: Anvil Fig. 167; Myatt.

- .2 Hot piping 30 mm size and larger: protective saddle with insulation under saddle.

- .1 Acceptable product: Anvil Fig. 160 to 166; Myatt.

2.21 DUCT HANGERS AND SUPPORTS

- .1 Hangers: Galvanized steel band iron or rolled angle and 10 mm rods.
- .2 Wall Supports: Galvanized steel band iron or fabricated angle bracket.
- .3 Vertical Support at Floor: Rolled angle.

2.22 RACK AND TRAPEZE SUPPORTS

- .1 Provide steel trapeze and pipe rack components having a minimum thickness of 2.7 mm (12 gauge) with a maximum deflection of 1/240 of the span unless otherwise noted.
- .2 Provide trapeze pipe support cross members and general fittings as required.
- .3 Approved Supplier:
 - .1 Unistrut or approved equal.

2.23 FINISHES ON HANGER RODS, HANGERS AND SUPPORTS

- .1 All steel hanger rods, hangers and supports shall be galvanized or factory primed with alkyd red oxide primer to CAN/CGSB-1.40-M89.

2.24 INSTRUMENT AIR CONNECTIONS

- .1 Provide instrument air connections to each instrument with a run of 6 mm nylon tubing from the nearest instrument air header to within close proximity of each device requiring instrument air.
- .2 Terminate each tubing run with a 12 mm ball valve (stainless steel) within 1500 mm horizontal distance of the device and 1,500 mm off the floor. Group multiple valves neatly together with a common orientation.
- .3 Provide a vertical riser connection at the header to avoid condensate entrainment. From the top of the riser, slope the tubing generally down to the device.

2.25 QUICK DISCONNECTS

- .1 Provide quick disconnects which are not disconnectable under pressure. Unless otherwise shown or specified, provide products listed below.
- .2 For air service, acceptable products are:

MECHANICAL GENERAL REQUIREMENTS

- .1 Dixon Air King
- .2 Tomco, 12 mm diameter. Tomco, THK.
- .3 For water service, sizes as shown. Acceptable products are:
 - .1 For 25 mm or less diameter hose, two lug, malleable iron, female NPT: Dixon Air King.
 - .2 For 38 mm and 50 mm diameter hose, two four lug, malleable iron, female NPT: New Line Dixon Air King.
 - .3 For 75 and 100 mm diameter or greater; quick-acting, dual clip: Rite-pro, Dixon.

2.26 FLUSHING CONNECTIONS

- .1 Provide flushing connections on all piping for the conveyance of sludge, scum, grit or other liquid containing solids greater than 0.5 percent. Locate flushing connections adjacent to all isolation valves, on dead end branches, at tees and 90 degree elbows, and at intermediate locations which limit the distance between flushing connections to less than 30 metres. Show flushing connections on piping submittals.
- .2 Allow for 5 – 12.5 mm sample ports tapped into 150 to 300 mm pipes. Engineer will provide location during commissioning.

2.27 PURGE CONNECTIONS

- .1 Provide purge connections on all gas lines. Locate adjacent to both sides of all isolation valves and spectacle flanges, and at any other locations shown in the drawings. Purge points shall be a minimum of 20 mm NPS pipe, fitted with a shut off valve which shall be capped.

2.28 MECHANICAL BRANCH CONNECTIONS

- .1 Provide mechanical branch connections as required for flushing connections and pipe tapings. Provide branch connection recommended by the manufacturer for the service and pipe installed. Acceptable products are:
 - .1 Gruvlock Clamp T
 - .2 Ford Service Saddles (F/FS)
 - .3 Victaulic Mechanical T

2.29 DRAIN VALVES

- .1 Locate at all low points and section isolating valves unless otherwise specified.
- .2 Minimum 20 mm size unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap and chain.

2.30 ELECTRICAL MOTORS

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Provide motors to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 40°C for open housing and 50°C for drip proof housing, and operate at 1200 or 1800 r/min unless otherwise specified.

MECHANICAL GENERAL REQUIREMENTS

- .3 Motors shall have ball or roller type bearings.
- .4 Provide grease lubrication fittings on motors with frame sizes 254T and larger.
- .5 Refer to electrical specification for voltage, phase and cycle.

2.31 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW: standard adjustable pitch sheaves, having +/- 10% range. Use mid-position of range for specified r/min.
- .4 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .5 Motor slide rail adjustment plates to allow for centre line adjustment.

2.32 GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm sheet metal tops and bottoms.
 - .3 38 mm diameter holes on both shaft centers for insertion of tachometer.
 - .4 removable for servicing.
 - .5 Install guards to allow movement of motors for adjusting belt tension.
- .3 Provide means to permit 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 Securely fasten in place.
 - .3 Removable for servicing.
- .5 Unprotected inlets and outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

2.33 SPARE PARTS AND SPECIAL TOOLS

- .1 To Section 01795 – Spare Parts as follows.
 - .1 One set of belts for each piece of machinery.
 - .2 One filter cartridge or set of filter media for each filter or filter bank in addition to the final operating set.

MECHANICAL GENERAL REQUIREMENTS

- .2 Provide one set of special tools required to service equipment as recommended by the equipment manufacturer.

2.34 ACCESS DOORS

- .1 Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting, and servicing.
- .2 Flush mounted 600 mm x 600 mm for body entry and maximum size possible to 300 mm x 300 mm for hand entry unless otherwise noted. Doors to open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as tiles or marble surfaces: use stainless steel with brushed satin or polished finish as directed by consultant.
 - .2 Remaining areas: use prime coated steel.
- .4 Installation:
 - .1 Locate such that all concealed items are accessible.
 - .2 Locate such that hand or body entry is achieved.
 - .3 Installation is specified in applicable sections.

2.35 FLASHING

- .1 Steel Flashing: 0.55 mm galvanized steel.
- .2 Lead Flashing: sheet lead, as follows:
 - .1 For Waterproofing: 25 kg/m².
 - .2 For Soundproofing: 5 kg/m².
 - .3 Lead Sheet Size:
 - .1 Roof Plumbing Vents: as required to provide base flashing overlap to ARCA detail.
 - .2 Floor Drains: minimum 920 x 920 mm and as specified.
 - .3 Other Locations: as specified.
- .3 Safes: 25 kg/m² sheet lead or 200 micrometre neoprene.
- .4 Caps: Steel, 0.70 mm thickness minimum, 1.6 mm thickness at fire resistance structures.

2.36 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment, and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting, and servicing of all systems and equipment during regular work hours, prior to acceptance.

MECHANICAL GENERAL REQUIREMENTS

2.37 TEMPORARY OR TRIAL USAGE

- .1 Temporary or trial usage by the engineer of mechanical equipment supplied under contract shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

3. EXECUTION

3.1 EXAMINATION

- .1 Examine areas where work is to be performed for:
 - .1 Anything that affects execution and quality of work.
 - .2 Piping clearances.

3.2 VALVES AND EQUIPMENT IDENTIFICATION

- .1 Tagging:
 - .1 See Section 1.11.
- .2 The drawings designate the size and line service specification of all pipe, fittings, valves and equipment to be supplied by the Contractor in the following manner.
- .3 Valve Identification Symbols

- .1 Valve Identity Symbols

<u>Symbol</u>	<u>Valve Type</u>
ARV	Air Release Valve
BAV	Ball Valve
BBV	Block and Bleed Valve
BPV	Back Pressure Valve
BUV	Butterfly Valve
BV	Block Valve
CAV	Combination Air Vacuum
CHV	Check Valve
DCVA	Double Check Valve Assembly
FCV	Flow Control Valve
GAV	Gate Valve
GLV	Globe Valve
NEV	Needle Valve
PRV	Pressure Reducing Valve
PSV	Pressure Sustaining, Pressure Relief Valve
SV	Solenoid Valve

- .2 Valve Marking
Each valve to bear the manufacturer's name or trademark and reference symbol to indicate the service conditions for which the manufacturer guarantees the valve. The marking to be in accordance with MSS-SP-25.

MECHANICAL GENERAL REQUIREMENTS

.3 Manual Valve Actuators

.1 Actuators for valves to be as follows:

Type of Valve	Size	Valve Actuator
Gate Valve	250 mm & smaller	Handwheels
Globe Valve	250 mm & smaller	Handwheels
Butterfly Valves	100 mm & smaller	Lever operated
	150 mm & larger	Gear operated
Ball Valves	100 mm & smaller	Lever operated
Plug Valves	100 mm & smaller	Lever operated
	150 mm & larger	Gear Operated

.4 Valve operators to turn in a counter-clockwise direction to open unless otherwise indicated on the drawings.

.4 Equipment Identification

.1 Processes

<u>Symbol</u>	<u>Equipment</u>
AC	Air Compressor
B	Blower
EXP	Expansion Joint
FI	Flow Indicator
M	Mixer
PI	Pressure Indicator
P	Pump
SK	Skimmer
STR	Strainer
TK	Tank

.2 Plumbing

<u>Symbol</u>	<u>Equipment</u>
CO	Cleanout
DWH	Domestic Water Heater
ED	Equipment Drain
FD	Floor Drain
FFD	Funnel Floor Drain
FSL	Flow Switch
HB	Hose Bibb
HD	Hub Drain
NFHB	No Freeze Hose Bib
PTK	Pressure Tank
PS	Pressure Switch
RD	Roof Drain

.3 Heating, Ventilation, and Air Conditioning

<u>Symbol</u>	<u>Equipment</u>
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MECHANICAL GENERAL REQUIREMENTS

B	Boiler
BDD	Back Draft Damper
CC	Cooling Coil
CF	Ceiling Fan
CU	Condensing Unit
DM	Damper
EF	Exhaust Fan
ET	Expansion Tank
FC	Fan Coil Unit
FF	Force Flow Unit
GC	Glycol Fill Tank
L	Louvre
P	Pump
SF	Supply Fan
T	Thermostat
UH	Unit Heater

3.3 PIPING INSTALLATION

.1 General:

- .1 Conform to requirements of ANSI B31 code for pressure piping.
- .2 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.
- .3 Install groups of piping parallel to each other, spaced to permit application of insulation (when required), identification, and service access, on hangers.
- .4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .5 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .6 Install flanged or welded nozzles, branch connections, welding outlets, adapters and taps, true and faced at right angles to the axis of the pipe. Do not extend connection inside of pipe.
- .7 Make pipe ends round and true, suitable for weld connection.
- .8 Prepare pipe ends in accordance with ANSI B16.25 for butt welding.
- .9 Copper pipe and tubing to be free from surface damage. Replace damaged pipe or tubing.
- .10 Ream ends of pipe and tubes before being made up.
- .11 Lay metal tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .12 Use non-corrosive lubricant or Teflon tape applied to male thread only.
- .13 Groove pipe ends, cut square, seating surface clean and free from indent and score marks.
- .14 Install dielectric fittings wherever piping of dissimilar metals are joined.
- .15 Install flanges or unions to permit removal of equipment and valves without disturbing piping systems, as required by piping standard.
- .16 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.
- .17 Support piping during construction to prevent abnormal stresses on the pipe works.
- .18 Install pipe supports as required.
- .19 Install pipe hangers as required.

MECHANICAL GENERAL REQUIREMENTS

.2 Flanges Bolting to Valves:

- .1 Do not weld adjacent flanges when any valve is in place.
- .2 Remove valve prior to welding.
- .3 Clean gasket surfaces, flange faces and butt welding connections.
- .4 Protect connecting surfaces.

.3 Bolted Connections:

- .1 Clean pipe ends and gaskets.
- .2 Lubricate gaskets with soapy water and bolts with thread lubricant.
- .3 Tighten bolts progressively by crossover method and not in rotation around the joint.
- .4 Tighten bolts to the torque recommended by the manufacturer.
- .5 Use properly sized wrenches for bolt tightening to prevent rounding of nut and bolt heads.

.4 Threaded Connections:

- .1 Clean pipe ends and threads.
- .2 Use appropriate pipe dope for potable use when threading pipe.

3.4 WELDING SPECIFICATIONS

.1 Welders Qualifications:

- .1 All welders shall have an Alberta Class "B" Pressure Welding Certificate. Welders shall be qualified by a local approved testing agency. All welders shall have qualified under ASME B31.1-2006 Standard
- .2 All welders shall be qualified for the particular welding procedures they will perform.

.2 Welding Procedures:

- .1 Submit details of the procedures for Owner's Representative's review.
- .2 All welding shall be carried out in accordance with ASME B31.3-2006 Standards.
- .3 The Contractor shall use adequate weather shields to protect the welding operation from rain, snow and wind. The Owner's Representative has the right to stop all welding if in his opinion adverse weather conditions will affect the quality of the weld.
- .4 All dirt and slag shall be removed before the succeeding bead is applied.
- .5 Welding of Stainless Steel:
 - .1 All welding of the root pass of austenitic stainless steel pipe shall be done using the Gas Tungsten Arc Welding (GTAW) or Gas Metal Arc Welding (GMAW) process with appropriate filler metal and shielding gas.
 - .2 Preparation and welding in accordance with ASME B31.3 Section V.
 - .3 Fabrication shall be in accordance with ASME B31.3 Inspection code shall be Category D.
 - .4 Post weld cleaning: All stainless steel fabrications and welds shall be pickled in accordance with AWWA C220, ASTM A380 and ASTM A967. Stainless piping welds shall be coated with the appropriate pickling paste or immersed in a liquid bath of pickling solution. Any pickling product for use on piping for a potable system shall be NSF certified. Any noticeable discoloration found on the stainless pipe shall be removed by pickling.

MECHANICAL GENERAL REQUIREMENTS

- .5 Field Welding of Stainless Steels:
 - .1 Field welding shall conform to ASME B31.3.
 - .2 Field welding shall be kept to a minimum and performed only with the prior consent of the Engineer.
 - .3 Stainless steel pipe shall be cleaned with alcohol or acetone to a pre-weld zone extending 50 mm on either side of the weld.
- .3 Standard of Acceptability:
 - .1 The Engineer shall have the right to inspect all welds by visual, radiological or other non-destructive test method. Inspection may be made during welding or after the weld has been completed. Under visual examination welds shall be free of cracks, inadequate penetration, unrepaired burn-through and other defects, and shall present a neat workmanlike appearance. Radiological examination may be used at the discretion of the Owner's Representative to determine the penetration, slag inclusion, cracks and other defects. The Owner's Representative shall be the sole judge as to the acceptability of each weld.
 - .2 If a dispute results as to the acceptability of a weld, a specimen may be taken of the weld at the location determined by the Owner's Representative and subjected to tests in accordance with ASME B31.3-2006 Standards. An acceptable weld shall be per Z183.
 - .3 If the specimen test shows that the weld is unacceptable as outlined above, the Contractor shall bear the full cost of all testing and repairing the pipe where the specimen is removed to the satisfaction of the Owner's Representative. The Owner's Representative shall have the right to reject any weld if in his opinion the weld defects are detrimental to the strength of the weld.
 - .4 The cost of all radiological inspection shall be born by the Owner unless the inspection was requested by the Contractor.
- .4 Leakage Testing
 - .1 Leakage testing on completed butt joints shall normally be made by testing the line hydrostatically to the pressure rating of the pipe or as specified by design in hydrostatic testing specification.
- .5 Repair of Defective Welds
 - .1 Minor defects in welds may be removed by grinding out the defective portion. Replacement welds in joints may be checked by repeating the original test.
 - .2 Major defects and all cracks shall be cut out mechanically and the joint re-welded.
 - .3 All cost for repairing defective welds, including radiographic inspection of the corrected work, shall be borne by the Contractor.

3.5 VALVE INSTALLATION

- .1 Storage of Valves:
 - .1 Store valves in cool and clean location, away from moving vehicles or other objects.
 - .2 Prevent dirt and debris entering the valve internals.
 - .3 Protect the valve seats against painting.
 - .4 Store valves with their handwheels, operator shafts and operators in an upright position.

MECHANICAL GENERAL REQUIREMENTS

.2 Handling Valves

- .1 Do not place chains, cables and ropes through valve ports or attached to operators or handwheels.
- .2 Use sling either around valve body or with bolts or rods through the flange holes.

.3 Installation of Valves:

- .1 Installation of valves to be by competent personnel and in strict accordance with manufacturer's instructions.
- .2 Inspect pipe and remove all foreign debris or objects that may prevent closing of valve prior to the installation of any valves.
- .3 Install butterfly valves with their operating shafts in the horizontal position unless otherwise directed by the Owner's Representative.
- .4 Flanges or fittings adjacent to butterfly valves shall not be welded with the valve in place.

3.6 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.
- .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.7 PIPE HANGERS AND SUPPORTS

.1 Hanger Spacing

Spacing and middle attachment rod diameter as specified in paragraphs below or as table below, whichever is more stringent.

- .1 Plumbing piping: most stringent requirements of the Plumbing Code for the Province of Saskatchewan or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas piping: up to 15 mm size - every 1.8 m.
- .4 Copper piping: up to 15 mm size - every 1.5 m.
- .5 PVC piping: To manufacturer's recommendation for the maximum temperature of the service and to prevent any visible deflection or movement.
- .6 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .7 Within 300 mm of each horizontal elbow.

MECHANICAL GENERAL REQUIREMENTS

.8 Table:

Maximum Pipe Size(mm)	Rod Diameter (mm)	Maximum Spacing Steel (m)	Maximum Spacing Copper (m)
To 30	10	2.1	1.8
40	10	2.7	2.4
50	10	3.0	2.7
65	10	3.6	3.0
75	10	3.6	3.0
100	16	4.2	3.6
150	22	5.1	
200	22	5.7	
250	22	6.6	
300	22	6.9	

.2 Hanger Installation:

- .1 Offset Hanger so that rod is vertical in operating position.
- .2 Adjust hangers to equalize load.

3.8 EQUIPMENT BASES AND SUPPORTS

- .1 Provide for major equipment, reinforced concrete housekeeping bases poured directly on structural floor slab 100 mm thick minimum, extended 100 mm minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
- .2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .3 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

3.9 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.
 - .3 Over 1200 mm wide: 40 x 1.6 mm at 2.4 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.
 - .2 640 to 900 mm wide: 25 x 25 x 3 mm.
 - .3 Over 1520 mm wide: 50 x 3 mm.
 - .4 940 to 1200 mm wide: 30 x 30 x 3 mm.

MECHANICAL GENERAL REQUIREMENTS

- .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.

3.10 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.
- .2 Flash vent and soil pipes projecting 75 mm minimum above roof membrane with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides. For pipes through outside walls turn flange back into wall and caulk.
- .3 Flash floor drains over finished areas with lead minimum 250 mm clear on sides. Fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations, minimum 200 mm high.
- .5 Attach counterflashings to mechanical equipment and lap base flashings on roof curbs.
- .6 All joints in counterflashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Use storm collars above all roof jacks.
- .7 Screw vertical flange section of roof jacks to face of curb.
- .8 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

3.11 PROTECTION OF OPENINGS

- .1 Protect equipment and system openings from dirt, dust and other foreign materials.
- .2 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances prior to being put into operation.

3.12 EQUIPMENT PIPING CONNECTIONS

- .1 Where equipment connections are a different size from the piping serving it all associated isolating valves and fittings to be the larger pipe size unless specifically indicated otherwise on the drawings. This rule to also apply in the case of control valves.

3.13 SLEEVES

- .1 Provide individual metal sleeves for all pipes, tubes or ducts penetrating all walls and floor slabs. Grout tightly in place for full depth of wall or slab.
- .2 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- .3 Standard sleeves to be 22 Ga. galvanized sheet steel with lock seam joints.
- .4 Use cast iron or steel pipe sleeve with annular fin continuously welded at midpoint:

MECHANICAL GENERAL REQUIREMENTS

- .1 Through foundation walls.
- .2 Where sleeve extends above finished floor.
- .5 Sizes:
 - .1 Refer to mechanical drawings for details.
 - .2 Provide 6 mm clearance all around, between sleeves and pipe or between sleeve and insulation.
- .6 Terminate sleeves flush with surface of concrete and masonry and above floors.
- .7 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight, durable joint.
- .8 Voids Around Pipes:
 - .1 Where sleeves pass through walls or floors, caulk space between sleeve and insulation or between sleeve and pipe with dry oakum. Seal space at each end of sleeve with waterproof, fire retardant, non-hardening mastic.
 - .2 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .3 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.
- .9 Where pipes and ducts pass through walls and floors having a fire separation rating, pack the space with approved caulking material and seal in accordance with CGSB19-GP-9.

3.14 ESCUTCHEONS AND PLATES

- .1 Install on pipes passing through finished walls, floors, and ceilings.
- .2 Use chrome or nickel plated brass, solid type with set screws for ceiling or wall mount.
- .3 Inside diameter to fit around finished pipe. Outside diameter to cover opening or sleeve.
- .4 Where sleeve extends above finished floor, escutcheons or plates to clear sleeve extension.
- .5 Secure to pipe or finished surface but not to insulation.

3.15 CUTTING AND PATCHING

- .1 Minimize cutting and patching required. Set sleeves and mark openings in concrete forms and masonry structure prior to the placement of concrete or masonry.

END SECTION

MECHANICAL IDENTIFICATION

1. GENERAL

1.1 RELATED SECTIONS

- .1 Site painting of mechanical work: Division 09.

1.2 REFERENCE DOCUMENT

- .1 Comply with requirements of latest edition of "Colour Coding Requirements for Mechanical and Electrical Systems" (Alberta Public Works, Supply and Services), hereinafter referred to as APWSS Colour Coding Requirements.
- .2 Obtain copy of APWSS Colour Coding Requirements document from the Minister prior to starting work.

2. PRODUCTS

2.1 TAGS, LABELS AND BANDING

- .1 Laminated Plastic Nameplate: self-adhesive composite laminated plastic nameplates with one smooth white surface and core of black plastic. Designed to leave black lettering on a white background when engraved.
 - .1 Mechanical Equipment: engraved lettering 20 mm high.
 - .2 Panels and Panel Mounted Equipment: engraved lettering 20 mm high.
 - .3 Equipment Cabinet front mounted switches and displays: engraved lettering 8 mm high.
- .2 Colour Banding Tape: adhesive backed plastic tape, integrally coloured.
- .3 Identification Labels: adhesive backed plasticized labels, yellow colour, with:
 - .1 Legends consisting of black lettering, minimum 50 mm high.
 - .2 Black direction of flow arrows.
- .4 Stencils: 50 mm high black lettering and flow arrows.

3. EXECUTION

3.1 LABELS

- .1 Use identification labels or stencils to apply legends and direction of flow arrows, as detailed in APWSS Colour Coding Requirements, and as follows:
 - .1 Apply to full colour coded mechanical piping and to mechanical ductwork in sufficient numbers of locations to provide easy identification.
 - .2 Apply to intermittent colour coded mechanical piping wherever colour coding bands occur.
- .2 Adhere labels with sufficient coat of contact cement to ensure permanent adhesion. Seal with two coats of clear lacquer.

MECHANICAL IDENTIFICATION

- .3 Identify major mechanical equipment with laminated plastic nameplates.
- .4 Identify electric starting switches, electric disconnects and remote push buttons with laminated plastic nameplates.

3.2 TAGS

- .1 Tag all valves in mechanical rooms, and all circuit balancing and isolating valves external to mechanical room except valves at terminal heating and cooling equipment.
- .2 Identify and tag air terminal boxes and radiator valves with numbers.
- .3 Identify and tag thermostats relating to terminal boxes and valve numbers.
- .4 Identify and tag temperature sensors or intelligent thermostats by mnemonic and related terminal box and valve numbers.

3.3 LOCATION IDENTIFICATION

- .1 Provide equipment, valve and damper location tacks or adhesive disks in T-bar type ceilings, colour coded as follows:
 - .1 Yellow - HVAC Equipment
 - .2 Red - Fire Dampers/Smoke Dampers
 - .3 Green - Plumbing Valves
 - .4 Blue - Heating/Cooling Valves
- .2 Locate tacks or disks in corner of T-bar panel closest to equipment.

3.4 DIRECTORIES

- .1 Install valve tag directory on wall in mechanical room.

END OF SECTION

VIBRATION ISOLATION

1. GENERAL

1.1 REFERENCE STANDARD

- .1 Provide and install mechanical equipment so that Average Noise Criteria Curves, as outlined in ASHRAE Guide, are not exceeded.

1.2 SUBMITTALS

- .1 Provide vibration isolation shop drawings showing isolator locations, load on each isolator, inertia slab dimensions.

1.3 GENERAL REQUIREMENTS

- .1 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.
- .2 Ensure equipment is sufficiently rigid for isolator point loading.

1.4 INSPECTION

- .1 Provide inspection services by vibration isolation equipment and materials manufacturer's representative for final installation and provide written report that installation is in accordance with specifications and manufacturer's recommendations.

2. PRODUCTS

2.1 VIBRATION ISOLATORS

- .1 Type 1: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- .2 Type 2: Open spring mount with iso-stiff springs (horizontal stiffness equal to vertical stiffness).
- .3 Type 3: Open spring mount with iso-stiff springs, heavy mounting frame and limit stop.
- .4 Type 4: Closed spring mount with iso-stiff springs and limit stop.
- .5 Type 5: Closed spring hanger with acoustic washer.
- .6 Type 6: Closed spring hanger with 25 mm thick acoustic isolator.
- .7 Type 7: Elastomer mount with threaded insert and hold down holes.
- .8 Type 8: Neoprene jacketed pre-compressed moulded fiberglass.
- .9 Type 9: Rubber waffle pads, 30 durometer, minimum 12 mm thick, maximum loading 280 kPa. Use neoprene in oily locations or outdoors.
- .10 Type 10: Rubber-steel-rubber pads, 12 mm thick rubber waffle pads bonded to 6 mm thick steel plate.

VIBRATION ISOLATION

- .11 Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- .12 Colour code spring mounts, springs selected to operate at no greater than 2/3 solid deflection and have 6 mm ribbed neoprene pads.

3. EXECUTION

3.1 APPLICATION

- .1 Provide vibration isolators for mechanical motor driven equipment throughout, unless specifically noted otherwise.

END OF SECTION

HANGERS AND SUPPORTS

1. GENERAL

1.1 REFERENCE DOCUMENTS

- .1 Pipe supports shall meet the requirements of ANSI/ASME B31.1-1995, Power piping.
- .2 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

1.2 GENERAL REQUIREMENTS

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.
- .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- .3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- .4 Fasten hangers and supports to building steel or inserts in concrete construction.
- .5 Provide and set sleeves required for equipment, including openings required for placing equipment.
- .6 Dielectrically isolate dissimilar metals.
- .7 Pipe, duct and conduit supports are not all necessarily shown on the Contract Drawings. The Contractor is responsible to ensure sufficient supports are supplied, fabricated, and installed to properly secure all pipe, fittings, and equipment to satisfy manufacturer's recommendations.

1.3 APPROVALS

- .1 Obtain approval from the Engineer prior to drilling for inserts and supports for piping systems.
- .2 Obtain approval from the Engineer prior to using percussion type fastenings.
- .3 Use of perforated band iron, wire or chain as hangers is not permitted.

2. PRODUCTS

2.1 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.
- .2 Size inserts to suit threaded hanger rods.

2.2 PIPE HANGERS AND SUPPORTS

HANGERS AND SUPPORTS

- .1 Hangers: Pipe sizes 15 mm to 40 mm: Adjustable wrought steel ring.
- .2 Hangers: Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes 150 mm Over: Adjustable wrought steel clevis.
- .3 Hangers: Hot Pipe Sizes 150 mm: Adjustable steel yoke and cast iron roll.
- .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150 mm and over.
- .5 Wall Support: Pipe Sizes to 80 mm: Cast iron hook.
- .6 Wall Support: 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.
- .7 Vertical Support: Steel riser clamp.
- .8 Floor Support: 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.
- .9 Floor Support: Hot Pipe Sizes 150 mm and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.
- .10 Design hangers so they cannot become disengaged by movements of supported pipe.
- .11 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping.
- .12 Insulate all piping from dissimilar metal supports.

2.3 HANGER RODS

- .1 Provide steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

2.4 DUCT HANGERS AND SUPPORTS

- .1 Hangers: Galvanized steel band iron or rolled angle and 10 mm rods.
- .2 Wall Supports: Galvanized steel band iron or fabricated angle bracket.
- .3 Vertical Support at Floor: Rolled angle.

2.5 FLASHING

- .1 Steel Flashing: 0.55 mm galvanized steel.
- .2 Lead Flashing: sheet lead, as follows:
 - .1 For Waterproofing: 25 kg/m².
 - .2 For Soundproofing: 5 kg/m².

HANGERS AND SUPPORTS

.3 Lead Sheet Size:

- .1 Roof Plumbing Vents: as required to provide base flashing overlap to ARCA detail.
- .2 Floor Drains: minimum 920 x 920 mm and as specified.
- .3 Other Locations: as specified.

.3 Safes: 25 kg/m² sheet lead or 200 micrometre neoprene.

.4 Caps: Steel, 0.70 mm thickness minimum, 1.6 mm thickness at fire resistance structures.

2.6 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 Round Ducts: Form sleeves with galvanized steel.
- .4 Rectangular Ducts: Form sleeves with galvanized steel or wood.
- .5 Size large enough to allow for expansion with continuous insulation.

2.7 FINISHES ON HANGER RODS, HANGERS AND SUPPORTS

- .1 All steel hanger rods, hangers and supports shall be galvanized or factory primed with alkyd red oxide primer to CAN/CGSB-1.40-M89.

3. EXECUTION

3.1 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.
- .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

HANGERS AND SUPPORTS

3.2 PIPE HANGERS AND SUPPORTS

- .1 Support horizontal steel and copper piping as follows:

Nominal Pipe Size	Distance Between Supports	Hanger Rod Diameter
15 mm	1.8 m	10 mm
20 mm to 40 mm	1.8 m	10 mm
50 mm & 65 mm	3.0 m	10 mm
80 mm & 100 mm	3.6 m	16 mm
150 mm to 300 mm	4.3 m	22 mm
350 mm to 450 mm	6.1 m	25 mm

- .2 Install hangers to provide minimum 12 mm clear space between finished covering and adjacent work.
- .3 Place a hanger within 300 mm of each horizontal elbow.
- .4 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.
- .5 Support horizontal soil pipe near each hub with 1.5 m maximum spacing between hangers.
- .6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Where practical, support riser piping independently of connected horizontal piping.

3.3 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.
- .2 640 to 900 mm wide: 25 x 25 x 3 mm.
- .4 940 to 1200 mm wide: 30 x 30 x 3 mm.

HANGERS AND SUPPORTS

- .4 Vertical Duct Floor Supports Minimum Sizes, riveted or screwed to ducts:

- .1 Up to 1520 mm wide: 40 x 40 x 3 mm.

3.4 EQUIPMENT BASES AND SUPPORTS

- .1 Provide for major equipment, reinforced concrete housekeeping bases poured directly on structural floor slab 100 mm thick minimum, extended 100 mm minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
- .2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .3 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

3.5 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.
- .2 Flash vent and soil pipes projecting 75 mm minimum above roof membrane with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides. For pipes through outside walls turn flange back into wall and caulk.
- .3 Flash floor drains over finished areas with lead minimum 250 mm clear on sides. Fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations, minimum 200 mm high.
- .5 Attach counterflashings to mechanical equipment and lap base flashings on roof curbs.
- .6 All joints in counterflashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Use storm collars above all roof jacks.
- .7 Screw vertical flange section of roof jacks to face of curb.
- .8 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

3.6 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.

HANGERS AND SUPPORTS

- .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.
- .4 Install chrome plated escutcheons where piping passes through finished surfaces.

END OF SECTION

DETAILED PIPING SPECIFICATIONS

1. GENERAL

1.1 INTENT

- .1 This section contains detailed piping specifications.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Contractor to provide detailed piping spool sheets before fabrication of piping. Spool sheets to include the following:
- .1 Outline and arrangement drawings
 - .2 Dimensional data
 - .3 Piping material
 - .4 List of fittings

1.3 PIPING IDENTIFICATION

- .1 The drawings designate the size and line service specification of pipe to be supplied by the Contractor in the following manner.
- .1 Line Identification is placed on each line in the following manner:

	PW	-	150	-	A1	-	D
Commodity	_____		_____		_____		_____
Line Size	_____		_____		_____		_____
Piping Line Code	_____		_____		_____		_____
Special Treatment	_____		_____		_____		_____

e.g. potable water, 150 mm line size, standard weight steel, internal epoxy coated

- .2 Legends and tables identifying the commodity, line code and special treatment symbols are included in this section of the specifications.
- .1 Commodity Symbols for Line Identification:
- | | |
|-----|------------------------------------|
| AA | Aqua Ammonia |
| ACI | Acid (pH Adjustment) |
| ACS | Powdered Activated Carbon Solution |
| AD | Air Distribution |
| AS | Air Supply |
| AL | Alum |
| ALS | Alum Solution |
| ALG | Algaecide Solution |
| AMG | Ammonia Gas |
| AMS | Ammonia Solution |
| BWS | Backwash Supply |
| CA | Citric Acid |
| CAS | Citric Acid Solution |
| CDG | Carbon Dioxide Gas |
| CDS | Carbon Dioxide Solution |

DETAILED PIPING SPECIFICATIONS

CIPS	Clean in Place Supply
CIPR	Clean in Place Return
CIPD	Clean in Place Drain
CLG	Chlorine Gas
CLS	Chlorine Solution
CO	Coagulant
COS	Coagulant Solution
CS	Caustic Soda
DCW	Domestic Cold Water
DHW	Domestic Hot Water
DHWR	Domestic Hot Water Recirculation
DE	DAF Effluent
DW	DAF Waste
DL	Diesel Fuel
DR	Drain
EW	Effluent Water
FL	Fluoride
FTW	Filter to Waste
FW	Filtered Water
G(H)	Natural Gas (High Pressure)
G(L)	Natural Gas (Low Pressure)
GLS	Glycol Supply
GLR	Glycol Return
HWS	Hot Water Supply
HWR	Hot Water Return
IA	Instrument Air
OF	Overflow
PLY	Polyelectrolyte (Liquid)
PLYS	Polyelectrolyte Solution
PO	Polymer
POS	Polymer Solution
PPS	Potassium Permanganate Solution
PSW	Plant Service Water
PW	Potable Water
RAS	Return Activated Sludge
RF	Refrigerant
RJW	Reject Water
RW	Raw Water
S	Sanitary Waste
SAM	Sample Line
SAS	Soda Ash Solution
SB	Sodium Bisulphate
SEN	Sensing Line
SH	Sodium Hypochlorite
SLG	Sludge
SPSW	Softened Plant Service Water
SU	Supernatant
SV	Sanitary Vent
TEW	Tempered Effluent Waste
VE	Vent
WAS	Waste Activated Sludge
WT	Weeping Tile

DETAILED PIPING SPECIFICATIONS

XR Excess Recirculation

.3 Line Codes:

The following is a description of the general line code classifications.

Line Code	Flange Rating	Schedule/ Thickness	Basic Material	Special Notes	Maximum Design Pressure
A1	ANSI 150	-	Carbon Steel	Standard Weight	Varies
A2	ANSI 150	-	Carbon Steel	Extra Strong	Varies
A3	ANSI 300	-	Carbon Steel	Extra Strong	Varies
B1	ANSI 150	Sch 80	PVC	-	Varies
B2	ANSI 150	Sch 40	PVC	-	Varies
B3	ANSI 150	SDR 18	PVC	-	1620 kPa
B4	ANSI 150	SDR 21	PVC	-	1380 kPa
B5	ANSI 150	SDR 26	PVC	-	1100 kPa
B6	ANSI 150	SDR 28	PVC	-	-
B7	ANSI 150	SDR 32.5	PVC	-	860 kPa
B8	ANSI 150	SDR 35	PVC	-	-
B9	ANSI 150	SDR 41	PVC	-	690 kPa
B10	ANSI 150	SDR 51	PVC	-	550 kPa
B11	ANSI 150	C900 & C 905	PVC	-	1050 kPa
B12	-	SCH 80	PVC (Well Riser Pipe)	Certa-Lock	-
C1	-	Type K	Copper	-	-
C2	-	Type L	Copper	-	-
C3	-	Type M	Copper	-	-
D1	ANSI 150	SCH 10S	Stainless Steel 304L	-	Varies
D2	ANSI 150	SCH 10S	Stainless Steel 316L	-	Varies
D3	ANSI 150	SCH 40S	Stainless Steel 304L	Standard Weight	Varies
D4	ANSI 150	-	Stainless Steel 316L	Standard Weight	Varies
D5	ANSI 300	SCH 40S	Stainless Steel 304L	-	Varies
D6	ANSI 300	SCH 40S	Stainless Steel 316L	-	Varies
D7	ANSI 300	SCH 80S	Stainless Steel 304L	-	Varies
D8	ANSI 300	SCH 80S	Stainless Steel 316L	-	Varies
E1	-	-	PVC-DWV	-	Plumbing Code
E2	-	-	ABS-DWV	-	Plumbing Code
F1	-	-	Big "O" Drain	c/w filter sock	-
G1	ANSI 150	-	Ductile Iron	-	-
G2	ANSI 150	-	Cast Iron	-	-
H1	-	DR 9	HDPE, C906	-	1380 kPa
H2	-	DR 11	HDPE, C906	-	1100 kPa
H3	-	DR 13.5	HDPE, C906	-	900 kPa
H4	-	DR 15.5	HDPE, C906	-	760 kPa
H5	-	DR 17	HDPE, C906	-	690 kPa
H6	-	DR 32	HDPE, C906	-	315 kPa
H7	-	DR 11	PE2406, Yellow	-	522 kPa
H8	-	DR 11	HDPE, PR 4710	-	1,800 kPa
J1	-	-	Asbestos Cement Pipe	-	-
J2	-	Class V	Reinforced Concrete Pipe	-	-
K1	-	-	PE OD Tubing	-	-
K2	-	-	PE ID Tubing	-	-
K3	-	-	LLDPE OD Tubing	-	-

DETAILED PIPING SPECIFICATIONS

K4 - - PP OD Tubing - -

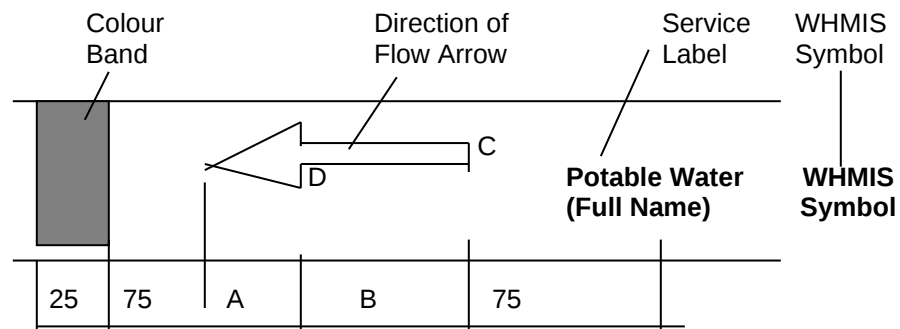
.4 Special Treatment Code:

Symbol **Description**

- (A) Cement mortar lining
- (B) Internal hot applied coal tar lining
- (C) External hot applied coal tar lining
- (D) Internal epoxy coated
- (E) External epoxy coated
- (F) External yellow jacketed
- (G) External double wrap polyken tape
- (H) Externally insulated
- (J) External shop prime
- (K) Densyl mastic wrap - buried flanges, couplers, and valves
- (L) Galvanized
- (M) Rock shield
- (N) Frost shield
- (P) Installed in RPVC conduit
- (R) Tracer wire installed above pipe

.5 Pipe Identification Symbols:

.1 The marking of the piping is to correspond to the following sketch:



.2 Sizing Requirements - The sizing and spacing of the various components in relation to the outside diameter of the pipe on which they are to be painted is to be as follows:

OUTSIDE DIA OF PIPE (OVER INSULATION)

	A	B	C	D
12min - 25 mm	12mm	50mm	6mm	3mm
32 mm - 50 mm	25mm	75mm	2mm	6mm
64 mm. and up	38mm	87mm.	25 mm	12mm

.3 Application

- .1 All pipeline identification symbols are to be adhesive labels.
- .2 Surface of pipe or insulation, on which symbols are to be applied, must be clean and dry.

DETAILED PIPING SPECIFICATIONS

.4 Symbol Colours

- .1 Colour **Band - width of colour band is to be** 25 mm on all diameters of pipe. Colour is to correspond to Section 09907 - Painting of Process Pipe and Equipment.
- .2 Direction of Flow Arrow - arrow is to indicate direction of flow of media in pipe. If direction is either way, a double headed arrow is to be used as shown in "Sizing Requirements". Colour arrow is to be black when pipe is a light colour. Colour of arrow is to be white when pipe is a dark colour.
- .3 Service Label – Labels are to designate what is in pipe.

.5 Location of Symbols- No hard and fast rules for the location of piping identification symbols are laid down, however some general requirements and guidelines are noted below.

.6 The purpose is to present the information to the maintenance person at the point in the building where it is likely to be needed.

.7 The maintenance person must not have to climb around objects, over pipes, etc., to read a pipe symbol. They shall be presented in such a manner that they are clearly visible when standing in a normal manner in the room or space. If the normal access to a space is above the pipes, then they should be identified on their tops so that they can be seen when looking down. The line of sight of the maintenance person shall always be kept in mind.

.8 Places for pipe identification are as follows:

- .1 On lateral runs where they leave risers at various floor levels.
- .2 On risers in pipe spaces near locations where entry to personnel is provided.
- .3 Near valves or branches where a number of pipes are racked together on a pipe rack.
- .4 Near pipe connection points to major pieces of equipment. Keep symbols far enough away so they would not get damaged by maintenance activity around equipment.
- .5 Near major shut-off valves at entry point of utility to building.
- .6 Near pipe exit point from building.

.9 Long runs of pipe in building shall be identified approximately every 15 m (50').

.10 A pipe passing through a wall should be identified on both sides of wall.

.11 Before undertaking the work, the Contractor is to complete a sample for viewing by the Consultant and Owner in order to obtain approval to proceed. The stencils prepared and the proposed paint are to be checked at that time by these parties.

DETAILED PIPING SPECIFICATIONS

SERVICE: Refer to Contract Drawings		LINE CODE: D5
PRIMARY FLANGE RATING: CLASS 300 ANSI B16.9		DESIGN PRESSURE:
TEMPERATURE (MAX): 40°C		CORROSION ALLOWANCE: 1.3 mm
ITEM	SIZES	GENERAL DESCRIPTION
Pipe	50 mm & smaller	Stainless Steel, ASTM A312/A312M Type 304L, seamless or straight seam welded, Schedule 40S, annealed, pickled and passivated per ASTM A380
	65 mm & larger	Stainless Steel, ASTM A778 Type 304L, seamless or straight seam welded, Schedule 40S, annealed, pickled and passivated per ASTM A380
Fittings	50 mm & smaller	Stainless Steel, ASTM A403 Type 304L, Threaded, forged, 1,000 CWP, ASTM A182/A182M, Grade F316L, Schedule 40S
	65 mm & larger	Stainless Steel, ASTM A774 Type 304L, welded, Schedule 40S
NOTE: 1. All structural penetrations shall consist of a type 304 stainless steel Schedule 40 thimble 2. Elbows to be long radius unless otherwise specified.		
Angle Collars	100 mm & smaller	Stainless Steel, ASTM A403 Type 304L, slip-on or butt weld
	150 mm & larger	Stainless Steel, ASTM A774 Type 304L, slip-on or butt weld
Van Stone Flanges, Rolled Angle, FF or RF	All Sizes	Stainless steel Type 304L, Class 300, ASTM A182 / ASME SA-182
Flange Adapters	50 mm to 300 mm 50 mm to 150 mm	Flanges for use on grooved pipe to be Victaulic Style 741 Style 441 stainless steel flange adapter.
NOTE: Flanges attached to fittings to be weld neck type equal in material, dimensions and rating to the Class D flange.		

DETAILED PIPING SPECIFICATIONS

SERVICE: Refer to Contract Drawings		LINE CODE: D5
PRIMARY FLANGE RATING: CLASS 300 ANSI B16.9		DESIGN PRESSURE:
TEMPERATURE (MAX): 40°C		CORROSION ALLOWANCE: 1.3 mm
ITEM	SIZES	GENERAL DESCRIPTION
Bolts	All sizes	Stainless Steel 304L.
Nuts	All sizes	Stainless Steel 304L.
Submerged Bolts & Nuts	All sizes	Stainless Steel 304L.
Flange Gaskets	75 mm to 250 mm	Red Rubber, ring type for RF flanges, full face for FF flanges, 2 mm thick.
	300 mm to 450 mm	Red Rubber, ring type for RF flanges for RF flanges, full face for FF flange, 3 mm thick.
Cathodically isolating flange kit	All sizes	Gaskets to be type "E", full faced, G-10 or G-11, 3 mm thick, epoxy glass, c/w homogeneous (jointless) nitrile O-rings. Bolt sleeves to be spirally wound mylar materials. Double washers to be G-10 or G-11 epoxy glass backed up with zinc plated steel washers. Pikotek "PGE" WS; PSI, Gasket Seal.
Unions	75 mm & larger	Use Flanges.
	65 mm & smaller	Class 300, stainless steel Type 304L, Teflon O-Ring

DETAILED PIPING SPECIFICATIONS

SERVICE: Refer to Contract Drawings		LINE CODE: D5
PRIMARY FLANGE RATING: CLASS 300 ANSI B16.5		DESIGN PRESSURE:
TEMPERATURE (MAX): 40°C		CORROSION ALLOWANCE: 1.3 mm
ITEM	SIZES	GENERAL DESCRIPTION
Pipe Couplings	65 mm & smaller 75 mm & larger	Use unions. The coupling type c/w harness (to AWWA M11) to be as shown on the drawings and to suit outside diameter of pipe (for submerged or buried service use Stainless Steel 304 bolts & nuts). .1 Flexible couplings to be Dresser Style 38, Robar. Couplings to be epoxy coated. .2 Victaulic Style 77 standard weight; Victaulic Style 44 w/ Type "D" Vic-ring. For submerged or buried service coupling to be Stainless Steel Victaulic Style 77S. .3 Use Victaulic adapters, length to suit pipe diameter.
Victaulic Gasket	All Sizes	Grade "E" EPDM suitable up to 230 deg F or Grade "T" Nitrle.
Thread Compound	As required	Teflon tape.
Plug Valves	All Sizes	Cast iron body and cover, ASTM A126 Class B; Cast iron plug, ASTM A126 Class B, c/w resilient facing, ASTM D2000-BG. Val-Matic or Dezurik.
Ball Valves	50 mm to 32 mm	Bray Flow-Tek Series 85 or Crane model 9502.

END OF SECTION

VALVES

1. GENERAL

1.1 INTENT

- .1 This section of the specifications refers to the supply, installation and testing of manually operated valves used for isolation, throttling, relief, regulating, and for specialty valves including those requiring electric, hydraulic, or pneumatic actuation.

1.2 RELATED SECTIONS

- .1 Section 01 34 00 - Shop Drawings, Product Data and Samples
- .2 Section 40 05 70 - Operation and Maintenance Manuals
- .3 Section 40 90 05 - Field Instruments
- .4 Section 40 05 01 - Mechanical General Requirements
- .5 Section 40 05 23 - Detailed Piping Specifications

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

- .1 Refer to Division 1 for requirements pertaining to product options and substitutions.

1.4 VALVE SIZES

- .1 Valves sizes are specified in preferred metric sizes.

1.5 SOURCE OF SUPPLY

- .1 Valves of same type shall be by a single manufacturer.

1.6 DEFINITIONS

- .1 Valve Identification
 - .1 Process piping valves are identified on the drawings by valve symbols. Refer to the Contract Drawings for lists of valve symbols and labels.
- .2 Actuators
 - .1 Supply valves with standard operators as detailed herein, unless otherwise noted in the Contract Documents.

1.7 SUBMITTALS

- .1 Technical data, specifications, dimensional drawings, and installation, operation and maintenance drawings for each type of valve, indicating valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

1.8 SHOP DRAWINGS

- .1 Comply with requirements of Section 15015.
- .2 Submit equipment schedule before ordering.

VALVES

- .3 Submit shop drawings in accordance with Section 01330 - Submittals.
- .4 Include a complete list of all tag identifications.

1.9 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into the manual specified in Section 01790 - Operation and Maintenance Data.
- .2 Include the reviewed tag lists

1.10 IDENTIFICATION

- .1 Indicators shall bear the following information permanently marked on body:
 - .1 Manufacturer's name or trademark.
 - .2 Pressure rating.
 - .3 Flow direction.
 - .4 Serial number

1.11 TAGGING

- .1 Provide each piece of equipment with a tag stamped or engraved with the appropriate equipment number, as listed in this Specification.
- .2 Tags to be 20 mm high, 75 mm long and 1.5 mm thick, plastic Romark "Ultra Suede", 8mm high alphanumeric characters, Helvetica font (01040 cutter), reverse engraved. Characters to be white on coloured background. Background colour to be red.
- .3 The code lettering and number system shall be as shown on the P & I drawings or as directed by the Engineer.
- .4 Affix tags to equipment securely.

1.12 MATERIALS

- .1 All materials to be new, free from defects and conforming to applicable reference standards.
- .2 All materials, linings and coatings in contact with water to be NSF approved for potable water.
- .3 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

2. PRODUCTS

2.1 GENERAL

- .1 Unless otherwise indicated, valves shall be the same size as the pipe run in which they are to be installed.
- .2 Equipment Description

VALVES

- .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 DRAWINGS

- .1 Process and Instrumentation Drawings and Mechanical Drawings indicate location of valves and intent of operation.
- .2 Detailed process drawings, HVAC drawings, process standard drawings, HVAC standard drawings, yard piping drawings and service piping schematics indicate the valves on the process schematics plus other valves required for isolation.

2.3 VALVE ENDS

- .1 In pipe runs less than 50 mm diameter provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.
- .2 Valves in pipe runs equal to or greater than 50 mm diameter to be flanged unless indicated otherwise.
- .3 For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern or Class 300 pattern conforming to ANSI B16.5 or as noted.
- .4 Grooved joint valve ends are acceptable, where applicable.
- .5 Use flanged joints for buried and exterior valves. Flanges to be compatible with pipe and jointing technique used.
- .6 Use flanged joints for buried butterfly valves.
- .7 Lug style wafer body valves shall have tapped holes, suitable for the bolt spacing of the pipe flanges placed on either side.
- .8 Wafer body valves shall have positioning holes, suitable for the bolt spacing of the pipe flanges placed on either side.
- .9 End flanges for gate valves to be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 300 flanges.

2.4 VALVE STEM EXTENSIONS

- .1 Provide valve stem extensions where additional clearance is required or of where valve operation without the extension is difficult and in manholes.
- .2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.5 SPARE PARTS

- .1 Provide spare parts in accordance with Division 1.
- .2 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five years.

VALVES

2.6 RESILIENT SEATED NON-BURIED BUTTERFLY VALVES, 200 mm – 450 mm DIAMETER

- .1 Applicable Equipment: BUV 113, BUV 123, BUV 133, BUV 143, BUV 153, BUV 161, BUV 171, BUV 180, BUV 182
 - .1 Liquid Type:
 - .1 Raw Water: BUV 113, BUV 123, BUV 133, BUV 143, BUV 153, BUV 161, BUV 171, BUV 180, BUV 182
 - .2 Valve Type:
 - .1 Wafer: N/A
 - .2 Lugged: BUV 113, BUV 123, BUV 133, BUV 143, BUV 153, BUV 161, BUV 171, BUV 180, BUV 182
 - .3 Full Flange: N/A
 - .3 Location:
 - .1 Okotoks Intake Pump Station: BUV 113, BUV 123, BUV 133, BUV 143, BUV 153, BUV 161, BUV 171, BUV 180, BUV 182
 - .4 Valve Size:
 - .1 200 mm: BUV 113, BUV 161, BUV 171
 - .2 300 mm: BUV 123, BUV 133
 - .3 450 mm: BUV 143, BUV 153, BUV 180, BUV 182
 - .5 Specified Valves: BUV 113, BUV 123, BUV 133, BUV 143, BUV 153, BUV 161, BUV 171, BUV 180, BUV 182
 - .1 Supplier: Bray, or approved equal
 - .2 Model: Bray Series 43 High Performance.
 - .3 Fluid Temperature: 5 ~ 25 °C
 - .4 Pressure Rating: 300 PSI
 - .5 Body: Stainless Steel
 - .6 Disc: Stainless Steel, ASTM A351 GR CF8M
 - .7 Seat Assembly: PTFE
 - .8 Mating Surface: stainless steel
 - .9 Seal: PTFE rings plus 1 Carbon Fibre ring
 - .10 Pin, Washer, and Nut: 316 stainless steel
 - .11 Bearing: 316 stainless steel
 - .12 Alternates:
 - .1 As approved by engineer.- .2 Materials: All materials used in the valves and hydraulic operators shall be first class in every respect and shall be incorporated into the assembly in a workmanlike manner. Materials shall be completely suitable for the service intended and selected and fabricated in accordance with the best engineering practice.
- .3 Testing: The Supplier shall furnish certified copies of reports describing the procedures and results of the Proof-of-Design test, performance test, leakage test and hydrostatic test for each valve. Delivery of any valve will not be accepted unless certified copies of the above tests have been received.
- .4 Shipping and Storage: The Supplier shall ensure that all units are properly protected from dust, grease, moisture and any other materials which may harmfully affect the valves during storage and/or shipping.

VALVES

- .5 Operators: Valves not having electric, hydraulic, or pneumatic operators shall be equipped with manual operators and position indicators. The location of the manual operator and position indicator shall be specified by the Owner. The maximum operator effort under any condition shall be 316 kg (80 pounds) pull and shall turn a clockwise direction to close. Valves 100 mm and smaller shall be hand levers. Valves 150 mm and larger shall be worm gear operated complete with wheel operator.
- .6 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equip operators with adjustable, self-locking mechanical stop-limiting devices designed to hold the valve in any intermediate position between full open and full closed to prevent overtravel of the disc/ball in the open and closed positions. Gear operators to be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.
- .7 Tag #: BUV 113, BUV 123, BUV 133, BUV 143, BUV 153, BUV 161, BUV 171, BUV 180, BUV 182

2.7 TILTED DISC CHECK VALVES

- .1 Applicable Equipment: CHV 112, CHV 122, CHV 132
 - .1 Liquid Type:
 - .1 Raw Water: CHV 112, CHV 122, CHV 132
 - .2 Location:
 - .1 Okotoks Intake Pump Station: CHV 112, CHV 122, CHV 132
 - .3 Valve Type:
 - .1 Full Flange: CHV 112, CHV 122, CHV 132
 - .4 Valve Size:
 - .1 200 mm: CHV 112
 - .2 300 mm: CHV 122, CHV 132
 - .5 Specified Equipment: CHV 112, CHV 122, CHV 132
 - .1 Manufacturer: Val-Matic or approved equivalent
 - .2 Model: Series 9700
 - .3 Pressure Rating: 300 Psi.
 - .4 Body: Ductile Iron
 - .5 End Connection: Class 250
 - .6 Disc: Ductile Iron
 - .7 Seat Ring: Aluminum Bronze
 - .8 Exterior Coating: ANSI/NSF 61 Fusion Bonded Epoxy
 - .10 Interior Coating: ANSI/NSF 61 Fusions Bonded Epoxy
 - .6 Tag #: CHV 112, CHV 122, CHV 132

2.8 PRESSURE RELIEF, PRESSURE SUSTAINING VALVE

- .1 Applicable Equipment: PRV 162
 - .1 Liquid Type:
 - .1 Raw Water: PRV 162
 - .2 Location:
 - .1 Okotoks Intake Pump Station: PRV 162

VALVES

- .3 Valve Pattern:
 - .1 Globe: PRV 162
 - .2 Angle: N/A
- .4 End Detail:
 - .1 Flanged: PRV 162
 - .2 Threaded: N/A
- .5 Valve Size:
 - .1 200 mm: PRV 162
- .6 Specified Equipment: PRV 162
 - .1 Manufacturer: CLA-VAL
 - .2 Model: 650-01BCVYKOKX
 - .3 Pressure Class: 300 lb.
 - .4 Body and Cover: Ductile Iron ASTM A536
 - .5 Flange: 300 lb.
 - .6 Disc Retainer and Diaphragm Washer: Cast Iron
 - .7 Trim (Disc Guide, Seat & Cover Bearing): Stainless Steel
 - .8 Disc: Buna-N Rubber
 - .9 Diaphragm: Nylon Reinforced Buna-N
 - .10 Stem, Nut, & Spring: Stainless Steel
 - .11 Pilot System Materials:
 - Pilot Control–Bronze ASTM B62
 - Trim–Stainless Steel Type 303
 - Rubber–Buna-N Synthetic Rubber
 - Tubing and Fitting–Copper & Bronze
 - .12 Adjustment Range: 100 to 300 psi
 - .13 Setpoint:
 - .1 180 psig: PRV 162
 - .14 Optional Features:
 - .1 Internal & External Epoxy Coating NSF 61 Approved
 - .2 “Y” Strainer for piloting and pilot isolation ball valves (3)
 - .3 Valve Position Indicator (Model X101)
 - .4 Anti-cavitation protection for high pressure drop.
- .7 Tag #: PRV 162

2.9 DUAL-SOLENOID CONTROL VALVE (RECIRCULATION VALVE)

- .1 Applicable Equipment: FCV 172
 - .1 Liquid Type:
 - .1 Raw Water: FCV 172
 - .2 Location:
 - .1 Okotoks Intake Pump Station: FCV 172
 - .3 Valve Pattern:
 - .1 Globe: FCV 172
 - .2 Angle: N/A
 - .4 End Detail:
 - .1 Flanged: FCV 172
 - .2 Threaded: N/A

VALVES

- .5 Valve Size:
 - .1 200 mm: FCV 172
- .6 Specified Equipment: FCV 172
 - .1 Manufacturer: CLA-VAL
 - .2 Model: 131-01
 - .3 Pressure Class: 300 lb.
 - .4 Body and Cover: Ductile Iron
 - .5 Flange: 300 lb.
 - .6 Disc Retainer and Diaphragm Washer: Cast Iron
 - .7 Trim (Disc Guide, Seat & Cover Bearing): Stainless Steel
 - .8 Disc: Buna-N Rubber
 - .9 Diaphragm: Nylon Reinforced Buna-N
 - .10 Stem, Nut, & Spring: Stainless Steel
 - .11 Pilot System Materials:
 - Pilot Control—Bronze ASTM B62
 - Trim—Stainless Steel Type 303
 - Rubber—Buna-N Synthetic Rubber
 - Tubing and Fitting—Copper & Bronze
 - .12 Solenoid: FV 172A/172B
 - .1 Direct acting
 - .2 FV 172A Normally closed (energize to open)
 - FV 172B Normally open (energize to close)
 - .3 Stainless steel body
 - .4 120 VAC, NEMA 4X enclosure
 - .13 Mechanical Flow Limiter:
 - .1 Setpoint: 113 L/min (30 USgpm)
 - .14 Optional Features:
 - .1 Internal & External Epoxy Coating NSF 61 Approved
 - .2 "Y" Strainer for piloting and pilot isolation ball valves (3)
 - .3 Valve Position Indicator (Model X101)
 - .4 Anti-cavitation protection for high pressure drop.
- .7 Tag #: FCV 172

2.10 PRESSURE REDUCING VALVES

- .1 Applicable Equipment: PRV 191
- .2 Location: Okotoks Intake Pump Station
- .3 Liquid: Raw Water
- .4 Size: 12 mm (1/2") NPT
- .5 Operating Conditions:
 - .1 PRV 191: Inlet pressure 180 psi, outlet pressure setpoint: 50 psi
- .6 Working Temperature: 5°C to 25°C
- .7 Specified Equipment:
 - .1 Manufacturer: CLA-VAL
 - .2 Model: CRD-L Direct Acting Pressure Reducing Valve
 - .3 Maximum Inlet Pressure: 400 psi
 - .4 Body and Cover: Bronze
 - .5 Connection: Threaded

VALVES

- .6 Diaphragm: Buna N
- .7 Trim: Stainless Steel
- .8 Disc: EPDM

.11 Supplier: Summit Valve

.12 Tag #: PRV 191

2.11 AIR RELEASE VALVE

- .1 Applicable Equipment: ARV 172, ARV 181
- .2 Location: Okotoks Intake Pump Station
- .3 Liquid: Raw Water
- .4 Size: 25 mm (1") NPT
- .5 Operating Conditions:
 - .1 ARV 172, ARV 181: Min pressure: 25 psi. Max pressure: 300 psi
- .6 Working Temperature: 5°C to 25°C
- .7 Floats and trim shall be 316 stainless steel.
- .8 To be supplied with isolation ball valve and adjustable throttling device.
- .9 Venting: Provide 19 mm vent gooseneck complete with hose connect to a floor drain.
- .10 Valve to be epoxy coated and lined and NSF61 certified.
- .11 Acceptable Manufacturer: Valmatic Model 38.5 or approved equivalent. Supplier: Summit Valves.
- .12 Tag #: ARV 172, ARV 181

2.12 COMBINATION AIR VALVES

- .1 Tag: CAV 111, 121, 131
- .2 Liquid Type: Raw water
- .3 Size: 50 mm inlet
- .4 Connection: Threaded
- .5 Operating Conditions:
 - .1 Pressure: 180 PSI
 - .2 Water Flow Rate: 81 L/s.
- .6 Orifice size and seat to be selected to suit operating conditions.
- .7 Acceptable Product: Valmatic or APCO approved equivalent

VALVES

3. EXECUTION

3.1 SHIPMENT, PROTECTION AND STORAGE

- .1 Deliver valves to site using loading methods which do not damage casings or coatings.
- .2 Clearly tag valves, stating size, type, coatings and mating parts.
- .3 Store on site until ready for incorporation in the work using methods recommended by manufacturer to prevent damage, undue stresses, or weathering.

3.2 PREPARATION

- .1 Valve and piping arrangement indicated in the drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in piping to allow for discrepancies between valve dimensions shown and those supplied for the work.
- .2 Field measure and check all equipment locations, pipe alignments, and structural installation prior to installation of valves. Ensure that valve locations and orientations provide suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and electric actuators.
- .3 Where conflicts are identified, inform the Engineer and initiate the necessary piping modifications at no cost to the Owner.

3.3 INSTALLATION

- .1 Install all equipment in strict accordance with manufacturer's and supplier's instructions.
- .2 Any damage resulting from either failure to observe the installation instructions or as a result of proceeding with the work without complete knowledge of how it is to be done will be the Contractor's responsibility.
- .3 Make equipment installation and connections by skilled tradesmen to the best standard.
- .4 Carry out work to produce a neat, accurate, secure, functional installation.
- .5 Repair at own expense, any damage done to the installation of materials while carrying out the work.
- .6 Install supports and bases in advance of equipment installation in accordance with manufacturer's instructions.
- .7 Generally pipe supports and hangers are not shown unless for indication purposes only.

3.4 VALVE EXTENSIONS

- .1 Install valve extensions where necessary to provide clearance from installation.

3.5 EQUIPMENT TESTING PROCEDURE

- .1 Submit a thorough description of the procedures to be employed in testing this equipment. The procedure will be reviewed by the Engineer for suitability and should be submitted 3 weeks prior to any testing.

VALVES

3.6 FIELD TESTING

- .1 When equipment installation has been completed to the standards indicated by these specifications, arrange for the Engineer to review installation and operation.

3.7 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

- .1 The equipment manufacturer's technical representative shall be familiar with the equipment supplied and shall come prepared with both knowledge and equipment to perform and interpret the test, inspections and procedures recommended by the manufacturer for the starting of equipment that has not previously been run.
- .2 The equipment manufacturer's technical representative shall, immediately after completion of the inspection, convey to the Engineer in writing, confirmation of the tests and inspections carried out and the result of this examination of the work.
- .3 If the inspection reveals defects in the work, correct as soon as possible and repeat the entire inspection procedure. Repeat until the work passes the inspection.
- .4 Document the results of the inspection by the equipment manufacturer's representative.
- .5 Ensure the installation meets all manufacturer's requirements for durable and trouble-free operation.

3.8 FIELD INSPECTION

- .1 The Engineer will request that the equipment be operated to demonstrate that it will perform as specified. The Engineer will note deficiencies, and if possible, the deficiency will be corrected immediately by the Contractor. All deficiencies that cannot be corrected at the time of inspection will be noted by the Engineer who will advise the Contractor of these deficiencies in writing. Correct the deficiencies as soon as possible and advise the Engineer of their correction. Should the deficiencies be of a sufficiently serious nature to require the work to be re-inspected, the cost of the inspection will be borne by the Contractor.

END OF SECTION

PRESSURE INDICATORS

1. GENERAL

1.1 SCOPE

- .1 This section of the specifications refers to the supply, installation and testing of pressure indicators used for visually indicating pressure in a pipeline not requiring feedback to any electronic device.

1.2 RELATED SECTIONS

- .1 Section 01 34 00 - Shop Drawings, Product Data and Samples
- .2 Section 40 05 70 - Operation and Maintenance Manuals
- .3 Section 40 05 01 - Mechanical General Requirements
- .4 Section 40 05 23 - Detailed Piping Specifications

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

- .1 Refer to Division 1 for requirements pertaining to product options and substitutions.

1.4 UNIFORMITY OF EQUIPMENT

- .1 All pressure indicators are to be supplied by one manufacturer throughout to the extent practical. Variations will be permitted only where the major supplier cannot supply a particular piece of equipment as specified.

1.5 SHOP DRAWINGS

- .1 Submit equipment schedule before ordering.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittals.
- .3 Include a complete list of all tag identifications.

1.6 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into the manual specified in Section 01790 - Operation and Maintenance Data.
- .2 Include the reviewed tag lists.

1.7 IDENTIFICATION

- .1 Indicators shall bear the following information permanently marked on body:
 - .1 Manufacturer's name or trademark.
 - .2 Pressure rating.
 - .3 Flow direction.
 - .4 Serial number

PRESSURE INDICATORS

1.8 TAGGING

- .1 Provide each indicator with a tag stamped or engraved with the valve and equipment number.
- .2 Tags to be 20mm high, 75mm long, and 1.5mm thick, plastic Romark "Ultra Suede", 8mm high alphanumeric characters, Helvetica font (01040 cutter), reverse engraved. Characters to be white on coloured background. Background colour to be black.
- .3 The code lettering and number system shall be as shown on the P & I drawings or as directed by the Engineer.
- .4 Affix tags to equipment securely.

1.9 MATERIALS – GENERAL

- .1 All materials to be new, free from defects and conforming to applicable reference standards.
- .2 All materials, linings and coatings in contact with water to be NSF approved for potable water.
- .3 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

2. PRODUCTS

2.1 GENERAL

- .1 Isolation Valves
 - .1 Isolate all indicators from service to allow for removal and maintenance.
 - .2 Use 316 stainless steel ball valves on stainless steel and carbon steel piping, bronze body valves on copper piping, and PVC ball valves on PVC piping. Refer to Section 15020 – Detailed Piping Specifications.
 - .3 Isolation valves diameter are to match equipment process connections.

PRESSURE INDICATORS

.2 Equipment 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 PRESSURE INDICATORS

.1 Applicable Equipment: PI 110, PI 120, PI 130, PI 173, PI 180, PI 181

.1 Liquid Type:

- .1 Raw Water: PI 110, PI 120, PI 130, PI 173, PI 180, PI 181

.2 Location:

- .1 Okotoks Intake Pump Station: PI 110, PI 120, PI 130, PI 173, PI 180, PI 181

.3 Required Pressure Range:

- .1 0 to 300 psi: PI 110, PI 120, PI 130, PI 173, PI 180, PI 181

.4 Specified Equipment: PI 110, PI 120, PI 130, PI 173, PI 180, PI 181

- .1 Manufacturer: Ashcroft or approved equivalent
- .2 Model: 63-1008AL-02L
- .3 Accuracy: $\pm 3-2-3\%$ of span
- .4 Dial Size: 63 mm (2.5")
- .5 Case: 304 Stainless Steel
- .6 Fill Fluid: Glycerin
- .7 Ring: 304 Stainless Steel
- .8 Window: Polycarbonate
- .9 Dial: Black figures on white background
- .10 Pointer: Black, aluminum
- .11 Bourdon Tube: "C" shaped bronze
- .12 Operating Temperature: -7 C to 65 C
- .13 Connections: 6 mm NPT lower mount connection
- .14 Accessories:
 - .1 Gauges to come with stainless steel body, TFE seat and seal, SS ball and stem, screwed ball valve.
 - .2 All connections as required.

.5 Approved alternative: WIKA

.6 Tag #: PI 110, PI 120, PI 130, PI 173, PI 180, PI 181

3. EXECUTION

3.1 INSTALLATION

- .1 Install all equipment in strict accordance with manufacturer's and supplier's instructions.
- .2 Any damage resulting from either failure to observe the installation instructions or as a result of proceeding with the work without complete knowledge of how it is to be done will be the Contractor's responsibility.

PRESSURE INDICATORS

- .3 Make equipment installation and connections by skilled tradesmen to the best standard.
- .4 Carry out work to produce a neat, accurate, secure, functional installation.
- .5 Repair at own expense, any damage done to the installation of materials while carrying out the work.
- .6 Install supports and bases in advance of equipment installation in accordance with manufacturer's instructions.

3.2 EQUIPMENT TESTING PROCEDURE

- .1 Submit a thorough description of the procedures to be employed in testing this equipment. The procedure will be reviewed by the Engineer for suitability and should be submitted 3 weeks prior to any testing.

3.3 FIELD TESTING

- .1 When equipment installation has been completed to the standards indicated by these specifications, arrange for the Engineer to review installation and operation.

3.4 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

- .1 N/A.

3.5 FIELD INSPECTION

- .1 The Engineer will request that the equipment be operated to demonstrate that it will perform as specified. The Engineer will note deficiencies, and if possible, the deficiency will be corrected immediately by the Contractor. All deficiencies that cannot be corrected at the time of inspection will be noted by the Engineer who will advise the Contractor of these deficiencies in writing. Correct the deficiencies as soon as possible and advise the Engineer of their correction. Should the deficiencies be of a sufficiently serious nature to require the work to be re-inspected, the cost of the inspection will be borne by the Contractor.

END OF SECTION

HYDROSTATIC AND PRESSURE TESTING

1. GENERAL

1.1 INTENT

- .1 The hydrostatic and pressure testing procedures outlined in this section are applicable to all non-buried piping systems.
- .2 All water retaining or carrying pipes and structures, and all chemical solution components shall be tested for leakage.
- .3 Where work is undertaken within existing structures or piping, they shall be pressure tested and disinfected prior to being put back into operation.
- .4 All testing shall be as specified herein or elsewhere in these specifications or as directed by the Owner's Representative.
- .5 The Contractor shall furnish the suitable temporary service connections, testing plugs or caps, pressure pumps, pipe connections, gauges, thrust supports, and all other required equipment and labour necessary for filling the pipeline or structure, expelling air, pumping to the required test pressure, and dewatering the line or structure without additional compensation.

1.2 RELATED SECTIONS

- .1 Section 40 05 01 – Mechanical General Requirements
- .2 Section 40 05 23 – Detailed Piping Specifications

1.3 REFERENCE STANDARDS

- .1 All materials, equipment, substances, etc. that will come in contact with potable water shall conform to ANSI/NSF standards 60/61 and the manufacturers shall be included on the list of approved manufacturers published by ANSI/NSF.
- .2 Hydrostatic testing procedures for PVC pipe systems, as outlined in *AWWA Manual M23 – PVC Pipe – Design and Installation*, latest edition.
- .3 Hydrostatic testing procedures for steel pipe systems, as outlined in *AWWA Manual M11 – Steel Pipe – A Guide for Design and Installation*, latest edition.

HYDROSTATIC AND PRESSURE TESTING

2. PRODUCTS

2.1 WATER

- .1 All water used for the hydrostatic and pressure testing will be supplied by the Owner from the distribution system at no cost to the Contractor. All water required for retesting, following the failure of the initial test, will be supplied by the Owner at the Contractor's expense. The water rate will be based on current residential rates.
- .2 The Contractor shall be responsible for the supply and installation of all temporary pipework, pumps, water trucks or other equipment required to transport the water from the point of supply to the structure or piping to be tested.
- .3 The Contractor shall provide the Owner and Owner's Representative with 48 hours of notice of his requirement for water for testing.

3. EXECUTION

3.1 CLEANING

- .1 Prior to hydrostatic or pressure testing, all water retaining structures, pipework and conduits shall be thoroughly cleaned. All dirt and loose material shall be removed.

3.2 PRESSURE TESTING OF PIPING

- .1 Pressure testing shall be conducted on the piping to the pressures and durations as follows (or the maximum rated pressure of the pipeline, whichever is less):
 - .1 Steel pipe systems:
 - .1 Test Pressure: 125% of design operating pressure
 - .2 Test Duration: 2 Hours

HYDROSTATIC AND PRESSURE TESTING

- .2 PVC pipe systems:
 - .1 Test Pressure: 150% of design operating pressure
 - .2 Test Duration: 1 Hour
- .2 Where any section of piping 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 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied, if necessary.
- .4 Thoroughly examine exposed parts while under pressure and correct for leakage as necessary. Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .5 The amount of leakage during the test period shall be zero. Repeat hydrostatic test until all defects have been corrected and no loss of water is observed.

3.3 INSTRUMENTATION PROTECTION

- .1 All instruments that have a maximum range of less than the hydrostatic or pneumatic test pressure noted above shall be removed or isolated during the pressure tests. On successful completion of the system test, the pressure shall be lowered to a pressure within the range of the instruments, and the isolated or removed instruments shall then be tested in accordance with other sections of these specifications.

3.6 SAFETY RELIEF VALVES

- .1 All safety relief valves for water services shall be supplied with test gauges for hydrostatic testing purposes. Upon completion of the hydrostatic testing, the Contractor shall remove the test gauges and repressure the system to the relieving pressure of the relief valves to ensure that the valves are relieving at their setpoint.

3.7 DEFECTS AND REPAIRS

- .1 Defects disclosed in the work shall be made good and retested or the work replaced without additional cost to the Owner.
- .2 Repairs to the piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces of pipe, such replacements shall be the same lengths as the defective pieces. Where the repairs are required to PVC pipe, the pipe shall be replaced as far as the first detachable fitting in each direction from the defect. Under no circumstances shall a new section of pipe be installed with solvent welded couplings.

HYDROSTATIC AND PRESSURE TESTING

- .3 Tests shall be repeated after any work has been replaced if, in the judgement of the Owner's Representative, it is necessary.
- .4 All pressure testing shall be done in the presence of the Engineer or Owner's Representative.

END OF SECTION

OPERATION AND MAINTENANCE MANUAL

1. GENERAL

1.1 DESCRIPTION OF TYPES OF OPERATION AND MAINTENANCE DATA

- .1 The following documents are designated as Operation and Maintenance Data.
- .2 For systems designed by the Contractor, Contractor Designed System Data includes the following:
 - .1 System Design and Performance Criteria.
 - .2 System and Controls Descriptions.
 - .3 System and Controls Schematics.
 - .4 Operating Instructions.
 - .5 Equipment Data.
 - .6 Other data as required by the Owner.
- .3 Installation Instructions includes the manufacturer's printed instructions describing the recommended installation procedures, and photographs, video footage, and computer software.
- .4 Operating Instructions includes the manufacturer's printed instructions describing proper operation, and photographs, video footage, and computer software.
- .5 Equipment Identification includes the nameplate information for each piece of equipment, in a form, and with content acceptable to the Owner.
- .6 Maintenance Instructions includes the manufacturer's printed instructions describing the manufacturer's recommended maintenance and photographs, video footage, and computer software.
- .7 Spare Parts Lists includes parts lists and the manufacturer's recommended maintenance products and spare parts.
- .8 Suppliers and Contractors List includes a list of Contractor, Subcontractors, and Suppliers who supplied and installed equipment, systems, materials, or finishes, organized by the Division of Specifications and system, and company names, addresses, and telephone numbers.
- .9 Tag Directory includes a directory identifying tag number and equipment description and location.
- .10 Drawings List includes a list of Drawings.
- .11 Shop Drawings includes the final reviewed Shop Drawings.
- .12 Product Data includes the manufacturer's product data for equipment, systems, materials, and finishes, and photographs, video footage, and computer software.
- .13 Material Safety Data Sheets (MSDS) includes the MSDS for all relevant products.
- .14 Certifications includes the following:

OPERATION AND MAINTENANCE MANUAL

- .1 Copies of inspection reports prepared by authorities having jurisdiction.
- .2 Certified copies of test reports prepared by independent testing agencies.
- .3 Any other certificates required by the Contract Documents.
- .15 Warranties and Bonds include the Owner's copy of manufacturer's warranties, maintenance bonds, and service contracts.
- .16 Reports includes the following:
 - .1 Documentation certifying the performance of tests required by the Contract Documents and the results of those tests.
 - .2 Documentation of other material, equipment, or system related information required by the Contract Documents.

1.2 OPERATION AND MAINTENANCE MANUAL BY THE CONTRACTOR

- .1 Prepare the operation and maintenance manual as follows:
- .2 General organization of each volume:
 - .1 Include the following in each volume:
 - .1 Title page.
 - .2 Table of contents. Identify volume number where listed information is located.
 - .3 Ten percent free space for additional data.
 - .2 Present textual information, schematics and data on 21.5 × 28 cm, 75 g/m², white bond paper.
- .3 Manual contents organization:
 - .1 For each major equipment, system, materials or finishes area, organize operation and maintenance data as follows:
 - .1 Operation Division: include the following, as applicable:
 - .1 System Design Criteria.
 - .2 System and Controls Descriptions.
 - .3 System and Controls Schematics.
 - .4 Operating Instructions.
 - .2 Maintenance Division: include the following, as applicable:
 - .1 Maintenance Tasks and Schedules.
 - .2 Spare Parts.
 - .3 Suppliers and Contractors.
 - .4 Tags and Directories.
 - .3 Contract Document Division: include the following, as applicable:
 - .1 Drawings List.
 - .2 Shop Drawings and Product Data.

OPERATION AND MAINTENANCE MANUAL

- .3 Certifications.
- .4 Warranties and Bonds.
- .5 Maintenance Brochures.
- .6 Reports.

.4 Document Binding Methods

- .1 Standard 21.5 × 28 cm sheets: punch sheets to fit binder.
- .2 Sheets up to 28 × 41.5 cm: punched and neatly folded to allow use without removing from binder.
- .3 Drawings larger than 28 × 41.5 cm: insert drawings in sturdy vinyl envelopes with reinforced binding holes, open on one side and overall folded size not exceeding 21.5 × 28 cm. Do not punch holes in drawings.

.5 Binders

- .1 Commercial quality, fabric coated, hard covers attached to spine with metal piano hinges, three post, designed to accommodate 21.5 × 28 cm paper. Maximum 100 mm thick.
- .2 Silk-screen project title and identification, in gold, on front cover and spine of binder. All binders to be forest green with gold lettering.
- .3 Covers to read as follows:

Operation and Maintenance
Manual

Foothills Okotoks
Intake Pump Station

Year

Prime Consultant: MPE Engineering Ltd.
General Contractor:
Mechanical Contractor:
Electrical Contractor:

The Spine to read as follows:

Operation and Maintenance
Manual

Foothills Okotoks
Intake Pump Station

year

.4 Divider tabs:

- .1 Heavy-weight coloured paper, mylar laminated with tab number and title printed on tab as follows.

OPERATION AND MAINTENANCE MANUAL

- .2 Main divisions: white tabs, labelled with division name, 2 bank tab length.
- .3 Sections of a main division: colour coded tabs, labelled with section name, 4 bank tab length.
- .4 Subsections: same colour tabs as the section, printed label, 8 bank tab length.
- .5 Co-ordinate tab colour codes and labelling format with the Owner.

1.3 SUBMITTALS

- .1 Provide the following submittals:
 - .1 One draft copy of the operation and maintenance manual prior to requesting inspection for Substantial Performance.
 - .2 Three copies and one digital copy of the completed operation and maintenance manual prior to requesting inspection for Total Performance.
- .2 The Owner reserves the right to withhold any amount of payment up to a maximum of \$20,000 until the Contractor provides satisfactory copies of the O&M manuals.

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

STARTUP AND COMMISSIONING

1. GENERAL

1.1 SECTION INCLUDES:

- .1 Requirements for placing Work in a state of readiness for acceptance by Owner.
- .2 Section supplements, but does not supersede, specific requirements of other sections.

1.2 INTENT

The Contractor is responsible for all phases of commissioning. The Owner's representative will supply a commissioning manager that will assist the Contractor to fully commission all aspects of the facility. The Commissioning Manager will coordinate full systems commissioning including scheduling, direction of commissioning activities, and informing the Contractor when the applicable equipment manufacturer's representatives are required on site. The Contractor shall supply qualified personnel to assist the Commissioning Manager through all phases of commissioning. The Contractor shall bear the cost of equipment manufacturers technical representatives on site representation. The Commissioning Manager will be the sole judge of the competence and qualifications required of the equipment manufactures technical representative.

2. SCHEDULE

- .1 Contractor to allow sufficient time for total systems commissioning and include in the overall project schedule.
- .2 Contractor to submit a Commissioning Schedule in "Draft" form, to the Owner's representative at the commencement of the Project. Commissioning Schedule is to be submitted as a supplement to overall Construction Schedule. The Commissioning Manager will review and comment on the Commissioning Schedule.

3. DEFINITIONS AND PROCEDURES

- .1 Prestart-up: consists of the non-operating functions required to bring Work to a state of readiness for placing systems into service. Related testing includes but is not limited to hydrostatic and pressure testing, disinfection and completion of Owner supplied installation checklists, labeling, wiring, loop wiring and megger checks on equipment as described in the contract document.
 - .1 Fill out equipment installation checkout lists for all process mechanical, building mechanical, instrumentation and controls and electrical equipment. Group listing into logical systems or sub-systems for orderly progression of activities during start-up.
 - .1 Equipment/Instrumentation installation checklists will be provided by the Commissioning Manager at the Project Start-up Meeting.
 - .2 To extent practical, remove all scaffolding, debris, planks tools and other construction related material.

STARTUP AND COMMISSIONING

- .3 Remove all sand, silt, dirt and debris from tanks, channels, chambers, instrumentation and control panels and electrical panels and vacuum clean.
 - .4 Clean all surfaces of tanks and conduits, including walls, roofs, floors and columns and as specified in individual Sections.
 - .5 Clean interior of all pipes and fluid-carrying equipment, including pumps and inspect with Engineer present.
 - .6 Conduct leakage and pressure tests in accordance with individual Sections.
 - .7 Conduct disinfection procedures in accordance with requirements of individual Sections.
 - .8 Submit all installation, programming and maintenance manuals for applicable equipment prior to Start-up as deemed necessary by the Owners Commissioning manager. Ensure that this documentation is included in the O&M manuals as laid out in Section 01790.
- .2 Start-up: Includes but is not limited to programming, calibration or balancing of instruments and equipment, filling out Start-up instrument and equipment setup sheets and confirming operation of control systems and protective devices and performance testing prior to placing equipment in service.
- .1 The Manufacturers technical representatives, in accordance with the requirements of individual Sections, shall be on site for full duration of Start-up of applicable equipment in a system. Supply at this time all documentation relating to testing of equipment and supplier's certification of satisfactory installation.
 - .2 The Commissioning Manager shall assist the Contractor in programming and setting up the instrumentation in Section 13312 with exceptions as directed in Section 13312.
 - .3 The Commissioning Manager shall assist the Contractor in filling out Start-up instrument and equipment setup sheets and confirming operation of control systems and protective devices prior to placing equipment in service. Equipment start-up sheets to be included in the O&M manual.
- .3 System Start-up:
- .1 Includes but is not limited to placing the system or systems into operation, re-confirming all equipment test results, performing any tests not yet carried out which may be deemed necessary by the Owners Representative to demonstrate satisfactory performance of equipment.
 - .2 Start-up of systems shall take place in an orderly manner. Coordination of start-up shall take place so that adequate staff is available and that conflicts do not occur due to multiple start-ups at the same time.
- .4 Commissioning:
- .1 Commissioning includes but is not limited to all the procedures and events included under Prestart-up, Start-up, System Start-up and Operator training of systems.

STARTUP AND COMMISSIONING

- .2 Commissioning is deemed complete when all systems have been operating continuously without fault and all process, mechanical and electrical equipment is free of vibration, overloading or overheating, is functioning in accordance with specified rates, methods and performance and all documentation has been completed submitted and reviewed to the satisfaction of the Commissioning Manager.
- .3 The period for continuous operation for completion of commissioning shall be 80 hours, during which time the system shall operate without fault or failure as described above. Provide competent staff to oversee the operation and arrange for manufactures' service personnel and subcontractors' personnel, if so required, to attend to any problems that arise. Failure of any part of the Works during this period will require restart of the 80 hour period following rectification of the fault or failure.
- .4 Provide sufficient qualified manpower for duration of the entire commissioning period. Make necessary adjustments during commissioning to enable the Works to be put into continuous operation.
- .5 Operator Training:
 - .1 Special training of facility staff to take place following successful start-up of all systems, during commissioning period. Coordinate visits of equipment suppliers' supervisors and schedule mutually agreeable times for special training periods.
- .6 System:
 - .1 A "system" is defined as an integral operating entity or loop in a process.
- .7 Manufacturers Technical Representative:
 - .1 The equipment manufacturer's technical representative shall be familiar with the equipment supplied and shall come prepared with both knowledge and equipment to perform and interpret the test, inspections and procedures recommended by the manufacturer for the starting of equipment that has not previously been run.
 - .2 The equipment manufacturer's technical representative shall, immediately after completion of the inspection, convey to the Engineer in writing, confirmation of the tests and inspections carried out and the result of this examination of the work.
 - .3 If the inspection reveals defects in the Work correct as soon as possible and repeat the entire inspection procedure. Repeat until the Work passes the inspection.
 - .4 Document the results of the inspection by the equipment manufacturer's representative.
 - .5 Ensure the installation meets all manufacturer's requirements for durable and trouble-free operation.

4. SEQUENCE OF EVENTS

- .1 Installation and Pre-Operational Checks
 - .1 Ensure equipment is installed in accordance with the manufacturer's instructions. Allow for sufficient days on-site by equipment supplier's qualified technician to

STARTUP AND COMMISSIONING

instruct installer and inspect installation.

- .2 Receive instruction from manufacturers in the methods and precautions to be followed in the installation of the equipment.

.2 Prestart-up

- .1 On completion of construction of a system, test and otherwise check the system as defined in definitions and as directed by commissioning manager and be satisfied that it is ready for pre start-up. Note all deficiencies brought to light by Prestart-up activities and rectify before moving to Start-up activities.
- .2 Cleaning, leakage testing and disinfection of all systems is required prior to Start-up activities.

.3 Start-up

- .1 On completion of Prestart-up, the Commissioning Manager in conjunction with the Contractor shall Start-up and otherwise check the equipment and instrumentation in the system as defined in definitions. Note all deficiencies brought to light by Start-up activities and rectify before proceeding to System Startup and placing into operation.
- .2 Correct any deficiencies uncovered during Start-up before proceeding to System Start-up activities. Retesting shall be conducted, when required, as determined by the Commissioning Manager.

.4 System Start-up

- .1 On satisfactory completion of Start-up of the devices in a system and after the documentation has been completed, submitted and reviewed and after deficiencies have been rectified to the satisfaction of the Owners commissioning manager the system shall be deemed ready to System Start-up.
- .2 Notify the Operations staff in writing 48 hours prior to a System Start-up.
- .3 The following constraints during System Start-up will be taken into account:
 - .1 Cleaning and disinfection of all systems is required prior to System Start-ups.
 - .2 System Start-ups to be done in an orderly manner following a written procedure authored by the Commissioning Manager so that all the various systems of the Works can be placed into simultaneous continuous operation.
 - .3 A complete simulated System Start-up or parts of the system may be required to reconfirm the equipment prestart test results, particularly in the case of, but not limited to, chemical or hazardous materials and shall be determined by the Owners Commissioning manager (e.g. Filling a chemical tank with water to confirm the accuracy and or settings of a level transmitter prior to filling with chemical).
 - .4 In the event that further deficiencies arise during System Start-up immediately rectify and if of a sufficiently serious nature stop the Start-up

STARTUP AND COMMISSIONING

of the system till such time as deficiencies are rectified.

- .5 Place the system or systems and place into operation as defined in Start-up and commissioning.

5. RESPONSIBILITY

- .1 Be responsible for overall commissioning and continuous operation as defined in definitions.
- .2 Coordinate equipment suppliers' representatives and all sub-trades personnel for start-up and commissioning as directed by Owner's Commissioning Manager.
- .3 Arrange for the services of the equipment manufacturer's technical representative, when equipment installation has been completed as directed by Owner's Commissioning Manager.
- .4 Equipment manufacturer's technical representative to inspect installation to ensure that equipment has been installed in accordance with manufacturer's requirements. Make adjustments in accordance with instructions of equipment manufacturer's technical representative.
- .5 Advise Engineer in writing that installation of equipment has been checked, installed correctly and is in working order following satisfactory System Start-up.
- .6 Cost of equipment manufacturer's representative shall be borne by Contractor. Do not designate a subtrade as a representative during construction, Prestart-up, start-up, System Start-up and continuous operation. In the event that the Work is phased and the equipment manufacturer's representative is required to additional trips to site the additional costs shall be borne by the Contractor.
- .7 Owners Commissioning manager will request that equipment be operated to demonstrate that it will perform as specified. Commissioning manager will note deficiencies. Correct deficiencies immediately. Advise Owners Commissioning manager in writing when deficiencies have been corrected.
- .8 If deficiencies are of a sufficiently serious nature as determined by the Commissioning Manager that manufacturers' representatives are required to make additional visits, additional costs shall be borne by Contractor.
- .9 If it is necessary to suspend start-up, or commissioning, or continuous operation due to deficiencies in any system, the full cost of interruption, call back and resumption of start-up, or commissioning, or continuous operation shall be paid by Contractor.
- .10 Commission and operate the Works during continuous operating period. Operation personnel may observe and assist during commissioning and continuous operating period.
- .11 The lack of availability of equipment manufacturers representatives shall not result in an extension to the contract.

6. SYSTEMS DEMONSTRATION

- .1 Special training of County and Town staff shall take place following successful System

STARTUP AND COMMISSIONING

Start-up of all systems, during the commissioning period. Coordinate visits of equipment suppliers' supervisors with Operations Staff and schedule mutually agreeable times for special training periods.

- .2 Demonstrate operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times.
- .3 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed upon times.
- .4 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .5 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .6 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent.
- .7 The individuals providing training on equipment must be a manufacture's certified technician with competent instructional skills and fully familiar with the detailed operation and maintenance of the provided equipment. The Owner will be the sole judge of the competence of the instructor and quality of instruction. The Owner reserves the right to withhold any amount of payment up to a maximum of \$15,000 until the Contractor provides training to the satisfaction of the Owner.
- .8 Training to cover the following items:
 - .1 Overview of equipment;
 - .2 Review of Operations and Maintenance Manual documentation for the equipment;
 - .3 Instruction and demonstration of operation. Includes start up, shut down, all possible equipment faults and possible rectification.
 - .4 Instruction and demonstration of maintenance to include daily, weekly, monthly, quarterly and annual preventative maintenance checks/actions as recommended by the manufacturer as well as trouble shooting summarized clearly on trouble shooting sheets for the specific model of each major piece of equipment.
- .9 All instructional training, supplemented by training and manual handouts, must be in sufficient detail to cover all Owner responsible operations and maintenance requirements to maintain manufacturers' warranties in tack. Training and documentation must highlight specific requirements that if completed or not completed may or would, void or jeopardize the equipment warranty.
- .10 Refer to specific equipment section for additional training requirements.

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

INSTRUMENTATION – FIELD INSTRUMENTS

1. GENERAL

1.1 INTENT

- .1 All field instruments required including:
 - 1. Electromagnetic Flow Meters
 - 2. Pressure Indicating Transmitters
 - 3. Pressure Switches
 - 4. Conductivity Level Switches
 - 5. Radar Level Transmitters.
 - 6. Turbidity Analyzer.
 - 7. pH Analyzer.
 - 8. Temperature Sensor.
 - 9. Smoke Detectors
 - 10. Temperature Transmitters
 - 11. Door Contacts
 - 12. Humidity Sensors

1.2 RELATED SECTIONS

- .1 Division 40 - 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.
- .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 in accordance with Section 01 34 00.

INSTRUMENTATION – FIELD INSTRUMENTS

1.6 OPERATION & MAINTENANCE DATA

- .1 Provide operating & maintenance data for incorporation into the Operation and Maintenance Manual according to Section 40 05 70.

2. PRODUCTS

2.1 GENERAL

- .1 Manufacturer and Supplier
 - .1 All instruments shall be of a manufacturer/supplier with service facilities in Southern Alberta.
- .2 NSF Certification
 - .1 All instruments in contact with water being treated or potable water, shall have NSF 61 certification.
- .3 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.
- .4 Painting
 - .1 Paint all equipment where applicable to appropriate sections in Division 9.
- .5 Instrument Isolation Valves
 - .1 Where indicated on P&I drawings, provide instruments with block valves, block and bleed valves, or 3-valve manifolds.
 - .2 Use 316 stainless steel valves on stainless steel and carbon steel piping, bronze-body valves on copper piping, and PVC ball valves on PVC piping.
 - .3 Acceptable Material
 - .1 Century CM2 block valve (316 SS)
 - .2 Century CM29 block and bleed valve (316SS)
 - .3 Chemline model OMP (PVC)
 - .4 Century CM3 (3-valve 316 SS)
 - .5 Crane 9302 (Bronze)
- .6 Instrument Description and Tagging
 - .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 All instruments shall bear a tag sign corresponding to process and instrumentation diagram tagging. Instruments tag signs shall be as specified in Section 15015.

INSTRUMENTATION – FIELD INSTRUMENTS

2.2 MAGNETIC FLOW METERS

- .1 General
 - .1 All meters within this subsection shall be provided by the same manufacturer.
 - .2 The flow indicating transmitter shall be suitable, in all respects, for use with specified application.
 - .3 The flow indicating transmitter shall be suitable for use with the specified flow and accuracy. Supplier to verify sizing based parameters listed in this specification.
- .2 Applicable Equipment: FIT 172, FIT 182
 - .1 Liquid Type:
 - .1 FIT 172, FIT 182: Raw Water.
 - .2 Size:
 - .1 FIT 172: 200 mm.
 - .2 FIT 182: 300 mm.
 - .3 Location:
 - .1 FIT 172, FIT 182: Okotoks Intake Pump Station
 - .4 Acceptable Supplier:
 - .1 Endress & Hauser
 - .5 Operating Conditions:
 - .1 Temperature: 1 to 25 °C
 - .2 Flow Rates:
 - .1 FIT 172: Max: 20 L/s, Min: 0 L/s
 - .2 FIT 182: Max: 360 L/s, Min: 0 L/s
 - .6 Transducer:
 - .1 Pressure Rating: 2068 kPa
 - .2 Body Material: Carbon Steel.
 - .3 Mounting: ANSI 300 Flange
 - .4 Liner material: Polyurethane.
 - .5 Electrode: 316 Stainless Steel.
 - .6 Grounding Rings: Required in non-metallic or metallic coated piping.
 - .7 Bidirectional Capability:
 - .1 FIT 172, FIT 182: No
 - .8 Transmitter:
 - .1 Output: 4-20 mA
 - .2 Power: 24 VDC
 - .3 Accuracy: 0.5% of full span.
 - .4 Mounting:
 - .1 FIT 172, FIT 182: Integral
 - .5 Output meter scale: LCD
 - .6 Calibration Range:
 - .1 FIT 172: 0 to 20 L/s
 - .2 FIT 182: 0 to 360 L/s
 - .7 Flow Rate Units: liters/sec

INSTRUMENTATION – FIELD INSTRUMENTS

- .8 Totalizer Units: cubic meters
- .9 Communications: HART, Ethernet I/P
- .9 Accessories:
 - .1 PC configuration software for instrument setup
 - .2 Cabling required for remote indicators and totalizers.
 - .3 Grounding Rings as per manufacturer's recommendations
- .10 Tag #: FIT 172, FIT 182

2.3 PRESSURE INDICATING TRANSMITTERS

- .1 General
 - .1 Pressure indicating transmitters must be suitable for service and application. Use isolation diaphragms where required.
- .2 Applicable Equipment: PIT 180, PIT 181
 - .1 Liquid Type:
 - .1 PIT 180: Raw Water
 - .2 PIT 181: Raw Water
 - .2 Location:
 - .1 PIT 180, PIT 181: Okotoks Intake Pump Station
 - .3 Acceptable Manufacturer:
 - .1 Endress & Hauser, Siemens, ABB, or approved equivalent.
 - .4 Specified Equipment: PIT 180, PIT 181
 - .1 Type: conventional gauge pressure transmitter c/w smart electronics.
 - .2 Interface: digital numeric display with pushbuttons capable of configuring device.
 - .3 Mounting: Direct.
 - .4 Process Connection: 1/2" NPT.
 - .5 Material (Wetted Parts): 316 Stainless Steel.
 - .6 Housing: Aluminum NEMA 4X.
 - .7 Power: Loop powered 2-wire - 24VDC unit.
 - .8 Output: 4-20mA to PLC.
 - .9 Accuracy: 0.15%.
 - .10 Calibrated Range:
 - .1 PIT 180: 0 - 300 PSI.
 - .2 PIT 181: 0 - 300 PSI.
 - .11 Communications: HART.
 - .5 Tag #s: PIT 180, PIT 181

2.4 SUBMERSIBLE PRESSURE TRANSMITTERS

- .1 Applicable Equipment: LT 2,
 - .1 Liquid Type: Raw Water
 - .2 Location:
 - .1 LT 2: Well #2.
 - .3 Mounting: As shown on drawings.
 - .4 Specified Equipment:
 - .1 Manufacturer: Vega, PMC, Endress & Hauser or approved equivalent

INSTRUMENTATION – FIELD INSTRUMENTS

- .2 Type: Submersible hydrostatic gauge pressure
- .3 Accuracy: 0.1% of full scale
- .4 Housing Material: 316L Stainless Steel
- .5 Power: Loop powered 24 VDC
- .6 Output: 4-20mADC
- .7 Cable: Molded Polyurethane Jacket
- .8 Cable Length: As required to accommodate mounting depth.
- .5 Measurement Range: 20 PSI - 0 to 10.0 m depth
- .6 Approved Manufacturer:
 - .1 Vega, PMC, Endress & Hauser or approved equivalent

2.6 RADAR LEVEL TRANSMITTERS

- .1 Applicable Equipment: LT 010
- .2 Liquid Type: Raw Water
- .3 Location: Intake Pump Wetwell
- .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: 0-14.0 m (From FSL to Bottom of Reservoir).
- .7 Accessories:
 - .1 Provide aluminum brackets to mount radar transmitter below access hatch of above ground reservoir.
 - .2 Alternative Manufacturer: Endress & Hauser

2.7 LEVEL SWITCHES

- .1 Applicable Equipment: LSLL 010, LSHH 010.
- .2 Liquid Type: Raw water
- .3 Location:
 - .1 LSLL 010: Intake Pump Wetwell, elevation 943.05 m.
 - .2 LSHH 010: Intake Pump Wetwell, elevation 947.90 m.
- .4 Specified Equipment:

INSTRUMENTATION – FIELD INSTRUMENTS

- .1 Manufacturer: Flygt or equivalent.
- .2 Model: ENH-10.
- .3 Type: Liquid level regulator.
- .4 Output: to PLC.
- .5 Accessories:
 - .1 Appropriately sized weights as required.
 - .2 Cable as required.
- .6 Mounting: As per manufacturer's requirements.

2.8 TEMPERATURE SENSOR (TE)

- .1 Applicable Equipment: TE 196
- .2 Type: RTD only.
- .3 Location:
 - .1 Outlet Header
- .4 Specified Equipment:
 - .1 Supplier: WIKA Instruments LTD or Endress & Hauser
 - .2 Type: RTD c/w termination head and well.
 - .3 RTD: 3 wire platinum 100 ohm. Length to match well.
 - .4 Head: Aluminum with threaded cover. Threaded connections for process and conduit. Terminal blocks for wire connections.
- .5 Well: Stainless steel of length suitable for 50% diameter pipe insertion

2.9 TURBIDIMETER/pH ANALYZER

- .1 Applicable Equipment: AIT/AE 194,195
 - .1 Liquid Type: Raw Water
 - .2 Location:
AIT/AE 194, 195: Discharge Line
 - .3 Specified Equipment:
 - .1 Manufacturer: Hach
 - .2 Model: DPMP-TUPHD
 - .3 Type: Dual Parameter Monitoring Panel for Turbidity and pH
 - .4 Turbidity Type: Laser
 - .5 Turbidity Range: 0-700 NTU
 - .5 pH Range: 2.0-14.0
 - .6 Sample Flow Required: 200 –750 ml/minute
 - .9 Outputs: Three selectable 4-20 mA outputs for turbidity, pH, temperature.
 - .11 Power: 120 VAC, 60 Hz
 - .12 Sample Inlet Fitting: ¼" NPT female
 - .13 Drain Fitting: ½" NPT female
 - .14 Enclosures: Nema-4X

INSTRUMENTATION – FIELD INSTRUMENTS

- .15 Accessories:
 - .1 Sufficient suitable sized cable to connect each turbidimeter to their respective display unit.
 - .2 Provide piping from the turbidimeter as required by the manufacturer to allow for calibration of the unit. Pipe drain water from analyzer to floor funnel and pipe floor funnel to floor drain and to sump.
 - .3 Operational Manual
 - .4 Provide ball valve, needle type flow control valve and flow indicator on inlet side of each turbidimeter in order to limit flow through the unit.
 - .5 Sample port on piping to turbidimeter.
 - .6 One (1) Calibration cylinder Cat No. 44153-00
 - .7 One (1) 1720 Series ICE-PIC Calibration/Verification Module Cat No. 52215-00
 - .8 One (1) Calibration Kit Cat No. 44156-00.
 - .9 Verification Standards:
 - .1 One (1) 0.1 NTU Cat No. 27233-53
 - .2 One (1) 0.3 NTU Cat No. 26979-53
 - .3 One (1) 0.5 NTU Cat No. 26980-53
 - .4 One (1) 1 NTU Cat No. 26598-53
 - .10 Comparative Calibration Standards
 - .1 One (1) 20 NTU Cat No. 26601-53
 - .11 PC configuration software for instrument setup
 - .12 Provide 10 PSI pressure regulator for each turbidimeter.
- .16 Commissioning: Contractor to arrange for the services of the equipment manufacturers technical representative to come to site and commission the turbidity analyzers.

3. EXECUTION

3.1 INSTALLATION

- .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.

INSTRUMENTATION – FIELD INSTRUMENTS

- .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 Drawings.

3.2 TESTING, ADJUSTING AND COMMISSIONING

- .1 Testing, adjusting and commissioning of all instruments shall be in accordance with the manufacturer's recommendations and the Contractor shall pay the costs.

END OF SECTION

PROCESS MEASUREMENT DEVICES

1. GENERAL

1.1 INTENT

- .1 All field instruments required including:
 - .1 Temperature Sensors
 - .2 Humidity Sensor
 - .3 Conductivity level switches
 - .4 Smoke Detectors
 - .5 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.
- .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

PROCESS MEASUREMENT DEVICES

- .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.
- .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.

PROCESS MEASUREMENT DEVICES

- .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 TEMPERATURE SENSORS

- .1 Applicable Equipment: TE 010, TE 790, TE791.
- .2 Type: RTD element c/w connection head with terminals.
- .3 Location:
 - .1 TE 010: Intake Wetwell Ambient.
 - .2 TE 790: Pump Room Ambient.
 - .3 TE 791: Electrical Room Ambient.
- .4 Specified Equipment TE 010:
 - .1 Supplier: WIKA Instruments LTD
 - .2 RTD Type: 100 ohm Platinum
 - .3 Well Type: Open Sleeve with flange suitable for attaching to concrete floor
 - .4 Well Material: 316 Stainless Steel
 - .5 Well Insertion Length: Suitable for 1000mm below 300mm concrete floor
 - .3 Connection Head: NEMA 4 c/w terminals
 - .4 Electrical connection: 3/4"NPT
 - .5 Output: RTD
- .5 Specified Equipment TE 790, TE 791:
 - .1 Supplier: WIKA Instruments LTD
 - .2 Model: Drawing No. ATS-17932-sheet no.1
 - .3 Type: Wall mount NEMA 4
 - .4 Electrical connection: 3/4"NPT
 - .5 Output: RTD

2.7 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

PROCESS MEASUREMENT DEVICES

2.8 CONDUCTIVITY LEVEL SWITCHES

- .1 Applicable Equipment: LSH 780
- .2 Liquid Type: Potable 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.
 - .5 Relay Base: 5400-SR.
 - .6 Mounting: As per manufacturer's requirements.

2.9 SMOKE DETECTORS

- .1 Applicable Equipment: ASH 761, ASH 764
 - .1 Equipment: Smoke Detector.
 - .2 Location: Ceiling height, and as indicated on drawings.
 - .1 ASH 761: Pump Room.
 - .2 ASH 764: Electrical Room.
 - .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.

PROCESS MEASUREMENT DEVICES

2.10 DOOR CONTACTS

- .1 Applicable Equipment: ZSC 753.
- .2 Equipment: Magnetic door contact.
- .3 Location:
ZSC 753: Pump Station Exterior Door.
- .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

- .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.

PROCESS MEASUREMENT DEVICES

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

VERTICAL TURBINE PUMPS

1. GENERAL

1.1 INTENT

- .1 Supply and install vertical turbine pump(s) as indicated on the Contract Drawings and in this Specification.
- .2 Approved Manufacturers:
 - .1 Goulds
 - .2 Approved Alternates:
 - .1 Peerless
- .3 Approved Suppliers:
 - .1 Sego Industries Inc.
3905 14th Ave North
Lethbridge, AB T1H 6P6
Phone: 403-328-1770
- .4 Approved Alternate Supplier:
 - .1 Chamco Industries Ltd.
Bay 110, 553 Kingsview Way SE
Airdrie, AB T4A 0C9
Phone: 403-945-8134
Fax: 403-945-2250
 - .1 Equipment supplied by approved alternate must be of the same or greater quality than equipment from specified manufacturer.
 - .2 All alternate pumps must conform to the intent of the approved manufacturer including technical specification, type, performance, flanges, materials of construction, motors, seals, etc.
 - .3 The Contractor is responsible for any piping, valving, and fitting modifications that may occur from using approved alternate pump selection.
 - .4 The Contractor is responsible for any electrical modifications including VFD's, generator sizing, wiring, etc. that may occur from using alternate pump selection.

1.2 RELATED SECTIONS

- .1 Section 01340 – Shop Drawings, Product Data and Samples
- .2 Section 01790 – Operation and Maintenance Data and Manuals
- .3 Section 13311 – Instrumentation - Wiring
- .4 Section 15015 – Mechanical General Requirements

VERTICAL TURBINE PUMPS

- .5 Section 15020 – Detailed Piping Specifications
- .6 Section 15110 – Valves
- .7 Section 15190 – Disinfection, Hydrostatic and Pressure Testing

1.3 REFERENCE STANDARDS

- .1 ANSI Standards:
 - .1 B-16.5 Pipe Flanges and Flanged Fittings
 - .2 ANSI/HI 9.6.4-2009 American National Standard for Rotodynamic Pumps for Vibration Measurements and Allowable Values
- .2 OH&S Standards:
 - .1 Applicable Standards

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 34 00.
- .2 Shop drawings and product data to include the following:
 - .1 Performance curves, which include differential head, efficiency, water NPSHR, and brake horsepower.
 - .2 Outline and arrangement drawings.
 - .3 Cross-section drawings.
 - .4 Materials of construction.
 - .5 Details of stuffing box or mechanical seal arrangement.
 - .6 Critical speed analysis.

1.5 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into the manual specified in Section 40 05 70.
- .2 Maintenance data to include the following:
 - .1 Manufacturer's name, type, model year, capacity and serial number.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list with names and addresses.
 - .4 As-built wiring diagrams.
 - .5 Performance curves.

1.6 DESIGN CRITERIA

VERTICAL TURBINE PUMPS

- .1 Unless stated herein or waived in writing by the Engineer, vertical turbine pump construction, materials, methods and performance shall conform to AWWA Standard E101-77, latest revision.
- .2 Setting:
 - .1 The Contractor shall be responsible for ascertaining and confirming the exact pump setting length. The setting length shall also be confirmed by site measurement prior to manufacturing the pumps.
 - .2 The dimension from the underside of the pump suction bell to the bottom of the sump shall conform to the manufacturer's recommendations and this dimension shall be clearly indicated on the pump shop drawings.

1.7 TAGGING

- .1 Provide each instrument with a tag stamped or engraved with the equipment number.
- .2 Tags to be 20 mm high, 75 mm long, and 1.5 mm thick Lamecoid with 10 mm high alphanumeric characters, Helvetica font, reverse engraved. Characters to be white on coloured background. Background colour to be red.
- .3 The code lettering and number system shall be as shown on the P & I drawings or as directed by the Engineer.
- .4 Affix tags to equipment securely.

1.8 QUALITY ASSURANCE

- .1 Ensure that installations conform with all applicable local, Provincial, and/or Federal codes, standards, and regulations in effect at time of bid.
- .2 Comply with the requirements of the following organizations, at minimum:
 - .1 CSA, Canadian Standards Association.
 - .2 NEC, National Electric Code.
 - .3 NEMA, Standards of National Electrical Manufacturers Association.
 - .4 ANSI, American National Standards Institute.
 - .5 ASTM, American Society for Testing and Materials.
 - .6 AISI, American Iron and Steel Institute.
 - .7 AGMA, American Gear Manufacturer's Association.
 - .8 AISC, American Institute of Steel Construction.
 - .9 AWS, American Welding Society.
 - .10 ASME, American Society of Mechanical Engineers.
 - .11 NSF, National Sanitation Foundation.

1.9 MATERIALS

- .1 All materials to be new, free from defects and conforming to applicable reference standards.

VERTICAL TURBINE PUMPS

- .2 All materials, linings and coatings in contact with water to be NSF approved for potable water.
- .3 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

1.10 GENERAL

- .1 Critical Speed Analysis:
 - .1 A critical speed analysis shall be computed by the pump manufacturer using a finite element analysis program or application-specific programs, as approved by the Engineer. The following information shall be included with the pump shop drawing submittal package:
 - .1 A pdf version of the critical speed analysis.
 - .2 A summary pdf document that covers pump critical speeds, minimum speeds, operating ranges as per specification, number and length of column segments, distances between steady bearings, shaft size, materials.
 - .3 Recommendations.

2. PRODUCTS

2.1 INTAKE PUMP (VP 110)

- .1 Conditions:
 - .1 Liquid: Raw Water
 - .2 Temperature: 20°C (68°F)
 - .3 Flow: 35 l/sec
 - .4 TDH field: 121 m @1770 RPM
90 m @ 1620 RPM
 - .5 Wetwell Depth (From T.O.C. to B.O.C.):
 - .1 12.80 m **(To be field confirmed by Contractor.)**
 - .6 Pump operates on variable frequency drive:
 - .1 Range of Pump Operating Speeds:
 - .1 Minimum = 1200 rpm
 - .2 Maximum = 1800 rpm
- .2 Approved Products
 - .1 **Goulds model 12WALC**, 6 stage, vertical turbine pump rated for the following conditions when operating at 1770 rpm and with performance to curve for 8.75" impeller, as supplied by Sego Industries Inc.
 - .1 Pump:
 - .1 Stages: 6
 - .2 Impeller Diameter: 8.75"
 - .3 Efficiency: 83%
 - .4 Required NPSH: 2.6 m
 - .5 Motor HP: 75.0 HP
 - .6 Minimum submergence: 498 mm above lip of bell

VERTICAL TURBINE PUMPS

- .2 Pump Components:
 - .1 Discharge Head: ductile iron
 - .2 Discharge Flange: 152 mm (6")
 - .3 Column: 152 mm (6") flanged, Open Line Shaft
 - .4 Discharge Head, Column and Bowl Length (DH+COL+BL): 12,588 mm (495.60") **(To be field confirmed by Contractor.)**
 - .5 No. of Column Segments: Based on bearing spacing
 - .6 Column Connections: Flanged.
 - .7 Shaft: 416 Stainless Steel all 25.4 mm (1.00"); c/w 416 Stainless Steel Two piece 25.4 mm (1.00") Threaded Top Shaft with bronze adjusting nut, steel locking screws and gib key; and one bronze line shaft bearing retainer with a neoprene line shaft bearing
 - .8 Mechanical Seal: modular cartridge seal, Chesterton 155 1SCO NSF61. Discharge water to be piped back to clear well.
 - .9 Bowl Assembly: Cast iron threaded suction, intermediate bowls and discharge manifold, 316SS impeller and bronze bowl bearings, steel taper lock, 416 SS bowl shaft and neoprene lateral seal ring.
- .2 The exterior and interior of the column pipe, bowl, and the discharge head must be coated with 8 mils Tnemec 141 Class 1. NSF 61 approved epoxy.
- .3 Winding RTD with external junction box for upper and lower bearing.
- .4 Mechanical Seal: Chesterton 155 1SCO NSF61
 - .1 Face/primary ring: Resin-Impregnated Carbon
 - .2 Seat/mating ring: Sintered Silicon Carbide
 - .3 Sleeve/gland plate/Collar/Retainer/Drive ring/anti-extrusion ring: 316ss
 - .4 O-ring: Fluoroelastomer Ethylene Propylene
 - .5 Gland gasket: Glass filled PTFE
 - .6 Spring: Alloy C-276 (UNS N10276)
 - .7 Quench Bushing: Resin-Impregnated Carbon
- .5 Accessories: Dynamic Balancing on Impellers.
- .3 Motor:
 - .1 **75HP**, 1800 rpm, 480/3/60 USEM-Nidec Type AUI vertical hollow shaft, high thrust, inverted duty, premium efficient electric motor in WP 1 enclosure and fitted with a non-reverse ratchet. NEMA design B, Class F insulation, Inverter grade as per MG1 Part 31. Motor to have a 1.15 service factor.
- .4 Performance testing: Manufacturer shall conduct a non-witness performance test, provide the engineer with the test curve and obtain engineer's approval before pump shipping.

2.2 INTAKE PUMP (VP 120/130)

- .1 Conditions:
 - .1 Liquid: Potable Water

VERTICAL TURBINE PUMPS

- .2 Temperature: 20°C (68°F)
- .3 Flow: 81 l/sec
- .4 TDH field: 130 m @1770 RPM
110 m @ 1620 RPM
- .5 Wetwell Depth (From T.O.C. to B.O.C.):
 - .1 12.80 m **(To be field confirmed by Contractor.)**
- .6 Pump operates on variable frequency drive:
 - .1 Range of Pump Operating Speeds:
 - .1 Minimum = 1200 rpm
 - .2 Maximum = 1800 rpm
- .2 Approved Products
 - .1 **Goulds model 12RJHC**, 7 stage, vertical turbine pump rated for the following conditions when operating at 1770 rpm and with performance to curve for 8.56" impeller, as supplied by Sego Industries Inc.
 - .1 Pump:
 - .1 Stages: 7
 - .2 Impeller Diameter: 8.12"
 - .3 Efficiency: 82%
 - .4 Required NPSH: 6.25 m
 - .5 Motor HP: 200 HP
 - .6 Minimum submergence: 775 mm above lip of bell
 - .2 Pump Components:
 - .1 Discharge Head: ductile iron
 - .2 Discharge Flange: 203 mm (8")
 - .3 Column: 203 mm (8") flanged, Open Line Shaft
 - .4 Discharge Head, Column and Bowl Length (DH+COL+BL): 12,588 mm (495.60") **(To be field confirmed by Contractor.)**
 - .5 No. of Column Segments: Based on bearing spacing
 - .6 Column Connections: Flanged.
 - .7 Shaft: 416 Stainless Steel all 25.4 mm (1.00"); c/w 416 Stainless Steel Two piece 25.4 mm (1.00") Threaded Top Shaft with bronze adjusting nut, steel locking screws and gib key; and one bronze line shaft bearing retainer with a neoprene line shaft bearing
 - .8 Mechanical Seal: modular cartridge seal, Chesterton 155 1SCO NSF61. Discharge water to be piped back to clear well.
 - .9 Bowl Assembly: Cast iron threaded suction, intermediate bowls and discharge manifold, 316SS impeller and bronze bowl bearings, steel taper lock, 416 SS bowl shaft and neoprene lateral seal ring.
 - .2 The exterior and interior of the column pipe, bowl, and the discharge head must be coated with 8 mils Tnemec 141 Class 1. NSF 61 approved epoxy.
 - .3 Winding RTD with external junction box for upper and lower bearing.
 - .4 Mechanical Seal: modular cartridge seal, Chesterton 155 1SCO NSF61
 - .1 Face/primary ring: Resin-Impregnated Carbon
 - .2 Seat/mating ring: Sintered Silicon Carbide
 - .3 Sleeve/gland plate/Collar/Retainer/Drive ring/anti-extrusion ring: 316ss

VERTICAL TURBINE PUMPS

- .4 O-ring: Fluoroelastomer Ethylene Propylene
- .5 Gland gasket: Glass filled PTFE
- .6 Spring: Alloy C-276 (UNS N10276)
- .7 Quench Bushing: Resin-Impregnated Carbon
- .5 Accessories: Dynamic Balancing on Impellers.
- .3 Motor:
 - .1 **200HP**, 1800 rpm, 480/3/60 USEM-Nidec Type AUI vertical hollow shaft, high thrust, inverted duty, premium efficient electric motor in WP 1 enclosure and fitted with a non-reverse ratchet. NEMA design B, Class F insulation, Inverter grade as per MG1 Part 31. Motor to have a 1.15 service factor.
 - .4 Performance testing: Manufacturer shall conduct a non-witness performance test, provide the engineer with the test curve and obtain engineer's approval before pump shipping.

2.3 ACCESSORIES

- .1 Provide all anchor bolts, shims and miscellaneous accessories necessary for installation of the pumping equipment and drivers.
- .2 Provide the following spare parts, to be delivered to the site and handed over to the Owner at the time of commissioning:
 - .1 Sufficient lubricating oils and greases of correct grade and specification for 12 months operation of all equipment requiring such.
 - .2 Any other spares which may be required to comply with the manufacturer's operating and maintenance instructions and recommendations during the course of the first 12 months of operation.

3. EXECUTION

3.1 MARKING, PACKING, AND PACKAGING

- .1 Equipment shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. Equipment shall be shipped with a label containing equipment description, manufacturing order number, part number, serial number, manufacturer, and date.
- .2 The proper caution or warning signs as prescribed by OH&S standard shall be customer determined and supplied.
- .3 All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.

3.2 SHIPPING, RECEIVING AND STORAGE

- .1 Various sections of the equipment to be properly match-marked to assist in positioning and assembly at the site.

VERTICAL TURBINE PUMPS

- .2 The pumps shall be shipped to site assembled to the greatest extent possible to reduce installation and start-up costs.
- .3 Provide instructions on storage and protection well in advance of shipping. If any special instructions are necessary covering safe storage, give them to the Contractor.
- .4 The Contractor will sign the carrier's bill of lading to indicate receipt of the required number of crates, packages, etc., and will note thereon any apparent shortages of or visible damage to such crates, packages, etc. The supplier shall furnish to the Contractor, lists showing the contents of the said crates, packages, etc., complete with all necessary handling and off-loading instructions. Such lists shall be furnished sufficiently early so that copies will be available at the site when delivery of the said equipment and appurtenances is made. Within seven days after the date of delivery to the site, the Contractor will notify the Supplier in writing of shortages or damage in equipment delivered.
- .5 The Contractor will provide unloading facilities and place the equipment in location or storage. The Contractor will be responsible for off-loading at site, for storing the equipment, appurtenances and materials and for protection against weather loss, damage, or theft. The supplier shall provide full instructions of all precautions to be observed in connection with the handling, storing and protection of the equipment.

3.3 INSTALLATION

- .1 Install all pumping equipment in strict accordance with manufacturer's and supplier's instructions.
- .2 Any damage resulting from either failure to observe the installation instructions or as a result of proceeding with the work without complete knowledge of how it is to be done will be the Contractor's responsibility.
- .3 Make equipment installation and connections by skilled tradesmen to the best standard.
- .4 Carry out work to produce a neat, accurate, secure, functional installation.
- .5 Repair at own expense, any damage done to the installation of materials while carrying out the work.
- .6 Install anchor bolts and concrete bases in advance of equipment installation in accordance with manufacturer's instructions.
- .7 Set sole plates in place and shim to correct alignment. Grout as required.
- .8 Upon completion of installation, fill, add to, and check equipment requiring lubricating oils, greases and coolants. Types and amounts to be in strict accordance with manufacturer's recommendations.

VERTICAL TURBINE PUMPS

3.4 EQUIPMENT TESTING PROCEDURE

- .1 Submit a thorough description of the procedures to be employed in testing this equipment. The procedure will be reviewed by the Engineer for suitability and should be submitted 3 weeks prior to any testing.

3.5 FIELD TESTING

- .1 When equipment installation has been completed to the standards indicated by these specifications, arrange for the services of the equipment manufacturer's technical representative.
- .2 The equipment manufacturer's technical representative shall inspect the installation to ensure that the equipment has been installed in accordance with the manufacturer's requirements. If the installation is not in order, correct the deficiencies indicated by the technical representative. Start, run and adjust equipment at this time. The technical representative shall then advise the Engineer in writing that the installation has been checked, has been installed correctly and is in working order.
- .3 Bear all the costs of the equipment manufacturer's technical representative.
- .4 Use only personnel who have taken an active part in the actual installation of the system. Do not designate a subtrade as representative at any time during the construction prior to final inspection.
- .5 Vibration measurements and allowable values shall conform to ANSI/HI 9.6.4-2009 American National Standard for Rotodynamic Pumps. Vibration measurements shall be within allowable values in three dimensions (X,Y,A), at all speeds within the stated pump operating range.

3.6 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

- .1 The equipment manufacturer's technical representative shall be familiar with the equipment supplied and shall come prepared with both knowledge and equipment to perform and interpret the test, inspections and procedures recommended by the manufacturer for the starting of equipment that has not previously been run.
- .2 The equipment manufacturer's technical representative shall, immediately after completion of the inspection, convey to the Engineer in writing, confirmation of the tests and inspections carried out and the result of this examination of the work.
- .3 If the inspection reveals defects in the work, correct as soon as possible and repeat the entire inspection procedure. Repeat until the work passes the inspection.
- .4 Document the results of the inspection by the equipment manufacturer's representative.
- .5 Ensure the installation meets all manufacturer's requirements for durable and trouble-free operation.

3.7 FIELD INSPECTION

- .1 Final inspection will be made by the Engineer only after the equipment manufacturer's technical representative has advised that equipment installation is in order and the

VERTICAL TURBINE PUMPS

Contractor has advised in writing that the system can be operated.

- .2 The Engineer will request that the equipment be operated to demonstrate that it will perform as specified. The Engineer will note deficiencies, and if possible, the deficiency will be corrected immediately by the Contractor. All deficiencies that cannot be corrected at the time of inspection will be noted by the Engineer who will advise the Contractor of these deficiencies in writing. Correct the deficiencies as soon as possible and advise the Engineer of their correction. Should the deficiencies be of a sufficiently serious nature to require the work to be re-inspected, the cost of the inspection will be borne by the Contractor.

3.8 OPERATOR TRAINING

- .1 Supplier shall provide the services of a skilled technical representative for a minimum period of one (1) day at the site to instruct plant personnel in the operation and service of the equipment.

END OF SECTION

SUBMERSIBLE TURBINE PUMPS

1. GENERAL

1.1 RELATED SECTIONS

- .1 Division 40 – Mechanical
- .2 Division 26 – Electrical

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.
- .2 Indicate:
 - .1 Manufacturer's name, type, model, year, capacity and serial number of pump and motor.
 - .2 Manufacturer's specifications for all equipment supplied.
 - .3 Performance curves, which include differential head, capacity, efficiency, water NPSHR and brake horsepower.
 - .4 Outline and arrangement drawings.
 - .5 Cross-section drawings.
 - .6 Materials of construction.
 - .7 Details of stuffing box or mechanical seal arrangement.
 - .8 Load, efficiency, speed, torque, current and power factor curves for motor.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into the manual specified in Section 40 05 70 – 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 Recommended spare parts list and addresses of representatives.
 - .4 As-Built wiring diagrams.
 - .5 Performance curves.

SUBMERSIBLE TURBINE PUMPS

2. PRODUCTS

2.1 GENERAL

- .1 Manufacturer and Supplier:
 - .1 All pumps and motors shall be of a manufacturer/supplier with service facilities in Southern Alberta.
- .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 substantial steel or brass nameplates attached to the unit, clearly inscribed with the manufacturer's name, year of manufacturing and the principal rating data. The pump nameplates shall have the capacity at the rated point inscribed in litres per second and the head in metres.
- .3 Painting:
 - .1 Paint all equipment in accordance with Division 9.

2.2 SUBMERSIBLE TURBINE WELL PUMP

- .1 Tag: WP 1
 - .1 Location: Production Well
 - .2 Conditions:
 - .1 Liquid: Potable Water
 - .2 Temperature: 20°C (68°F)
 - .3 Flow: 29 L/sec
 - .4 TDH: 121 m (Phase 2)
90 m (Phase 1)
 - .5 Well Depth: 9.5 m. **(To be field confirmed by Contractor.)**
 - .6 Pump to operates on variable frequency drive:
 - .1 Range of Pump Operating Speeds:
 - .1 Minimum = 1800 rpm (30 Hz)
 - .2 Maximum = 3600 rpm (60 Hz)
 - .3 Specified Equipment:
 - .1 Manufacturer: Grundfos Submersible Turbine Pumps or approved equivalent.
 - .2 Supplier: Sego Industries Inc.
 - .3 Model: SP 475S600-7
 - .4 Stages: 7
 - .5 Discharge Size: 150 mm (6") NPT
 - .6 Pump Components:
 - .1 Discharge Bowl: ASTM 304 SS
 - .2 Intermediate Bowl: ASTM 304 SS
 - .3 Impeller: ASTM 304 SS

SUBMERSIBLE TURBINE PUMPS

- .4 Strainer: ASTM 304 SS
- .5 Shaft: ASTM 416 SS
- .6 Coupling: ASTM 416 SS
- .7 Motor and Electrical Data:
 - .1 Model: Grundfos MS 6000
 - .2 Motor Diameter: 200 mm (8")
 - .3 Motor: 75 HP; 575 VAC; 3 phase, 60 Hz; 3450 rpm.
- .8 Accessories:
 - .1 Integral Check Valve

3. EXECUTION

3.1 INSTALLATION

- .1 Install all pumping equipment in strict accordance with manufacturer's and supplier's instructions.
- .2 Any damage resulting from failure to observe the installation instructions or as a result of proceeding without sufficient knowledge of proper installation techniques will be Contractor's responsibility.
- .3 Carry out all work necessary to produce a neat, accurate, secure and functional installation. All units shall be installed in accordance with the "Hydraulic Institute Standards" and appropriate practice in the industry.
- .4 Upon completion of installation, fill, add to and check equipment requiring lubricating oils, greases, coolants and water. Types and amounts to be in strict accordance with manufacturer's recommendations.

3.2 FIELD TESTING

- .1 Submit a thorough description of the procedures to be employed in testing this equipment to the Owner's Representative 7 days prior to any testing.
- .2 The equipment manufacturer's technical representative shall inspect the installation to ensure that the equipment has been installed in accordance with the manufacturer's requirements. Any deficiencies indicated must be corrected by the Contractor prior to the test.
- .3 The technical representative shall advise the Owner's Representative in writing that the installation has been checked and the equipment has been installed correctly and is in working order.
- .4 Final inspection and commissioning can be undertaken only after the equipment manufacturer's representative has advised that the equipment installation is in order.

END OF SECTION