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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 not does constitute a complete list of the *Work* of this Contract.

1.2 Work Covered by the Contract Documents

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

- (a) All required submittals including work plans, procedures, shop drawings, qualification documentation, etc.
- (b) Quality control measures and testing.
- (c) Temporary measures, to maintain water treatment plant operations
- (d) Construction facilities.
- (e) Demolition, removal, disposal (or salvage to *Owner*) of existing equipment and materials. *Work* includes salvage of existing fencing to the *Owner*.
- (f) The removal of existing equipment and floor-embedded skid. Repair existing concrete floor slab and surfacing.
- (g) Field verification and layout of piping, electrical and mechanical.
- (h) Supply and installation of cast-in-place concrete including reinforcing steel and formwork.
- (i) The *Contractor* shall retain a qualified third-party firm specializing in pipeline integrity inspection services for the inspection and visual condition assessment of the existing under-slab piping (including penetrations) as identified on the *Drawings*. The *Contractor* shall provide personnel as needed for the completion of this work. The *Contractor* shall engage the firm to undertake a remote camera inspection of each existing under-slab piping leg identified on the *Drawings*. The scope of deliverables will include a written report summarizing the interior condition assessment findings and include a projected lifespan of each under-slab piping leg inspected.
- (j) Supply and installation of new piping including:
 - (i) Fabricated stainless steel piping including all fittings, couplings, flanges, valves, etc.
 - (ii) Supply and installation of all production and custom fabricated pipe supports. Fabricated piping supports require the *Contractor's* Engineer to provide seal shop drawings.

SUMMARY OF WORK

- (iii) Exposing, surface preparing and coating, and connecting to existing piping penetrations as noted on the *Drawings*. This *Work* overlaps with the condition assessment of under-slab piping. Remove existing coatings adjacent each penetration prior to the condition assessment to allow inspection of base metal. Repair coatings shall not be applied until the condition assessment has been completed.
- (iv) Flow control valve with local vendor control panel. Includes providing electrical support during functional testing and setup and customization of vendor controller software. Includes coordination of vendor-supplied training to Town personnel.
- (v) Pressure testing of all new piping.
- (k) Supply and installation of electrical including integration with existing equipment.
 - (i) Power, network and control cables including glands/connectors.
 - (ii) Cable Tray including supports and transition pieces to the existing cable tray as well as temporary cable supports when upsizing tray.
 - (iii) Additions to existing control and VFD panels.
- (l) Provide an electrician onsite to assist Owner's programming and integration team during commissioning.

1.3 Work by Others – Not Used

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 Treatment Plant facility 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.

10.0 CONSTRUCTION SEQUENCE

10.1 The Contractor shall submit a Tie-in and Connection plan with the existing Water Treatment system to the *Consultant* for review and approval at least 10 business days before starting the connection.

10.2 The sequencing of the work, and a detailed plan for execution is critical to ensure there are minimal interruptions to the potable water and fire protection water supply to the community.

WORK RESTRICTIONS

- 10.3 The *Contractor* is only allowed a 4-hour shut down of the Water Treatment Plant to complete the tie ins. The connection to be complete during the evening between 11:00 PM and 5:00 AM to avoid reduce the service interruption to the residents.
- 10.4 The connection shall include [description of this work]

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

SUBMITTALS PROCEDURES

digital copy of the manual as directed by the *Consultant* and provide the *Owner* with an 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

HEALTH AND SAFETY PROCEDURES

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Alberta
 - .1 Occupational Health and Safety Regulations, Act and Code 2019.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site-specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Consultant and authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within 7 days after receipt of comments from Consultant.
- .8 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Consultant
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.4 SAFETY REQUIREMENTS

- .1 Contractor shall verify that emergency procedures including appropriate First Aid facilities and First Aid personnel are in place at the Work Site.
- .2 Contractor shall also have access to the Owner's First Aid Facilities. Conditions for use will be reviewed at the Project Start-up Meeting.

HEALTH AND SAFETY PROCEDURES

- .3 Contractor shall employ a full time, on-site Construction Safety Officer (CSO) who is responsible for the following:
 - .1 Providing new employee orientation
 - .2 Overseeing site activities
 - .3 Providing appropriate training on personal protective equipment and Workplace Hazardous Materials Information System (WHMIS)
 - .4 Conducting and documenting accident investigations as required
 - .5 Conducting daily work site inspections
 - .6 Conducting weekly site safety meetings, train new employees and verifying that Subcontractors, sub-subcontractors, suppliers and others working on the site are aware of safety requirements
 - .7 Requirement for a full time, on-site CSO may be waived where it can be shown that the site superintendent is certified and trained to act as the Safety Officer.
 - .8 CSO shall be certified by a training program recognized by the Alberta Construction Safety Association.
- .4 Maintain on site sufficient quantities of PPE, including but not limited to: hard hats, safety glasses, hearing protection and other items of clothing or special equipment as necessary to verify that visitors to the site, the Consultant and the Owner's representative are adequately protected.
- .5 Verify that all Contractor's employees, Subcontractors, sub-subcontractors, suppliers and others working on the site, meet clothing requirements of shirts with sleeves no shorter than midway between shoulder and elbow and full length pants; muscle shirts or sleeveless shirts, cut-offs or shorts will not be allowed on the work site.

1.5 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Consultant and Owner prior to commencement of Work.

1.6 REGULATORY REQUIREMENTS

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.7 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

HEALTH AND SAFETY PROCEDURES

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act of Alberta.

1.10 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Consultant verbally and in writing.

1.11 PRIME CONTRACTOR

- .1 Responsibility for Work Site Safety - This Contractor Is "Prime Contractor":
 - .1 The Contractor shall, for the purposes of the Occupational Health and Safety Act (Alberta), and for the duration of the Work of this Contract:
 - .1 Be the "Prime Contractor" for the "Work Site", and
 - .2 Meet all requirements of the Occupational Health and Safety Act and Regulations, Workers Compensation Board legislation, the Fire Code legislation and all other applicable laws that govern work place safety.
 - .2 The Contractor shall direct all Subcontractors, sub-subcontractors, Other Contractors, employees, suppliers, workers and any other persons at the "Work Site" on safety related matters, to the extent required to fulfill its "Prime Contractor" responsibilities pursuant to the Act, regardless of:
 - .1 Whether or not any contractual relationship exists between the Contractor and any of these entities, and
 - .2 Whether or not such entities have been specifically identified in this Contract.
 - .3 Safety Certification: Safety certification is a condition of contract award; Contractor is required to maintain a valid Certificate of Recognition (COR) for the duration of the Work of this Contract.

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Consultant.
- .2 Provide Consultant with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Consultant may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Consultant.

HEALTH AND SAFETY PROCEDURES

1.15 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Consultant.

1.16 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

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.

ENVIRONMENTAL PROCEDURES

- 1.5.2 Do not use watercourse beds for borrow material without approval from Federal, Provincial and Municipal authorities.
- 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.

ENVIRONMENTAL PROCEDURES

- 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.
- 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

ENVIRONMENTAL PROCEDURES

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

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.

ENVIRONMENTAL PROCEDURES

- 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.
 - 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

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

ABBREVIATIONS AND ACRONYMS

	(w)	ISO	International Organization for Standardization
	(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

ABBREVIATIONS AND ACRONYMS

-
- | | | |
|-----|--------|--|
| (i) | NFPA | National Fire Protection Association |
| (j) | SAE | Society of Automotive Consultants |
| (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 |

ABBREVIATIONS AND ACRONYMS

1.4.3	Area	
(a)	Square meter	m ²
(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

ABBREVIATIONS AND ACRONYMS

	(e)	Cubic meter per second	m ³ /s
1.4.9		Power, Energy, Heat, Work	
	(a)	Watt	W
	(b)	Kilowatt	kW
	(c)	Kilowatt hour	kWh
	(d)	Joule	J
1.4.10		Electricity	
	(a)	Ampere	A
	(b)	Volt	V

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 be 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

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*.

PRODUCTS/WORKMANSHIP

2.2 Cutting and Remedial *Work*

- 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

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

FIELD ENGINEERING

- 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.
- 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) Chemical System – including pumps, skids, tanks, controls and alarms.
 - (ii) The Control System – including all control signals, automatic valves, operational alarms, interlocks, and shutdowns.
 - (iii) SCADA Integration as needed.

GENERAL COMMISSIONING REQUIREMENTS

- (iv) Electrical Control, Instrumentation, and Programming.
- (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.
 - (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:

GENERAL COMMISSIONING REQUIREMENTS

- (a) Chemical Pump Systems
- (b) Flow Meters
- (c) Flow Control Valves
- (d) Pressure Transmitters
- (e) Level Transmitters
- (f) Level Switches

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*.

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

GENERAL COMMISSIONING REQUIREMENTS

- 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*.
 - 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

GENERAL COMMISSIONING REQUIREMENTS

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
- (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.

GENERAL COMMISSIONING REQUIREMENTS

- 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 2 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:
 - (a) *Subcontractors*, and *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 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 2:
 - (a) The *Owner* will operate the *Work*, and the *Contractor* must observe.

GENERAL COMMISSIONING REQUIREMENTS

- (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*.

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DECEMBER 2024
REVISION NUMBER: 0

CERTIFICATE OF SATISFACTORY INSTALLATION – FORM 101

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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

SECTION: 01 91 00
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DECEMBER 2024
REVISION NUMBER: 0

CERTIFICATE OF SATISFACTORY TESTING – FORM 102

Installing Contractor: _____

Comments: _____

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GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Consultant
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

CERTIFICATE OF SATISFACTORY COMMISSIONING – FORM 103

Installing Contractor: _____

[illegible]

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

Date:

Consultant
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

DIVISION 03 - CONCRETE

CONCRETE FORMING AND ACCESSORIES

1. GENERAL

1.1 General Requirements

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

1.2 Related Requirements

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

1.3 Reference Standards

- .1 CSA Group (CSA):
 - .1 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
 - .2 CSA O86:19, Engineering Design in Wood
 - .3 CSA O121-17, Douglas Fir Plywood
 - .4 CSA O151-17, Canadian Softwood Plywood
 - .5 CSA O153-13, Poplar Plywood
 - .6 CSA O325-16, Construction Sheathing
 - .7 CSA O437.0-93, OSB and Waferboard
 - .8 CSA S269.1-16, Falsework and Formwork
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S701.1-17, Standard for Thermal Insulation, Polystyrene Boards

CONCRETE FORMING AND ACCESSORIES

1.4 Administrative Requirements

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

1.5 Action and Informational Submittals

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

CONCRETE FORMING AND ACCESSORIES

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

1.6 Quality Assurance

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

1.7 Delivery, Storage, and Handling

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

CONCRETE FORMING AND ACCESSORIES

2. PRODUCTS

2.1 Materials

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

3. EXECUTION

3.1 Formwork Preparation

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

CONCRETE FORMING AND ACCESSORIES

3.2 Tolerances

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

3.3 Fabrication and Erection

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

CONCRETE FORMING AND ACCESSORIES

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

3.4 Removal and Reshoring

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

3.5 Site Quality Control

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

3.6 Cleaning

CONCRETE FORMING AND ACCESSORIES

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

END OF SECTION

CONCRETE REINFORCING

1. GENERAL

1.1 General Requirements

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

1.2 Related Requirements

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

1.3 Reference Standards

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

CONCRETE REINFORCING

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

1.4 Administrative Requirements

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

1.5 Action and Informational Submittals

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

CONCRETE REINFORCING

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

1.6 Quality Assurance

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

1.7 Delivery, Storage, and Handling

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

CONCRETE REINFORCING

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

2. PRODUCTS

2.1 Reinforcement Materials

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

2.2 Fabrication

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

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- .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.

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

1.4 Abbreviations and Acronyms

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

1.5 Definitions

CAST-IN-PLACE CONCRETE

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

1.6 Reference Standards

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

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- .10 ASTM D1751- 23, Standard Specification for Performed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- .11 ASTM D1752- 18, Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-M 86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .3 CSA Group (CSA):
 - .1 CSA A23.1: 19 /A23.2: 19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
 - .2 CSA A283: 19, Qualification Code for Concrete Testing Laboratories
 - .3 CSA A3000- 18, Cementitious Materials Compendium

1.7 Administrative Requirements

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

1.8 Action and Informational Submittals

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

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

1.9 Quality Assurance

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

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

1.10 Delivery, Storage, and Handling

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

1.11 Site Conditions

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

CAST-IN-PLACE CONCRETE

- .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.

CAST-IN-PLACE CONCRETE

- .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.

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- .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.

CAST-IN-PLACE CONCRETE

- .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 FINISHED

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.

CONCRETE FLOOR FINISHED

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 chemical resistant epoxy resin binder and coating available in unlimited colours for horizontal surfaces.
- .2 Sika Duroplast -100N with sikagard primers Duroplast EE for CMU and Concrete and Cor-Pro -470 for steel for vertical surfaces.

Part 3 Execution

3.1 VERIFICATION OF CONDITIONS

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

3.2 APPLICATION

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

END OF SECTION

DIVISION 04 - MASONRY

MASONRY MORTARING AND GROUTING

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 04 05 19 - Masonry Anchorage and Reinforcing
- .2 Section 04 05 23 - Masonry Accessories
- .3 Section 04 22 00 – Concrete Unit Masonry

1.3 Reference Standards

- .1 CSA Group (CSA)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 A Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371-14, Masonry Construction for Buildings.
 - .4 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 Action and Informational Submittals

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

MASONRY MORTARING AND GROUTING

- .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry mortar and grout 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. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .3 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 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 masonry mortar and grout packages from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 Site Conditions

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 27 degrees C prior to, during, and 48 hours after completion of masonry work.

MASONRY MORTARING AND GROUTING

- .2 Weather Requirements: CAN/CSA-A371

2. PRODUCTS

2.1 Materials

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
 - .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement
 - .1 Use low VOC products.
 - .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
 - .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
 - .1 Use low VOC products.
 - .4 Packaged Dry Combined Materials for mortar: to CAN/CSA-A179, Type S, using gray colour cement.
- .3 Aggregate: supplied by one supplier.
 - .1 Fine Aggregate: to CAN/CSA-A179, natural sand, manufactured sand and/or silica sand.
 - .2 Course Aggregate: to CAN/CSA-A179
- .4 Water: clean and potable.
- .5 Lime:
 - .1 Quick Lime: to CAN/CSA-A179, Type S.
 - .2 Hydrated Lime: to CAN/CSA-A179, Type S.
- .6 Bonding Agent: epoxy type.
- .7 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 Admixtures

- .1 Water Repellent Agents: liquid.

MASONRY MORTARING AND GROUTING

- .1 Use low VOC products and in compliance with Section 03 30 00 Cast-in-Place Concrete.
- .2 Air Entrainment Agents: pre-blended type
 - .1 Use low VOC products and in compliance with Section 03 30 00 Cast-in-Place Concrete.
- .3 Plasticizer Agents: Liquid type.
 - .1 Use low VOC products and in compliance with Section 03 30 00 Cast-in-Place Concrete.
- .4 Accelerator Agents: Non-chloride type.
 - .1 Use low VOC products and in compliance with Section 03 30 00 Cast-in-Place Concrete.

2.3 Mortar Mixes

- .1 Mortar for exterior masonry above grade:
 - .1 Load Bearing: type S based on property specifications.
 - .2 Non-Load Bearing: S based on property specifications.
- .2 Following applies regardless of mortar types and uses specified above:
 - .1 Mortar for concrete brick: type S based on proportion specifications.
 - .2 Mortar for grouted reinforced masonry: type S based on proportion specifications.

2.4 Mortar Mixing

- .1 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use
- .2 Maintain sand uniformly damp immediately before mixing process.
- .3 Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.
- .4 Using anti-freeze compounds including calcium chloride or chloride based compounds is **not** prohibited.
- .5 Adding air entraining admixture to mortar mix is **not** prohibited.

MASONRY MORTARING AND GROUTING

- .6 Use a batch type mixer in accordance with CAN/CSA-A179
- .7 Re-temper mortar only within 90 minutes of mixing, when water is lost by evaporation.
- .8 Use mortar within 90 minutes after mixing.

2.5 Grout Mixes

- .1 Bond Beams: grout mix 20 MPa strength at 28 days; 175 mm slump; premixed type in accordance with CSA A23.1/A23.2.
- .2 Lintels: grout mix 20 MPa strength at 28 days; 175 mm slump; premixed type in accordance with CSA A23.1/A23.2.
- .3 Grout: Minimum compressive strength of 20 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA-A179

2.6 Grout Mixing

- .1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed
- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 fine grout.
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Using calcium chloride or chloride based admixtures is **not** prohibited.

2.7 Mix Tests

- .1 Testing Mortar Mix:
 - .1 Test mortar to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for mortar based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Consistency.
 - .3 Mortar aggregate ratio.
 - .4 Sand/cement ratio.
 - .5 Water content and water/cement ratio.
 - .6 Air content.

- .7 Splitting tensile strength.
 - .2 Testing Grout Mix:
 - .1 Test grout to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for grout based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Sand/cement ratio.
 - .3 Water content and water/cement ratio.
 - .4 Slump.
 - 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry 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 Apply bonding agent to existing concrete surfaces.
 - 3.3 Construction
 - .1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.
 - 3.4 Mixing
 - .1 Clean mixing boards and mechanical mixing machine between batches.
 - .2 Mortar: weaker than units it is binding.

MASONRY MORTARING AND GROUTING

- .3 Contractor to appoint one individual to mix mortar, for duration of project. In event that this individual is changed, mortar mixing must cease until new individual is trained, and mortar mix is tested.

3.5 Mortar Placement

- .1 Install mortar to requirements of CAN/CSA-A179
- .2 Remove excess mortar from grout spaces.

3.6 Grout Placement

- .1 Install grout in accordance with CAN/CSA-A179
- .2 Work grout into masonry cores and cavities to eliminate voids.
- .3 Installing grout in lifts greater than 400 mm, without consolidating grout by rodding is **not** prohibited.
- .4 Displacing reinforcement while placing grout is prohibited.

3.7 Field Quality Control

- .1 Site Tests, Inspection: as follows:
 - .1 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA-A179
 - .2 Test and evaluate grout prior to construction and during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified

3.8 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.9 Protection

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each workday. Anchor securely in position.

MASONRY MORTARING AND GROUTING

END OF SECTION

MASONRY ANCHORAGE AND 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 04 05 13 - Masonry Mortar and Grouting
- .2 Section 04 05 23 - Masonry Accessories
- .3 Section 04 22 00 – Concrete Unit Masonry

1.3 Reference Standards

- .1 CSA Group (CSA):
 - .1 CSA A23.1-14/A23.2-24, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry
 - .3 CAN/CSA-A370-14, Connectors for Masonry
 - .4 CAN/CSA-A371-14, Masonry Construction for Buildings
 - .5 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement
 - .6 CSA S304-14(R2015), Design of Masonry Structures
 - .7 CSA W186- M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction
- .2 Reinforcing Steel Institute of Canada (RSIC):
 - .1 Reinforcing Steel Manual of Standard Practice, 2020

MASONRY ANCHORAGE AND REINFORCING

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 anchorage and reinforcing materials 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 province of project location.
 - .2 Submit drawings detailing bar bending, anchorage details lists and placement drawings.
 - .3 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 Site Measurements

- .1 Make site measurements necessary for proper fit of members.

1.7 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.

MASONRY ANCHORAGE AND REINFORCING

.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 anchorage and reinforcing materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

- .1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA G30.18, Grade 400W.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1.
- .3 Ties: uncoated steel finish.
 - .1 Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.
 - .2 Joint Reinforcement Ties: CSA A371 with corrosion protection to CSA S304 and CSA A370:
 - .1 Single Wythe Joint Reinforcement: ladder type:
- .4 Anchors: to CAN/CSA-A370:
 - .1 Conventional Anchors: type steel bolts plate anchors, sized to suit application.
 - .2 Anchor Bolts: proprietary (patented) anchors, stainless steel finish.
- .5 Adhesive Anchors: proprietary systems measure and mix system where epoxy materials are hand-measured and mixed in accordance with manufacturers' written instructions.

2.2 Fabrication

- .1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA-A370.
- .3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.

MASONRY ANCHORAGE AND REINFORCING

- .4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 Source Quality Control

- .1 Provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcement work.
- .2 Upon request inform Consultant of proposed source of supplied material.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for anchorage and reinforcing materials 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 written approval to proceed from Consultant.

3.2 Preparation

- .1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 Installation

- .1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.
- .2 Prior to placing concrete, mortar and/ or grout, obtain Consultant's site inspection and written recommendations of placement of reinforcement and connectors.

3.4 Bonding and Tying

- .1 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371 and manufacturer's instructions.

MASONRY ANCHORAGE AND REINFORCING

- .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.
- .2 Install horizontal joint reinforcement 400 mm on centre.
- .3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
- .4 Place joint reinforcement continuous in first and second joint below top of walls.
- .5 Lap joint reinforcement ends minimum 200 mm.
- .6 Connect running bond unit joint corners and intersections with strap anchors 400 mm on centre.

3.5 Reinforced Lintels and Bond Beams

- .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.
- .2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.
- .3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.6 Grouting

- .1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.

3.7 Anchors

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

3.8 Lateral Support and Anchorage

- .1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.9 Movement Joints

- .1 Reinforcement not continuous across movement joints unless otherwise indicated.

3.10 Field Bending

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.

MASONRY ANCHORAGE AND REINFORCING

- .2 When field bending authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars and connectors with cracks or splits.

3.11 Site Quality Control

- .1 Obtain Consultant's site inspection and written recommendations on placement of reinforcement and connectors, prior to placing mortar and/or grout.

3.12 Field Touch-Up

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

3.13 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.

END OF SECTION

CONCRETE UNIT MASONRY

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 04 05 13 - Masonry Mortar and Grouting
- .2 Section 04 05 19 - Masonry Anchorage and Reinforcing
- .3 Section 04 05 23 - Masonry Accessories

1.3 Reference Standards

- .1 CSA Group (CSA):
 - .1 CAN/CSA-A165 Series-14(R2024), CSA Standards on Concrete Masonry Units
 - .2 CAN/CSA-A371-14, Masonry Construction for Buildings
 - .3 CSA S304-14, Design of Masonry Structures
- .2 National Research Council Canada (NRC):
 - .1 National Building Code of Canada 2020 (NBC)
- .3 ULC Standards (ULC):
 - .1 CAN/ULC-S101-07(R2010), Standard Methods of Fire Endurance Tests of Building Construction and Materials

1.4 Action and Informational Submittals

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

CONCRETE UNIT MASONRY

- .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 Quality Assurance

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 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.
 - .1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.
 - .2 Do not use brick tongs to move or handle masonry.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Do not double stack cubes of concrete unit masonry.
 - .3 Cover masonry units with non-staining waterproof membrane covering.
 - .4 Allow air circulation around units.
 - .5 Installation of wet or stained masonry units is prohibited.
 - .6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
 - .7 Store and protect concrete unit masonry from nicks, scratches, and blemishes.
 - .8 Replace defective or damaged materials with new.

CONCRETE UNIT MASONRY

2. PRODUCTS

2.1 Materials

- .1 Standard concrete block units Type: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
 - .1 Classification: H/15/C/M.
 - .2 Dimensions Nominal: 200 and/or 300 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide square units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.
 - .4 Colour: to be coordinated with client prior to purchase and installation.

2.2 Reinforcement

- .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.3 Connectors

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.4 Flashing

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

2.5 Mortar Mixes

- .1 Mortar and mortar mixes in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

2.6 Grout Mixes

- .1 Grout and grout mixes in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

2.7 Cleaning Compounds

- .1 Use low VOC products.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

CONCRETE UNIT MASONRY

2.8 Tolerances

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete unit masonry 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 Protect adjacent finished materials from damage due to masonry work.

3.3 Installation

- .1 Concrete block units:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .2 Special Shapes:
 - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.

CONCRETE UNIT MASONRY

- .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
- .3 End bearing: not less than 200 mm and/or as indicated on drawings.
- .4 Install special site cut shaped units.

3.4 Reinforcement

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.5 Connectors

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.6 Flashing

- .1 Install flashings: in accordance with Section 04 05 23 - Masonry Accessories.

3.7 Mortar Placement

- .1 Place mortar in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

3.8 Grout Placement

- .1 Place grout in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

3.9 Construction

- .1 Cull out masonry units, in accordance with CAN/CSA-A165 and approved range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .3 Construct masonry walls using running bond unless otherwise noted.
- .4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .6 Install movement joints and keep free of mortar where indicated.

CONCRETE UNIT MASONRY

- .7 Hollow Units: Spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .8 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .9 Tamp units firmly into place.
- .10 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .11 Tool exposed joints concave; strike concealed joints flush.
- .12 After mortar has achieved initial set up, tool joints.
- .13 Do not interrupt bond below or above openings.

3.10 Repair/Restoration

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.11 Site Quality Control

- .1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Consultant in accordance with CSA S304.1.
- .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.12 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Standard Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.13 Protection

CONCRETE UNIT MASONRY

- .1 Brace and protect concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION

MASONARY UNIT

1. General
- 1.1 RELATED SECTIONS
- .1 Custom metal fabrications:

.2 Rigid insulation:

.3 Metal flashings for roofing:

.4 Sealants:
- Section 05 50 00.

Section 07 21 13.

Section 07 62 00 and 07 62 10.

Section 07 92 00.
- 1.2 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION
- .1 Reinforcement supplied under Section 03 30 00.
- 1.3 REFERENCE DOCUMENTS
- .1 American Society for Testing and Materials (ASTM):

.1 ASTM A641/641M-09a

.2 ASTM A653M-09

.3 ASTM C140-09

.4 ASTM C426-07

Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

Sampling and Testing Concrete Masonry Units.

Linear Drying Shrinkage of Concrete Masonry Units.
- .2 Canadian Standards Association (CSA):

.1 CAN/CSA A82.1-M87 (R2003)

.2 CAN3-A82.8-M78(R2003)

.3 CSA A165 Series-04

.4 CSA A179-04

.5 CAN3-S304-M84 (R1997)

.6 CSA S304.1-04,

.7 CSA A371-04(R2009)

.8 CSA A370-04

.9 CAN/CSA-A3000-08

Burned Clay Brick (Solid Masonry Units Made From Clay or Shale)

Hollow Clay Brick.

CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3), Includes Update No. 1 (2006)

Mortar and Grout for Unit Masonry

Masonry Design For Buildings

Design of Masonry Structures

Masonry Construction for Buildings

Connectors for Masonry

Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005)
- .3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):

.1 SCAQMD Rule 1168-05

Adhesives and Sealants Applications.
- 1.4 ADMINISTRATIVE REQUIREMENTS
- .1 Coordination:
- .1 Coordinate lines, levels and coursing with work of other Sections.

MASONARY UNIT

- .2 Obtain built-in items prior to start of this work.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver masonry units on pallets, suitably protected from road grime and moisture absorption due to exposure to rain or melting snow.
- .2 Unload and store on dry, level areas.
- .3 Protect masonry materials from damage during all phases of delivery, storage and handling.

2. Products

2.1 CONCRETE MASONRY UNITS

- .1 Concrete Block Masonry Units: to CSA A165.1 and as follows:
 - .1 Classification: H/15/D/0.
 - .2 Method of Curing: Autoclave or low pressure steam curing is acceptable, provided that masonry units comply with linear shrinkage and moisture content requirements of CSA A165.1 for type M units at time of delivery to site. Notwithstanding the foregoing, age all units before delivery to site, as follows:
 - .1 Autoclaved units: minimum 7 days.
 - .2 Low pressure steam cured units: minimum 28 days.
 - .3 Sizes: as indicated on drawings.
 - .4 Special Shapes: Bond beam, lintel beam, corner and other shapes as required or indicated on drawings. Provide external corner units as a single unit, with required architectural face appearance on one side and one end.
 - .5 Face Textures, Finishes and Colours: Following types, as indicated on drawings:
 - .1 Smooth face, natural colour.

2.3 HORIZONTAL JOINT REINFORCEMENT

- .1 Reinforcement which will also function as masonry connectors:
 - .1 Conventional Continuous Welded Ties/Reinforcing: to CSA A370, in ladder or truss configuration.
- .2 Reinforcement:
 - .1 Steel Wire: to ASTM A641/A641M, hot dip galvanized.
 - .2 Continuous Welded Double Wire Welded Ladder or Truss Type: to CSA A370.
 - .3 Single Wire Type: 3.66 mm diameter.
- .3 For continuous welded ladder or truss type, provide:
 - .1 widths to suit wall widths, and
 - .2 prefabricated tee-shaped and 90° corner configurations for use at wall intersections and corners.

MASONARY UNIT

2.4 MASONRY CONNECTORS

- .1 Select any suitable conventional or non-conventional type as defined by CSA A370, and as follows:
 - .1 Corrosion Protection: level II.
 - .2 Maximum unsupported length of connectors in cavity shall not exceed that permitted by CSA A370 or recommended by connector manufacturer, whichever is the smaller dimension.
 - .3 Connectors selected shall accommodate differential vertical movement of 13 mm between masonry veneer and structural backup.

2.5 FASTENERS FOR MASONRY CONNECTORS

- .1 Design Criteria: capable, when installed in specified substrates, of meeting requirements of CSA A370.
- .2 Corrosion Resistance: to requirements of CSA A370.
- .3 Screws: steel, hex washer head, to suit substrate.
- .4 Inserts: drilled-in, compression type.
- .5 Nails: steel, spiral type, suitable for substrate.
- .6 Provide fastener types to listed substrate as follows:
 - .1 Steel Studs Screws
 - .2 Structural Steel Screws
 - .3 Masonry & Standard Aggregate Concrete Inserts or screws
 - .4 Concrete with light-weight aggregate Inserts with adhesive
 - .5 Wood studs Screws

2.6 ACCESSORIES

- .1 Control Joint Fillers: Preformed rubber, neoprene or polyvinylchloride, size and profile to suit intended application and as indicated on drawings.
- .2 Cavity Weeps/Vents: Preformed plastic 100 mm long.

2.7 MORTAR AND GROUT

- .1 Mortar: to CSA A179, property specifications, and as follows:
 - .1 All locations, Mortar Type N, Max' Compressive Strength 6MPa, Colour natural.
- .2 Mortar Colour Admixtures: Metallic oxide pigments. Colour will be selected by Consultant from manufacturer's standard range. Pigments shall not exceed 10-15% by weight of cement content.
- .3 Masonry cement is not permitted.
- .4 Grout: to CSA A179.

2.8 FLASHINGS

- .1 Modified Bitumen Base Flashing: SBS modified sheet membrane, minimum 1.0 mm thick self-adhering type.

MASONARY UNIT

- .2 Metal flashings as detailed on the drawings.

- 3. Execution

- 3.1 EXAMINATION

- .1 Examine work of other Sections upon which work of this Section is dependent. Should discrepancies be found which affect the proper performance of the work of this section, do not commence work until such discrepancies have been resolved.

- 3.2 COLD WEATHER REQUIREMENTS

- .1 For masonry work which will be done below 5°C, measure temperatures of masonry material prior to use; maintain temperatures as close as possible for mortar batches; ensure mortar temperature on mortar boards does not exceed 50°C; use dry masonry units; lay masonry on unfrozen surfaces free from snow and ice; use windbreaks when laying masonry not protected by enclosures; provide a high-low registering thermometer where directed on site.
 - .2 When mean air temperature will, over a 24 hour period, go below 5°C but not below 0°C, conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C. Protect entire constructed masonry by enclosing within weatherproof membrane for 48 hours.
 - .3 When mean air temperature will, over a 24 hour period, go below 0°C but not below -4°C, conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C and maintain temperature of mortar boards above 0°C. Protect entire constructed masonry by enclosing within weatherproof membrane for 48 hours.
 - .4 When mean air temperature is below -4°C, conduct laying of masonry in enclosures heated to maintain air temperature above 0°C. Conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C and heat units if necessary so that temperature of units at time of laying is minimum -7°C. Maintain enclosure in position for 48 hours and maintain air temperature within enclosure at minimum 0°C.

- 3.3 MIXING MORTAR

- .1 Mix mortar in accordance with CSA A179, using maximum amount of water consistent with workability.
 - .2 Provide gauging equipment and ensure that shovel count is accurate.
 - .3 Use mechanical mixer of one sack minimum capacity for large batches, mechanically mixing for not less than 3 minutes and not more than 5 minutes. Hand mixing may be used for small batches.
 - .4 Re-temper mortar to replace water lost by evaporation.
 - .5 Use and place mortar in final position within 2 hours after mixing.
 - .6 For coloured mortar, mix coloured pigment with 10% to 15% dry cement by weight. Do not use same mixer for regular and coloured mortar.

MASONARY UNIT

3.4 PLACING OF MASONRY, GENERALLY

- .1 Meet or exceed requirements of CSA A371.
- .2 Where mortar has started to harden at units requiring repositioning, remove and replace with fresh mortar.
- .3 Construct cavity walls using techniques that will minimize mortar dropping in cavity space. This may require the use of batten boards to catch mortar droppings. No mortar shall bridge cavity space or plug cavity vents at bottom of cavity.

3.5 PLACING CLAY BRICK MASONRY UNITS

- .1 Except when outdoor temperature within 24 hours of placing is less than 5°C, and if IRA (Initial Rate of Absorption) exceeds 1.55 g/min/1000 mm², dampen clay brick 3 to 24 hours before installation. Do not saturate. Do not lay until surface is dry.

3.6 PLACING CONCRETE MASONRY UNITS

- .1 Do not wet concrete masonry units prior to installation. Cut with dry blade saws.
- .2 Place units in face shell mortar bedding for running bond and full mortar bedding for horizontal stacking bond.
- .3 Remove excess mortar from cores intended for grouting. Puddle or vibrate grout to completely fill cores.

3.7 BONDS AND PATTERNS

- .1 Except where otherwise indicated on drawings, lay up all masonry in running bond.

3.8 JOINTING

- .1 Tool mortar joints to a dense, smooth surface, after thumbprint hard.
- .2 Except where otherwise indicated on drawings, provide following joint types at specified locations:
 - .1 Exterior brick masonry - Concave

3.9 INSTALLATION OF REINFORCEMENT

- .1 Install reinforcement in accordance with CSA 371 and as indicated on drawings.
- .2 Place horizontal joint reinforcement in accordance with CSA 371, and as follows:
 - .1 Place in first and second mortar joints above and below openings. Extend reinforcement minimum 600 mm past openings.
 - .2 Place in first and second mortar joints below tops of walls.
- .3 Stop horizontal reinforcement on each side of control joints.

MASONARY UNIT

3.10 INSTALLATION OF MASONRY CONNECTORS

- .1 Install masonry connectors in accordance with CSA A370.
- .2 Comply with fastener manufacturer's recommendations for edge distance in applicable substrates. Do not fasten into mortar joints of masonry backup.
- .3 Install top row of masonry connectors not more than one-half of typical tie spacing below top of veneer panels.
- .4 Ensure that connectors installed over or through sheathing are adequately fastened to studs or other structural framing.

3.11 INSTALLATION OF FLASHING

- .1 Install flashing under exterior masonry walls and as indicated on drawings.
- .2 Extend flashings through brick veneer, turn up minimum 200 mm on back-up substrate.
- .3 Secure butyl rubber flashing to back-up substrate with adhesive as detailed on drawings.
- .4 Lap joints 150 mm and seal with adhesive.

3.12 INSTALLATION OF ACCESSORIES

- .1 Control Joints: install continuous control joint fillers as indicated on drawings.
- .2 Cavity Vents:
 - .1 Install vents in vertical joints immediately over flashing and near tops of walls, in exterior wythes of cavity wall construction at 600 mm o.c. horizontally.
 - .2 Do not install vent tubes in control or expansion joints. Refer to Section 07 92 00 for venting of control and expansion joints.

3.13 BUILT-IN WORK

- .1 Build-in all door and window frames, steel lintels, anchors and bolts, and any other items to be built into masonry.

3.14 CUTTING AND FITTING

- .1 Fit and cut chases for piping, conduits, ducts, and sleeves. Install grounds, blocking, inserts, etc., as required.
- .2 Do all cutting, fitting, drilling, patching and making good for other trades.
- .3 Obtain the Consultant's approval before cutting any part which may impair appearance or strength of the work.

3.15 CLEANING

- .1 Clean off excess mortar and smears.
- .2 Clean and wash masonry surfaces with masonry manufacturer's approved solution using only fibre brushes.

END OF SECTION

MASONARY UNIT

DIVISION 05 - METALS

STRUCTURAL STEEL FOR BUILDINGS

1. GENERAL

1.1 General Requirements

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

1.2 Related Requirements

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

1.3 Reference Standards

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

STRUCTURAL STEEL FOR BUILDINGS

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

1.4 Action and Informational Submittals

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

STRUCTURAL STEEL FOR BUILDINGS

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

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

STEEL JOIST FRAMING

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 31 00 – Steel Decking
- .2 Section 09 91 23 - Interior Painting

1.3 Reference Standards

- .1 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
 - .1 CISC/CPMA 2-75-[1975], Quick-Drying, Primer for Use on Structural Steel
 - .2 CISC/CPMA 1-73a-[1975], Quick-Drying, One-Coat Paint for Use on Structural Steel
- .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 CSA S16-1], Design of Steel Structures
 - .3 CSA S136-16, North American Specification for the Design of Cold Formed Steel Structural Members
 - .4 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel
 - .5 CSA W55.3-08(2018), Certificate of Companies for Resistance Welding of Steel and Aluminum

STEEL JOIST FRAMING

- .6 CSA W59-18, Welded Steel Construction (Metal Arc Welding) [Metric]
- .3 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual-[current edition]

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 steel joist framing 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 the province of the Work.
 - .2 Indicate on erection drawings, relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.
 - .3 Indicate particulars, on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.
- .4 Delegated Design Submittals:
 - .1 Submit copies of calculations and joist design drawings for typical joists to Consultant for review minimum 4 weeks before fabrication and delivery.

1.5 Quality Assurance

- .1 Submit copies of mill test reports minimum 4 weeks before fabrication of steel joists and accessories. Reports to show:
 - .1 Chemical and physical properties.
 - .2 Other details of steel incorporated into work.
 - .3 Certification by qualified metallurgists confirming that tests conform to requirements of CSA G40.20/G40.21

STEEL JOIST FRAMING

- .2 Submit affidavit prepared by fabricator of structural steel joists stating materials and products used in fabrication conform to this specification.

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.

1.7 Site Conditions

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

2. PRODUCTS

2.1 Design Criteria

- .1 Design steel joists and bridging to carry loads indicated in joist schedule shown on drawings to CSA S16.
- .2 Design joists and anchorages for uplift forces as indicated.
- .3 Manufacture joists to consider load effects due to fabrication, erection and handling.
- .4 Limit roof joist deflection due to specified live load to 1/360 maximum of span and deflection due to specified total load to 1/240 maximum of span.

2.2 Materials

- .1 Open web steel joists: to CSA S16.
- .2 Structural steel: to CSA G40.20/G40.21.
- .3 Welding materials: to CSA W59
- .4 Shop paint primer: to [MPI - INT 5.1A] [MPI - INT 5.1B] [CISC/CPMA-1] [CISC/CPMA-2].

STEEL JOIST FRAMING

- .5 Shear studs: to CSA W59, Appendix H

2.3 Fabrication

- .1 Fabricate steel joists and accessories as indicated in accordance with CSA S16 and in accordance with reviewed shop drawings.
- .2 Weld in accordance with CSA W59
- .3 Provide diagonal and horizontal bridgings and anchorages as indicated.

2.4 Shop Painting

- .1 Clean, prepare and shop prime surfaces of steel joists to CSA S16 and SSPC SP6.
- .2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP1 brush blast.
- .3 Apply one coat of CISC/CPMA 2 primer to steel surfaces to achieve dry film thickness of .065 mm to .080 mm maximum except:
 - .1 Surfaces encased in concrete.
 - .2 Surfaces to receive site installed stud shear connectors and steel decks.
 - .3 Surfaces and edges site welded.
 - .4 Faying surfaces of friction-type connections.
 - .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures minimum 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint thoroughly dry.
- .6 Strip paint bolts, nuts, sharp edges and corners before prime coat dries.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for steel joist framing installation in accordance with manufacturer's written instructions.

STEEL JOIST FRAMING

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultan] 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 Consultan].

3.2 Erection

- .1 Do structural steel work: to CSA S16.
- .2 Do welding: in accordance with CSA W59
- .3 Ensure installers certified to CSA W47.1 for fusion welding
- .4 Submit certification welded joints qualified by Canadian Welding Bureau.
- .5 Erect steel joists and bridging as indicated to CSA S16 and in accordance reviewed erection drawings.
- .6 Complete installation of bridging and anchorages before placing construction loads on joists.
- .7 Site cutting or altering joists or bridging not shown on shop drawings: to approval of Consultant.
- .8 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

3.3 Site Quality Control

- .1 Inspection and testing of materials and work carried out by testing laboratory designated by Consultant.
- .2 Testing laboratory to inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory to also monitor test loading of joists used by manufacturer to verify design and check representative site connections. Consultant will determine extent of and identify inspections.
- .3 Submit test report to Consultant within 3 days after completion of inspection.
- .4 Owner will pay costs of tests as specified in Section 01 29 83 - Payment Procedures: Testing Laboratory Services.
- .5 Test shear studs to CSA W59

3.4 Site Painting

STEEL JOIST FRAMING

- .1 Paint: in accordance with Section 09 91 23 - Interior Painting.
- .2 Touch up damaged surfaces and surfaces without shop coat with MPI - INT 5.1B and CISC/CPMA-2 in accordance with manufacturers' recommendations.

3.5 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.

3.6 Protection

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

END OF SECTION

STEEL DECKING

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 12 23 – Structural Steel for Buildings
- .2 Section 05 21 00 – Steel Joist Framing

1.3 Reference Standards

- .1 ASTM International (ASTM):
 - .1 ASTM A653/A653M- [18], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A780-01 Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
 - .3 ASTM A792/A792M-10 [(2015)], Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .2 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 10M-[13], Standard for Steel Roof Deck
 - .2 CSSBI 12M-[15], Standard for Composite Steel Deck
- .3 CSA Group (CSA):
 - .1 CSA S16-19, Design of Steel Structures
 - .2 CSA S136-16, North American Specification for the Design of Cold Formed Steel Structural Members including Update No. 1 (2014), Update No. 2. (2014), Update No. 3 (2015)

STEEL DECKING

- .3 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel Structures
- .4 CSA W59-18, Welded Steel Construction, (Metal Arc Welding) including Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015)

1.4 Design Requirements

- .1 Design steel deck to CSA S136 and CSSBI.
- .2 Design roof steel deck to CSA S16, CSA S136, and CSSBI.
- .3 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.
- .4 Deflection under specified live load maximum 1/240 of span, except when gypsum board ceilings hung directly from deck, live load deflection maximum 1/360 of span.

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, printed product literature and data sheets for steel decking 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 province of the Work.
 - .2 Submit design calculations if requested by Consultant.
 - .3 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.
 - .4 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of decks.

1.6 Quality Assurance

STEEL DECKING

1.7 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 decking from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

- .1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather.
- .2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.
- .3 Closures: in accordance with manufacturer's recommendations.
- .4 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm minimum. Metallic coating same as deck material.
- .5 Primer: to section 09 91 23 - Interior Painting.
 - .1 VOC limit 250 g/L maximum.

2.2 Types of Decking

- .1 Steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, non-cellular, interlocking side laps.

3. EXECUTION

3.1 Examination

STEEL DECKING

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for steel decking 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 after unacceptable conditions remedied and after receipt of written approval to proceed from Consultant.

3.2 Preparation

- .1 Locate bundles of deck materials to prevent overloading of supporting members.
- .2 Install temporary shoring before placing deck panels, if required to meet deflection limitations.

3.3 Erection

- .1 Structural steel work: in accordance with CSA S136 and CSSBI.
- .2 Welding: in accordance with CSA W59, except where specified otherwise
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel.
- .4 Erect steel deck as indicated and in accordance with CSA S136 and CSSBI and in accordance with reviewed erection drawings.
- .5 Lap ends: to [50] mm minimum.
- .6 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59
- .7 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.
- .8 Openings and Areas of Concentrated Loads
 - .1 No reinforcement required for openings cut in deck maximum 150 mm square.
 - .2 Frame deck openings with dimension between 150 to 300 mm or as recommended by manufacturer, except as otherwise indicated.

STEEL DECKING

- .3 For deck openings with dimension minimum 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.
 - .9 Connections: Install connections in accordance with CSSBI recommendations as indicated
- 3.4 Site Touch-Up Painting**
 - .1 Upon erection completion, mechanically brush clean bolts, rivets, welds, and burned or scratched surfaces.
 - .2 For galvanized steel surface with damage and without shop coat, repair with site touch up primer.
- 3.5 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.
- 3.6 Protection**
 - .1 Protect installed products and components from damage during construction.
 - .2 Repair damage to adjacent materials caused by steel decking installation.

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

**DIVISION 07 - THERMAL AND MOISTURE
PROECTION**

Part 1	General
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.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 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 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 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. Install insulation during dry weather conditions.

RIGID BOARD INSULATION

Part 2	Products
2.1	INSULATION
.1	Vertical below grade: Polystyrene, Type 4: to CAN/ULC-S701. Thickness indicated on drawings.
2.2	BOARD DIMENSIONS AND SHAPE
.1	Minimum Width: 400 mm.
.2	Minimum Length: 1200 mm.
.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).

RIGID BOARD INSULATION

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:
 - .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

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.

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

- .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:

- .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.

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

- .2 SPRAY APPLIED POLYURETHANE FOAM
- .1 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) |
- .2 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.

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

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.

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.

SPRAY APPLIED POLYURETHANE FOAM AIR SEAL

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 BITUMINOUS 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

MODIFIED BITUMINOUS MEMBRANE ROOFING

- .3 CSA-A123.23 (R2020) - Product Specification for Polymer-Modified Bitumen Sheet, Prefabricated and Reinforced
- .6 Underwriters Laboratories of Canada
- .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:

MODIFIED BITUMINOUS MEMBRANE ROOFING

- .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 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:

MODIFIED BITUMINOUS MEMBRANE ROOFING

- .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:
 - .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

MODIFIED BITUMINOUS MEMBRANE ROOFING

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.

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 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.

MODIFIED BITUMINOUS MEMBRANE ROOFING

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 Trades-person 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.
 - .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

MODIFIED BITUMINOUS MEMBRANE ROOFING

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.
- .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 FLASHINGS 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.

METAL FLASHINGS FOR BITUMINOUS MEMBRANE ROOFING

- .5 Flashing Nails: #12 hot dipped zinc coated, annular ringed.
- .6 Sheet Metal Screws: Cadmium plated, self-tapping, pan head.
- .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.

METAL FLASHINGS FOR BITUMINOUS MEMBRANE ROOFING

- .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.
- .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.

METAL FLASHINGS FOR BITUMINOUS MEMBRANE ROOFING

- .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.
 - .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 GOOD

Part 1 General

1.1 REFERENCE DOCUMENTS

- .1 Alberta Roofing Contractor's Association (ARCA):\ul style="list-style-type: none;"> - .1 Roofing Applications Standard Manual
- .2 Aluminum Association (AA):\ul style="list-style-type: none;">- .1 AA-C22-A41 Anodized Clear Coatings
- .2 AA-C22-A42 Integral Colour Coatings
- .3 American Society for Testing and Materials (ASTM):\ul style="list-style-type: none;">- .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):\ul style="list-style-type: none;">- .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:\ul style="list-style-type: none;">- .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 GOOD

- .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 GOOD

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:

FIRESTOPPING

- .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.

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.

FIRESTOPPING

- .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.

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, outsized 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, outsized 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.

JOINT SEALANTS

- .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.
- .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.

JOINT SEALANTS

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

END OF SECTION

DIVISION 09 - FINISHES

GYPSUM BOARD

Part 1 General

1.1 REFERENCE DOCUMENT

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

GYPSUM BOARD

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.
 - .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.

GYPSUM BOARD

- .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.
- .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.

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- .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.
- .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.

GYPSUM BOARD

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.

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.

GYPSUM BOARD

- .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.
- .5 Locate vertical joints at least 300 mm from jamb lines of doors, windows and other openings.

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- .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.

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- .7 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surfaces of boards and panels.
- .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) 4090 Graveley St. Burnaby, BC V5C 3T6 tel: 888-674-8937 toll free fax: 888-211-8708 toll free www.paintinfo.com	OR	Alberta Painting Contractors Association 2725 - 12th Street N.E. Calgary, AB T2E 7J2 Tel: 403-250-0903 Fax: 403-291-9562
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- .5 South Coast Air Quality Management District ([SCAQMD](#)), California State
- .1 SCAQMD Rule 1113, January 2004 - Architectural Coatings

PAINTING AND FINISHING – GENERAL REQUIREMENTS

1.2 SUBMITTALS

.1 Product Data:

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

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:

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .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.
 - .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.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .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.
 - .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.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

- .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, splashing, 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.
 - .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

PAINTING AND FINISHING – GENERAL REQUIREMENTS

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.

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.

PAINTING AND FINISHING – GENERAL REQUIREMENTS

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

PAINTING AND FINISHING – GENERAL REQUIREMENTS

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 4.2 – CONCRETE MASONRY UNITS (Exterior Finish)			
EXT 4.2D	Elastomeric		Elastomeric Coating, Apply in strict accordance with manufacturer's instructions.

END OF SECTION

INTERIOR PAINTING AND FINSHING

- 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

INTERIOR PAINTING AND FINSHING

RIN 9.2 – PLASTER AND GYPSUM BOARD

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

END OF SECTION

DIVISION 26 - ELECTRICAL

BASIC ELECTRICAL REQUIREMENTS

1. REGULATORY REQUIREMENTS

- .1 Comply with Safety Codes Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code.
- .2 Unless otherwise indicated, all references to "Canadian Electrical Code" or "CEC" shall mean the edition of the Canadian Electrical Code, Part I, CSA C22.1, and the variations made thereto by Alberta regulation, which are in force on the date of bid closing for the Contract.
- .3 All electrical products shall be tested, certified and labeled in accordance with a certification program accredited by the Standards Council of Canada. Where a product is not so labeled, provide written approval by the authority having jurisdiction.
- .4 Submit to authority having jurisdiction and Utility Company, necessary number of drawings and specifications for examination and approval prior to commencement of electrical work. Pay associated fees.
- .5 Submit to Owner, copy of electrical permit obtained from authority having jurisdiction.
- .6 If authority having jurisdiction conducts an electrical inspection, submit copy of certificate of acceptance provided by authority having jurisdiction.

2. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples, as specified, indicating details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment and materials.

3. OPERATION AND MAINTENANCE DATA

- .1 Provide the following for all systems and components:
 - .1 Manufacturer's product data, including performance curves and schematic and wiring diagrams for all electrical control systems.
 - .2 Manufacturer's installation instructions.
 - .3 Manufacturer's operation instructions.
 - .4 Manufacturer's maintenance instructions, including complete parts list for all serviceable components.
- .2 Provide a comprehensive list of Subcontractors, Sub-subcontractors and suppliers who supplied and installed systems and components.
- .3 Provide copies of all inspection certification reports from authorities having jurisdiction.

BASIC ELECTRICAL REQUIREMENTS

4. RECORD DRAWINGS

- .1 Record actual locations of all pull boxes, panelboards, luminaires, feeders, electrical equipment and electrical site services.
- .2 Record any changes to circuit designations.
- .3 Indicate on record drawings exact dimensioned locations of buried services and embedded or concealed conduits in floors and masonry walls. Obtain acceptance of this information by Engineer before commencing backfilling or concrete placement.
- .4 Include on record drawings all revisions due to engineering change orders, site alterations, additions and field ordered changes made during construction.

5. COORDINATION

- .1 Coordinate work specified in Division 26 with work specified in other Divisions. Ensure that proper arrangements and provisions are made for work specified in Division 26.

6. SOURCE OF SUPPLY

- .1 All like materials shall be by a single manufacturer.

7. REFERENCE STANDARDS

- .1 Comply with standards of following organizations:
 - .1 Electrical and Electronic Equipment Manufacturers Association of Canada (EEMAC).
 - .2 Institute of Electrical and Electronic Engineers (IEEE).

8. PRODUCT OPTIONS AND SUBSTITUTIONS

- .1 Product Options
 - .1 For products specified by Non–proprietary Specification:
 - .1 Select any product by any manufacturer that meets the requirements of the Contract Documents.
 - .2 For products specified by Proprietary Specification:
 - .1 Select any product or manufacturer named; or
 - .2 Select a substitute product or manufacturer in accordance with substitutions.

BASIC ELECTRICAL REQUIREMENTS

- .3 For products specified by Proprietary Specification and accompanied by words indicating that substitutions will not be accepted:
 - .1 Select any product or manufacturer named; Substitutions will not be permitted.
- .2 Substitutions
 - .1 Where Substitute Products are permitted, unnamed products will be authorized by the Owner, subject to the following:
 - .1 Substitute Products shall be the same types as, be capable of performing the same functions as, and meet or exceed the standards of quality and performance of the named product(s). Substitute Products shall not require revisions to the Contract Documents nor to work of Other Contractors.
 - .2 Do not order or install Substitutions without the Owner's authorization.
 - .3 If, in the Owner's opinion, a Substitution does not meet the requirements of the Contract Documents, provide a product that, in the Owner's opinion, does meet the requirements of the Contract Documents.
- .3 Changes to Authorized Products and Manufacturers
 - .1 Do not change products or manufacturers, authorized by the Owner for use in performance of the Work, without the Owner's written authorization.

9. DISCONNECTS

- .1 Disconnects: to CAN/CSA C22.2 No.4-M89, heavy duty, lockable, non-fused, with poles, voltage, amperage, kw ratings and enclosures as indicated on drawings and required by CEC to suit application.

10. SUPPORTING DEVICES

- .1 Provide metal brackets, frames, clamps, channels, straps and related devices to adequately support weight of equipment and raceways.

BASIC ELECTRICAL REQUIREMENTS

11. TESTING

- .1 Prior to energizing any portion of the electrical system, perform megger tests on all parts of the distribution system. Results shall meet the requirements of the CEC, authority having jurisdiction and the Contract Documents.

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

CONDUIT

1. GENERAL

1.1 COORDINATION

- .1 Coordinate with other work including wire and cable, boxes and fittings and panel work, as necessary to interface installation of conduit with other work.
- .2 Coordinate installation of conduit in concrete with concrete work specified other Divisions.
- .3 Coordinate installation of conduit which penetrates fire rated walls, floors and ceilings with firestopping work specified in other Divisions. Ensure that integrity of the fire rated element is maintained.

2. PRODUCTS

2.1 CONDUIT, GENERAL

- .1 Except where otherwise required by Canadian Electrical Code (CEC), provide conduit of types specified in Conduit Installation Schedule and sizes indicated on drawings or specified.
- .2 Conduit embedded in concrete floors shall be maximum 50 mm size.
- .3 Where sizes are not indicated, select proper sizes to suit intended use, fulfill wiring requirements, and comply with Canadian Electrical Code (CEC).

2.2 METAL CONDUIT AND TUBING

- .1 Rigid Metal Conduit: to CSA C22.2 No. 45-M1981, and as follows:
 - .1 Galvanized Rigid Steel Conduit: zinc coated steel.
 - .2 Fittings: same material as conduit.
- .2 Flexible Metal Conduit: to CSA C22.2 No. 56-1977, and as follows:
 - .1 Liquid-Tight Flexible Metal Conduit: continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 12 mm diameter.
 - .2 Liquid-Tight Flexible Metal Conduit Fittings: cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.
- .3 Miscellaneous Fittings: locknuts, bushings, reducers, chase nipples, 3 piece unions, split couplings, plugs, and expansion fittings specifically designed for their particular application.

2.3 NON-METALLIC CONDUIT

- .1 Rigid PVC (Unplasticized) Conduit: to CSA C22.2 No. 211.2-M1984

CONDUIT

3. EXECUTION

3.1 INSTALLATION OF CONDUIT, GENERAL

- .1 For existing building and new pre-fabricated buildings, conduit shall be surface mounted on walls and ceilings.
- .2 Conduit system shall be weatherproof in areas with process piping.
- .3 EMT with raintight fittings will be allowed where it is not subject to mechanical injury such as along walls and above 1200 mm from walkway surface. Where a conduit may be stepped on or bumped during typical operation and maintenance, rigid metal conduit shall be used.
- .4 Conduit shall be rigid pipe with proper support. The final 500 mm conduit connection into field instruments and equipment shall be liquid tight flexible metal. This is to allow easy disconnection and replacement of the device when required.
- .5 Plug conduit ends to prevent entry of dirt and moisture.
- .6 Seal conduit with duct seal compound or fiberglass where conduit leaves heated area and enters unheated area.
- .7 Provide necessary flashing and pitchpockets, making watertight joints where conduit passes through roof or waterproofing membranes.
- .8 Where conduit crosses building expansion joints, install expansion fitting approved by authority having jurisdiction, complete with grounding jumper. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.

3.2 INSTALLATION OF RIGID METAL CONDUIT

- .1 Cut conduit straight, properly ream, cut threads and brush threads clean.
- .2 Fasten conduit terminations in sheet metal enclosures with two locknuts and terminate with bushing. Install locknuts inside and outside enclosure.
- .3 Conduit installed underground shall be painted with two coats of corrosion inhibiting compound before backfilling.

3.3 INSTALLATION OF LIQUID TIGHT FLEXIBLE METAL CONDUIT

- .1 Liquid tight conduit is only to be installed for the final connection to instruments and equipment.
- .2 The length of liquid tight conduit shall be limited to two meters unless otherwise noted in the specifications or drawings.

CONDUIT

3.4 INSTALLATION OF NON-METALLIC CONDUIT

- .1 Make field bends and solvent cemented joints in accordance with manufacturer's instructions.

3.5 INSTALLATION OF EXPOSED AND SEMI-CONCEALED CONDUIT

- .1 Comply with the following when installing conduit exposed in service areas, unfinished areas, finished areas, and in accessible spaces behind ceilings, walls and floors:
 - .1 Install conduit to conserve headroom and cause minimum interference in spaces through which conduit passes.
 - .2 Install conduit so as not to interfere with ceiling inserts, luminaires or ventilation ducts or outlets.
 - .3 Alter routing to avoid structural obstructions, keeping crossovers to a minimum.
 - .4 Install exposed conduit and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls and structural members.
 - .5 Run conduit for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

3.6 INSTALLATION OF CONDUIT IN CONCRETE SLABS

- .1 Place conduit between bottom reinforcing steel and top reinforcing steel.
- .2 Separate conduit by not less than diameter of largest conduit to ensure proper concrete bond.
- .3 Ensure minimum 20 mm concrete cover.

END OF SECTION

BOXES AND FITTINGS

1. GENERAL

1.1 COORDINATION

- .1 Coordinate with other divisions for placement of boxes.

2. PRODUCTS

2.1 METAL OUTLET BOXES

- .1 Outlet boxes: to CAN/CSA-C22.2 No. 18-92 and as follows:
 - .1 Sheet Steel Boxes: pressed sheet steel, galvanized, blanked for conduit, integral locating lugs.
 - .2 Cast Boxes: corrosion resistant cast aluminum, factory threaded hubs, weatherproof.

2.2 NON-METALLIC OUTLET BOXES

- .1 Outlet boxes: to CAN/CSA-C22.2 No. 85-M89 and as follows:
 - .1 Same as sheet steel boxes, except of rigid PVC material.

2.3 PULL AND JUNCTION BOXES

- .1 Surface mounted pull and junction boxes: to CSA C22.2 No. 40-M1989 and as follows:
 - .1 Type: NEMA 4
 - .2 Material: 14 gauge steel, continuously welded seams ground smooth
 - .3 Covers: screw-on, closed cell, oil resistant neoprene gasket, stainless steel screws and clamps on four sides of cover to assure water tight seal.
 - .4 Barriers: where indicated and required
- .2 Recessed pull and junction boxes or surface mounted boxes in areas above 3000AFF: to CSA C22.2 No. 40-M1989 and as follows:
 - .1 Material: sheet steel
 - .2 Covers: screw-on
 - .3 Barriers: where indicated

BOXES AND FITTINGS

2.4 BUSHINGS, KNOCKOUT CLOSURES, AND LOCKNUTS

- .1 Bushings, Knockout Closures and Locknuts: to CAN/CSA-C22.2 No. 18-92, corrosion resistant.

2.5 AIR/VAPOUR HATS

- .1 Air/vapour Hats: polyethylene, minimum 0.40 mm thick, with minimum 25 mm wide flanges, designed to be installed over electrical boxes and provide an effective air/vapour seal.

3. EXECUTION

3.1 OUTLET BOX INSTALLATION

- .1 Provide boxes where indicated and as required for:
 - .1 Splices.
 - .2 Taps.
 - .3 Wire pulling.
 - .4 Equipment.
 - .5 Device location.
- .2 Install boxes flush mounted where applicable.
- .3 Except where otherwise indicated, install boxes for vertical mounting of devices.
- .4 Support boxes independent from conduit.
- .5 Use metal outlet boxes, except in following locations where non-metallic outlet boxes shall be used:
 - .1 Where subject to moisture or corrosive material.

3.2 LOCATION OF WALL OUTLET BOXES

- .1 Outlets are indicated on drawings schematically. Consider locations indicated as approximate. Verify locations prior to rough in.
- .2 Confirm size and location of equipment supplied and installed under other Sections, prior to rough in.
- .3 Do not install boxes back to back. Allow minimum:
 - .1 150 mm separation in conventional walls.
 - .2 600 mm separation in acoustic rated walls.

BOXES AND FITTINGS

- .4 Position boxes in masonry walls to suit masonry course lines.
- .5 Except where otherwise indicated, mount boxes at following heights:
 - .1 Local switches: 1200 mm
 - .2 Receptacles:
 - .1 General: 300 mm
 - .2 Above counters: 150 mm
 - .3 Above baseboard heaters: 200 mm
 - .4 Utility rooms: 1200 mm
 - .3 Telephone/data outlets:
 - .1 General 300 mm
 - .2 Beside local receptacle box
 - .3 Wall Mounted Speakers 2500 mm
 - .4 Fire Alarm:
 - .1 Pull Stations 1400 mm
 - .2 Bells/Horns/Strobes/Combinations 2500 mm
 - .5 Local Emergency Battery Receptacle: 2400 mm
- .6 Measure mounting height from finished floor to center line of device.
- .7 Owners representative reserves the right to change location of outlets prior to installation with no change in Contract Price, provided that distance does not exceed 3 m from originally indicated location.

3.3 PULL AND JUNCTION BOX INSTALLATION

- .1 Locate above accessible ceilings and in unfinished areas.
- .2 Locate so as to minimize need for access doors.
- .3 Support boxes independent from conduit.

3.4 AIR/VAPOUR HAT INSTALLATION

- .1 Install air/vapor hats around electrical boxes located in walls and ceilings.

END OF SECTION

CABLE TRAY, RACEWAY, WIREWAYS

1. GENERAL

1.1 COORDINATION

- .1 Coordinate with other work, including wire and cable, boxes and fittings and panel work, as necessary to interface installation of electrical raceways and components with other work.
- .2 Coordinate installation of cable trays which pass through fire rated walls, floors or ceilings with fire stopping work.

1.2 WORK INCLUDED

- .1 Design, supply and install cable tray arrangements and support fittings necessary to complete service wiring of equipment supplied by the contractor.

2. PRODUCTS

2.1 RACEWAYS, GENERAL

- .1 Provide raceways of types and sizes required to handle the cable capacity with 40% spare capacity.
- .2 Where not indicated, select proper types and sizes to fulfill wiring requirements and comply with Canadian Electrical Code.

2.2 CABLE TRAYS

- .1 Cable trays and fittings: to CSA C22.2 No. 126-M91 and EEMAC-F5-1, and as follows:
 - .1 Type: Ladder with 225mm (9") rung spacing and 150mm (6") side rails.
 - .2 CSA class: D1
 - .3 Size: Sized to handle cable capacity with 40% spare.
 - .4 Material: Aluminum.
 - .5 Accessories and fittings: Horizontal elbows, end plates, dropouts, vertical risers and drops, tees, wyes, expansion joints and reducers, manufactured for cable tray supplied.
 - .6 Radii on Fittings: Minimum 300 mm.

CABLE TRAY, RACEWAY, WIREWAYS

2.3 WIREWAYS

- .1 Wire ways, Auxiliary Gutters and Associated Fittings: to CSA C22.2 No. 26-1952 and as follows:
 - .1 Material: Sheet steel.
 - .2 Accessories: Elbows, tees, couplings, and hanger fittings manufactured for wire way supplied.

3. EXECUTION

3.1 INSTALLATION OF CABLE TRAYS

- .1 Support cable trays with quantity of hangers, clips, support channels at all bends and tee fittings to satisfactorily carry the loads and forces encountered: CSA standard require couplers to be not located farther from support than one-quarter of the span length. Recommend support is every 3 meters.
- .2 Provide cable tray grounding as to the Canadian Electrical Code. Effective grounding must be permanent and continuous, and have ample capacity to conduct any currents liable to be imposed on it.

END OF SECTION

ELECTRICAL IDENTIFICATION

1. GENERAL

1.1 RELATED SECTIONS

- .1 Not Applicable

2. PRODUCTS

2.1 IDENTIFICATION MATERIALS

- .1 Lamacoid Nameplates: 3 mm thick plastic engraving sheet, black face, white core, mechanically attached, sizes as follows:
 - .1 Size 1: 12 mm high with 5 mm high letters.
 - .2 Size 2: 20 mm high with 8 mm high letters.
 - .3 Size 3: 25 mm high with 12 mm high letters.
- .2 Wire Identification Materials: Use only the following:
 - .1 Machine printed heat shrink sleeves.
- .3 Colour Banding Tape: Adhesive backed plastic tape, integrally coloured.

3. EXECUTION

3.1 COLOUR IDENTIFICATION OF EQUIPMENT

- .1 Electrical equipment shall be prefinished in coded colours designating voltage or system, as indicated in Equipment Identification Schedule.
- .2 Voltage colour identification for line voltage equipment shall be as follows:

Voltage	Colour
.1 120/208 V or 120/240 V:	Grey
.2 347/600 V:	Grey
- .3 In addition to color identification of line voltage as stated in items 1&2, line voltage equipment with voltage greater than 300 volts (line to line) may be identified via clearly visible lamacoid (size 3).

3.2 NAMEPLATE IDENTIFICATION OF EQUIPMENT

- .1 Identify equipment with lamacoid nameplates, as indicated in Equipment Identification Schedule.

ELECTRICAL IDENTIFICATION

3.3 PANELBOARD DIRECTORIES

- .1 Identify loads controlled by each overcurrent protective device in each panelboard, by means of a typewritten panelboard directory.

3.4 COLOUR IDENTIFICATION OF WIRING

- .1 Identify No. 2 AWG wiring and smaller by continuous insulation colour.
- .2 Identify wiring larger than No. 2 AWG by continuous insulation colour or by colour banding tape applied at each end and at splices.
- .3 Colour coding shall be in accordance with Canadian Electrical Code, and as follows:

Voltage

Colour

- | | | |
|----|----------------------|---|
| .1 | 120/208 V, 3 phase: | Red, black and blue. |
| .2 | 120/208 V emergency: | Red, black and blue with yellow tracer. |
| .3 | 347/600 V 3 phase: | Orange, brown and yellow. |
| .4 | 347/600 V emergency: | Orange, brown and yellow with red tracer. |
- .4 Where multi-conductor cables are used, use same colour coding system for identification of wiring throughout each system.
 - .5 Maintain phase sequence and colour coding throughout each system.

3.5 COLOUR IDENTIFICATION OF WIRING

	Equipment	Size
.1	MCCs	3
.2	All compartments on MCCs	2
.3	HOA switches	1
.4	Thermostats and Dehumidstats	1
.5	All equipment and instruments, smaller than 300 mm X 300 mm X 300 mm, listed in Section 40 91 00 and P&I drawings.	1
.6	All instruments and equipment, greater than 300 mm X 300 mm X 300 mm, listed in Section 40 91 00 and P&I drawings.	2
.7	All HVAC equipment	3
.8	All Electrical Panels	2
.9	Junction boxes over 100 mm X 100 mm	1

END OF SECTION

ELECTRICAL STARTING AND TESTING

1. GENERAL

Not Used.

2. PRODUCTS

Not Used.

3. EXECUTION

3.1 BASIC ELECTRICAL START-UP AND TESTING

.1 Energizing Main Electrical System:

.1 Prior to energizing main electrical system:

.1 Verify supply authority voltage and phase rotation.

.2 Testing of Wiring and Wiring Devices:

.1 Test conductors at distribution centers and panelboards for insulation resistance to ground (megger test).

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation and circuitry.

.3 Ground Resistance Testing:

.1 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4-M1982 and Canadian Electrical Code.

.4 Starting Motors:

.1 Prior to starting motors:

.1 Confirm motor nameplate data with motor starter heater overloads, setting of MCP's and sizing of fuses.

.2 Verify rotation.

.3 Ensure disconnects are installed.

.4 Confirm labeling of motors, disconnects and starters.

ELECTRICAL STARTING AND TESTING

3.2 MOTOR CONTROL CENTRES

- .1 Ensure all starters are properly labeled prior to testing.

3.3 STANDBY POWER GENERATION SYSTEM

- .1 Factory Testing: See Section 26 32 13.0
- .2 Starting Standby Power Generation System:
 - .1 Prior to energizing power generation units on site:
 - .1 Ensure generating system is disconnected from normal power supply.
 - .2 Ensure all auxiliary support devices are operational, including ventilation and exhaust systems.
 - .3 Ensure that engine has proper lubricant levels, coolant levels and fuel supply.
 - .4 Ensure all testing on emergency distribution equipment and transfer switch as specified has been completed.
- .3 Site Testing:
 - .1 Conduct Site Testing in conjunction with manufacturer and in presence of the owner representative.
 - .2 Simulate operation of:
 - .1 Automatic starting cycle.
 - .2 Automatic shutdown.
 - .3 Refer to Section 26 32 13.0 for site test duration and requirements.

END OF SECTION

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

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 indicated 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

DIVISION 27 - COMMUNICATIONS

STRUCTURED CABLE

1. GENERAL

1.1 RELATED SECTIONS

- .1 Not Applicable

1.2 ABBREVIATIONS

- | | | |
|----|----------|---|
| .1 | ETL | Electronic Testing Laboratories |
| .2 | IDC | Insulation Displacement Connectors |
| .3 | UTP | Unshielded Twisted Pair |
| .4 | NEXT | Near End Crosstalk |
| .5 | ELFEXT | Equal Level Far End Crosstalk |
| .6 | PSNEXT | Power Sum Near End Crosstalk |
| .7 | PSELFEXT | Power Sum Equal Level Far End Crosstalk |

1.3 INSTALLER QUALIFICATIONS

- .1 Personnel installing communications cabling shall be trained and conversant with communications cabling practices required for this project.

1.4 SCOPE

- .1 System to be complete with all data and voice outlets, patch panels, patch cords, wire and cable required to from a complete system.
- .2 Install cable in raceway in all locations.

1.5 STANDARDS

- .1 Comply with the following standards:
- | | |
|----|---------------------------------|
| .1 | TIA/EIA 568-B1, B2 and B3 |
| .2 | TIA/EIA TSB-67, 72 and 75 |
| .3 | ANSI/TIA/EIA 568a-1, 2, 3, 4, 5 |
| .4 | TIA/EIA/IS 729 |
| .5 | BICSI |

STRUCTURED CABLE

2. PRODUCTS

2.1 SHORT HAUL OR HORIZONTAL CABLING

.1 UTP: to CAN/CSA T529-M95 and TIA/EIA 568 - B1, B2, B3, Category 6.

.1 Physical Characteristics:

- .1 Conductors: four-pair, 24 AWG, thermoplastic insulated, solid copper wire.
- .2 Twists: pairs variably twisted relative to one another. Minimum 29 twists/m per pair.
- .3 Cable Size: maximum OD 6.4 mm.
- .4 Breaking strength: 40.8 kg at temperature of -20°C ±1°C without jacket or insulation cracking.
- .5 Colour coding of pairs: tracer coloured white paired with each of blue, orange, green and brown.
- .6 Fire Rating: plenum-rated overall jacket, CSA FT-4 compliant.

.2 Transmission Characteristics: to EIA/TIA TSB 36-1991.

- .1 DC resistance: less than 94 ohms/km, with an unbalance between conductors in a pair of 5% maximum.
- .2 Mutual Capacitance of any one pair: maximum of 17 nF/305 m @ 1 MHz.
- .3 Characteristic Impedance 1-100 MHz: 100 ohms ±15%.
- .4 Maximum values for attenuation, loss and crosstalk, worst pair at 20°C:

Frequency (MHz)	AttenuationdB/10 00ft	NEXT Loss Pr-pr dB	PS NEXT Loss dB	ELFEXT pr-pr dB	PSELFEXT dB
1	2.5	76.0	53.0	57.4	54.4
4	4.5	53.6	50.6	45.3	42.2
8	6.3	50.0	45.6	39.3	36.3
10	7.0	47.0	44.0	37.4	34.4
16	9.2	43.6	40.6	33.3	30.3
20	10.3	42.0	39.0	31.4	27.4
25	11.4	40.4	37.4	29.4	26.4
31.25	12.8	38.7	35.5	27.5	24.5
62.5	18.5	33.6	30.6	21.5	18.5
100	24.0	30.1	27.1	17.4	14.4

STRUCTURED CABLE

2.2 LONG HAUL OR RISER CABLING

.1 Fiber Optic Cable Riser:

.1 Fiber Optic Cable: to CAN/CSA T529-M95.

.1 Physical Description:

.1 Conductors: 12 strand, 50/125 OM3 micron core/cladding diameter, multimode graded index.

.2 Continuous operating temperature: -20°C to +80°C.

.3 Strength member: Aramid.

.4 Minimum bend radius for installation:
dual strand – 130 mm
12 strand - 305 mm
Minimum bend radius for long term:
dual strand – 80 mm
12 strand - 178 mm

.5 Fire Rating: plenum-rated overall jacket, CSA FT-4 compliant.

.2 Transmission Characteristics:

.1 Minimum bandwidth: 160 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

.2 Maximum attenuation:

.1 3.5 dB/km @ 850 nm.

.2 1.5 dB/km @ 1300 nm.

.3 1.0 dB/km @ 1550 nm.

.2 Quantity: Install fibre optic cables as shown on drawings.

2.3 COMMUNICATIONS OUTLET ASSEMBLIES

.1 Communications Outlet - Boxes:

.1 Double wide box recessed or surface mount box, 63 mm minimum depth.

.2 Communications Outlet - Housings:

.1 Formed Outlet Plate.

.2 Accepts minimum of four snap-in or slide-in outlet inserts.

STRUCTURED CABLE

- .3 Mounts to standard two device opening or mounting ring.
- .4 Constructed of high-impact fire-retardant thermoplastic.
- .5 Unused ports to be filled with blank inserts.
- .3 Communication Outlet - Jacks:
 - .1 Copper-Based Inserts: to TIA/EIA 568-B1, B2, B3, Category 5 enhanced standards, worst pair:
 - .1 Termination via fixed or removable IDC, AT&T 110, Krone LSA-Plus, or NT BIX IDC's with hinged or separate stuffer cap.
 - .2 If removable IDC type is used, they must meet the following physical specifications:
 - .1 Connection of removable IDC's via 8-position edge connectors plated with minimum 40 microns of nickel. Capable of minimum 250 insertion and withdrawal cycles.
 - .2 Connection of removable IDC's via 8-pin header connector. Maximum 8.9 N engagement force and minimum 2.25 N disengagement force. Pins minimum 1.4 mm square.
 - .2 Modular Outlet - UTP:
 - .1 8-position unkeyed jack for voice and data compatible with 4-pair 100 ohm unshielded twisted pair.
 - .2 Capable of minimum of 200 insertion and withdrawal cycles.
 - .3 Copper-based contacts with 50 to 100 microns of nickel overlay uniformly coated with minimum 50 microns of gold overlay.
 - .4 Minimum contact force 1.1 N per contact. Minimum plug retention force 76 N.
 - .5 Conductors separated and aligned internally by comb structure.
 - .6 Electrical Specification:
 - .1 Contacts:
 - .1 Dielectric strength: 1000 V rms @ 60 Hz.
 - .2 Insulation resistance: 10 megohms, minimum.

STRUCTURED CABLE

- .3 Contact resistance: 0.02 ohms, maximum.
- .4 Current rating: 1.5 amps, maximum.
- .2 Insulation Displacement Connectors:
 - .1 Voltage Rating: 250 VAC.
 - .2 Current Rating: 5 amps.
 - .3 Resistance: 0.02 ohms maximum.
 - .4 Dielectric Withstanding: 2000 VAC for 60 sec.
 - .5 Insulation Resistance: 500 megohms minimum.
- .7 Rated for data transmission up to 100 MHz.
- .8 Wire configuration to T568A pair assignment.

2.4 HARDWARE

- .1 Provide all components of a particular type of the same manufacture. (for example: all rack components shall be of common manufacture).
- .2 Rack: Free-standing cabinet rack:
 - .1 Body fabricated of 2.5 mm minimum metal.
 - .2 Equipment mounting rails minimum 2.0 mm metal.
 - .3 Designed to accept EIA standard 483 mm wide panels. Drilled and tapped for No 10 screws for vertical panel of 2134 mm in increments of 44.5 mm.
 - .4 Grounding provision.
 - .5 Full height vertical wire management on both sides minimum 152mm x 152mm.
 - .6 Colour ASA 61 grey.
- .3 Wall Mounting:
 - .1 Backboard for Equipment:
 - .1 Backboard: If backboard does not already exist in equipment room use Poplar plywood, G1S, 1200mm x 1200mm x 19mm thick. Painted gray on front and all edges, prime coat back.
 - .2 Components indicated for wall mounting shall be low profile and mounted so as to minimize any protrusion into the equipment room.

STRUCTURED CABLE

- .4 UTP Patch Panels: supply all hardware from the same manufacturer.
 - .1 Ports: same type as corresponding outlets Ports/Panel: maximum quantity 48.
 - .2 Physical, Electrical, Transmission Properties: not less than specified for outlets, Category 5 enhanced, worst pair.
 - .3 Horizontal cable management minimum 90 mm high.
 - .4 Grounding lug hardware kit.
 - .5 Panel:
 - .1 Width 483 mm.
 - .2 Multiple of EIA standard module height of 44.45 mm.
 - .3 EIA mounting hole spacing.
 - .4 Rack mountable.
 - .6 Panel Height: 178 mm maximum.
 - .7 Material: metal of the following minimum thickness:
 - .1 3 mm flat anodized aluminum.
 - .2 1.65 mm formed aluminum.
 - .3 1.9 mm flat steel.
 - .4 1.5 mm formed steel.
- .5 Fibre Optic Cable Patch Panels
 - .1 Fibre interconnect center wall or rack mounted, low profile, modular design. Rack mount to be used in central equipment room, Wall mount to be used in remote equipment rooms.
 - .2 Ports: as required.
 - .3 Connectors: feed through type LC.
 - .4 Cable management and slack storage designed to accommodate fibre optic cable bend radius.
 - .5 Lockable doors or covers for cable termination and patch compartments.
 - .6 Anchor points for strain relief of fiber cable entry.

STRUCTURED CABLE

- .7 Grounding provisions.

2.5 PATCH CABLES

.1 UTP Type:

- .1 Patch Cables to match installed cable's transmission and electrical specifications.
- .2 Fire Rating: plenum rated overall jacket, CSA FT-4 compliant.
- .3 Modular Connectors:
 - .1 Matching types and minimum specifications as for outlet components.
 - .2 Long body type.
 - .3 Suitable for solid or stranded conductor and wire gauge used.
 - .4 Tool-stuffed or plier-stuffed with IDC contacts and plier-latched cap.
 - .5 Factory manufactured.
- .4 Quantity: Provide one 1 m and one 3 m UTP patch cord for each new cable outlet.

.2 Optical fiber patch cords:

- .1 Fiber Core and Cladding: identical to installed cable.
- .2 Transmission Properties: match installed cable's transmission and electrical specifications.
- .3 Configuration:
 - .1 Dual fiber, single jacket, with breakout assemblies separate SC connectors each end.
 - .2 Single fiber dual cable, separate SC connectors each end.
- .4 Factory manufactured.
- .5 Quantity: As required plus 10% or 2 (whichever is greater) spares of each length used.
- .6 Lengths: Use minimum standard length necessary for each location.

STRUCTURED CABLE

2.6 WIREWAYS AND SURFACE RACEWAYS

- .1 Provide slotted PVC raceway on rack sides or on backboard as applicable in equipment rooms.

2.7 IDENTIFICATION MATERIALS

- .1 Lamicoid 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 Wire Identification Materials:
 - .1 Machine-printed heat shrink sleeves.

3. EXECUTION

3.1 INSTALLATION

- .1 Cable Installation:
 - .1 Generally install FT4 rated data cable and voice cable using raceway.
 - .2 Install data and voice cable in conduit.
 - .3 Support cable runs independently of ceiling suspension system.
 - .4 Swab raceway system before installing wiring.
 - .5 Do not exceed manufacturer's maximum pulling force.
 - .6 Maintain not less than minimum bending radius for fiber and copper conductors.
 - .7 Install cable along or at right angles to building lines unless impractical to do so. Verify specific cases of deviation in advance.
 - .8 Maintain open copper-conductor cable at maximum practical distance from fluorescent ballasts and other EMF - or discharge-generating equipment.
 - .9 Ensure that cable is not flattened, squeezed, or crimped at any point along entire run. No splices or intermediate terminations in cable runs except by special permission in advance, with documentation detailing locations and nature of splices.
 - .10 Install cables in PVC raceway in telecom room and fan individual cables to applicable patch panels in neat, logical fashion.
 - .11 Tie wrap cables neatly into logical bundles.

STRUCTURED CABLE

- .12 Minimum 1 m of slack cable per run.
- .2 Connectors:
 - .1 Use tooling specific to connector types in use.
 - .2 Use connectors suitable for nature of conductor in cable, eg. stranded vs solid copper.
 - .3 Ensure that connectors' strain relief provisions are used. Strip jackets only amount required.
 - .4 Maintain pair twists within 13 mm of termination.
 - .5 UTP Connection Configuration in accordance with EIA/TIA 568A-1991 or CAN/CSA-T529-M95.

Pair	Colour	RJ-45 Pins
1	Blue	4
	White/Blue	5
2	White/Orange	3
	Orange	6
3	White/Green	1
	Green	2
4	White/Brown	7
	Brown	8
- .3 Outlets, Boxes and Fittings:
 - .1 Communications outlet assemblies to be used for work station locations in office areas. For other devices an appropriate plug is to be installed directly on the wire for direct connection to the device.
 - .2 Ensure in advance that outlet box/data outlet installation methods yield vertically-mounted data outlets.
 - .3 Install all outlets flush with finished surfaces unless indicated otherwise on the drawings.
- .4 Cabinets, Enclosures, Racks, Backboards:
 - .1 Install at locations and heights indicated on drawings.
 - .2 Use green insulated 6 AWG ground conductors for grounding racks. Use grounding bushing, solderless lug, clamp, or cup washer and screw.
 - .3 Protect ground conductors from mechanical injury.

STRUCTURED CABLE

- .4 Install ground conductors such that neither ground conductors nor data cables interfere with one another in regards to future servicing of patch panel rear connections.
- .5 Patch Panels:
 - .1 Mount patch panels in order shown on drawings.
 - .2 Ground as required by system.
 - .3 Attach horizontal wiring in an ordered fashion according to the numbers as indicated on the drawings.
 - .4 Mount panels to racks with as many screws as there are mounting holes or slots in panels.
 - .5 Provide and install necessary strain reliefs and cable support brackets, plus trays for cable loop behind panel and install cables utilizing such devices.

3.2 COMMUNICATIONS CABLE AND EQUIPMENT LABELING

- .1 Label communication outlets, panels and ports with size 1 Device Identification Materials.
- .2 Label each of cables with other end's address using Wire Identification Materials.
- .3 Label outlets with labels vertically aligned in each row.
- .4 Position panel labels in the same position on each panel.
- .5 Use the naming convention as indicated on the drawings when labeling communications cabling components.

3.3 TESTING

- .1 Test all runs upon completion of permanent terminations, using instrumentation acceptable to Owner. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.
- .2 Copper Media:
 - .1 Test for the following:
 - .1 Continuity.
 - .2 Pair placement and polarity.
 - .3 DC resistance.
 - .4 Characteristics at highest contemplated frequency for data and voice cables:

STRUCTURED CABLE

- .1 Attenuation.
 - .2 Mutual Capacitance.
 - .3 NEXT, PS NEXT, ELFEXT and PS ELFEXT.
 - .5 Run length.
- .2 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of predicted value. Retest runs with:
 - .1 Resistance and capacitance readings more than 10% above or below predicted values.
 - .2 NEXT, PS NEXT, ELFEXT or PS ELFEXT values 3dB higher than predicted values.
 - .3 Attenuation values 2dB higher than predicted values.
- .3 Reconnect or re-install and retest as necessary to correct excessive variations.
- .3 Fiber Optic Media:
 - .1 Ensure that test instrument is temperature-stabilized or is temperature-independent or temperature-compensated before commencing test.
 - .2 Test for following:
 - .1 Run attenuation at 850 nm and 1300 nm wavelengths.
 - .2 Run length.
 - .3 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of predicted value. Retest runs with:
 - .1 Attenuation values greater than 6.0 dB/km @ 850 nm and 4.0 dB/km @ 1300 nm.
 - .4 Reconnect or re-install and retest as necessary to correct excessive variations.

3.4 REPORT

- .1 Record results in tabular form.
- .2 Segregate horizontal runs, inter-room runs, and risers by category or run and by type of cable.

STRUCTURED CABLE

- .3 Present horizontals' results in ascending order, following grid numbering.
- .4 Report Submission:

STRUCTURED CABLE

- .1 Submit three reports printed on 215 mm x 280 mm white paper. Leave copies unbound for insertion into O&M manuals.
- .2 Submit report prepared in electronic form using Microsoft Excel on a CD.

END OF SECTION

DIVISION 31 – EARTHWORK

SOIL STRIPPING AND STOCKPILING

1.0 GENERAL

- 1.1 This section specifies requirements for stripping of topsoil and organic material from the site. The work includes:
 - 1.1.1.1 Stripping and hauling to disposal.
 - 1.1.1.2 Stripping and stockpiling for re-use.
- 1.2 Related Work
 - 1.2.1 Section 31 14 13 includes specifications for soil stripping and stockpiling referred to in the following sections:
 - 1.2.1.1 Landscape Subgrade Section 31 22 01
 - 1.2.1.2 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.2.1.3 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.2.1.4 Topsoil Placement and Grading Section 32 91 19.13
- 1.3 Regulations
 - 1.3.1 Abide by provincial and municipal regulations with regard to diversions or alterations to drainage patterns.
- 1.4 Limits
 - 1.4.1 Stripping shall not exceed the limits and depths shown on the drawings or as designated by the *Consultant*.
 - 1.4.2 The *Consultant* may waive stripping of wet land areas, at his or her discretion.

2.0 PRODUCTS

- 2.1 Not Applicable

3.0 EXECUTION

- 3.1 Notification
 - 3.1.1 The *Contractor* shall notify the *Consultant* in writing, a minimum of 5 working days prior to commencement of stripping.
 - 3.1.2 The *Consultant* and the *Contractor* shall inspect the area to be stripped to establish specific requirements and to review procedures, which shall be confirmed in writing by the *Contractor*.
- 3.2 Stripping and Stockpiling
 - 3.2.1 Load, haul and place in stockpiles as designated by the *Consultant*.

SOIL STRIPPING AND STOCKPILING

- 3.2.2 Stockpile in a manner that will not endanger persons, the work or adjacent property.
- 3.2.3 Keep topsoil stockpiles separate and do not mix with common excavation.
- 3.2.4 Stockpile wetland material in separate stockpile and do not mix with other soil stripping or common excavation as designated by the *Consultant*.
- 3.2.5 Maintain a minimum of 1-m separation between topsoil and common excavation material when piling.
- 3.2.6 Leave openings in stockpiles so that fields are accessible to the land owners.
- 3.3 Mixing
 - 3.3.1 If the topsoil and subsoil are mixed and the topsoil is adversely affected, the *Contractor* shall, at his own expense, engage a soils specialist to determine the necessary remedial work, and shall perform the required work.
- 3.4 Temporary Erosion And Sedimentation Control
 - 3.4.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.
 - 3.4.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - 3.4.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

GRADING

1.0 GENERAL

1.1 This section specified requirements for site grading. The *Work* includes:

- (a) the excavation of soil materials, the salvage of select soil materials, the operation of borrow areas and the construction of embankment. This work includes the removal and/or satisfactory placement of all materials necessary for the construction and preparation of embankments, slopes, drainage works and connections to the required alignment, grade and cross-sections. It also includes the excavation for culverts, underdrains, and foundation pits for buildings and other structures.
- (b) Rough Grading
- (c) Fine Grading
- (d) Finish Grading

1.1.2 Related Requirements

- (a) Section 31 22 00 includes specifications for grading referred to in the following sections:
 - (i) Soil Stripping and Stockpiling Section 31 14 13
 - (ii) Excavating, Trenching, and Backfilling Section 31 23 23.01
 - (iii) Rock Removal Section 31 23 16.26
 - (iv) Backfill Section 31 23 23.13
 - (v) Compaction Section 31 23 23.23

1.2 PRICE AND PAYMENT PROCEDURES

1.2.1 Measurement and Payment

- (a) Payment for all work performed as specified in this Section is deemed to be incidental to payment for work specified in other Sections unless specifically noted as payment item in the Tender Form.

1.3 REFERENCES

1.3.1 Definitions

- (a) Common Excavation: This means the excavating, hauling, placing and compacting in embankments of materials that are not classified as “topsoil” and/or “rock excavation” within the limits of the Contract.
- (b) Waste Excavation: This means the excavating, hauling, disposing and levelling, within the limits of the Contract and at designated disposal areas,

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of surplus or unsuitable materials, but not of materials classified as "topsoil" and/or "rock excavation".

- (c) Coordination: Contracting Requirements; Section 01 42 00 References; Section 01 42 16 - Definitions.

1.3.2 Reference Standards

- (a) City of Calgary 302.00.00
- (b) ASTM 698
- (c) The purpose of this Article is to fully identify standards that are referenced elsewhere using an abbreviated nomenclature.
- (d) Mere inclusion of a standard in this list does not necessarily require compliance with that standard.
- (e) Coordination: Contracting Requirements; Section 01 42 00 - References; Section 01 42 19 - Reference Standards may establish the edition date of standards not otherwise indicated. Division 01 may include full names and addresses of the organizations whose standards are referenced.

1.4 ADMINISTRATIVE REQUIREMENTS

- (a) When more than one of the subordinate titles is required, use this Article to categorize the requirements as related to the specific section. When only one of the subordinate titles is required, this Article title may be omitted and the subordinate title may be used as a primary Article title.

1.4.2 Coordination

- (a) Specify unusual or detailed coordination requirements affecting the work results of this Section. Example: Coordination or "hand-offs" between sections of similar scope in different contracts working on the same site during the same period.
- (b) Coordination: Section 01 31 00 - Project Management and Coordination.

1.4.3 Preinstallation Meetings

- (a) Describe requirements for meetings to coordinate products and techniques, and to sequence related work for sensitive and complex items, e.g., roofing or integrated systems.
- (b) Coordination: Section 01 31 00 - Project Management and Coordination; Section 01 31 19 - Project Meeting; Section 01 31 19.33 - Preinstallation Meetings.

1.4.4 Sequencing

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- (a) Include requirements for coordinating work that must be done in sequence with, or at the same time as, work in another section. The particular sequence of events should be specified here. The Owner's requirements for sequencing may also be specified here.
- (b) Coordination: Section 01 11 00 - Summary of Work; Section 01 12 00 - Multiple Contract Summary; 01 12 16 - Work Sequence.

1.4.5 Scheduling

- (a) Include requirements for coordinating work that requires unusual scheduling with work in other sections. The particular schedule of events should be specified here. Owner's requirements for scheduling (milestones, interim completion, and similar items) may also be specified here.
- (b) Coordination: Section 01 11 00 - Summary of Work; Section 01 32 00 - Construction Progress Documentation; Section 01 32 13 - Scheduling of Work.

1.5 SUBMITTALS

- (a) Use this Article to identify required submittals. Submittal descriptions should cover the nature of the submittal itself but not repeat the requirements that the submittal is intended to illustrate. These requirements should be specified elsewhere in Part 1, Part 2, or Part 3, as appropriate. All submittals are optional; specify only the submittals justified by the project type and type of work covered by the section.
- (b) In sections with simple submittal requirements, grouping all submittals under this single Article may be acceptable. This Article title may be retained when more than one of the subordinate titles is used, or this Article title may be omitted and the subordinate title used as a primary Article title. Use of the subordinate titles may help clarify procedures or assist in navigation and readability.
- (c) Coordination: Section 01 33 00 - Submittal Procedures.

1.6 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

- (a) The "Action Submittals" Article is for use in categorizing submittals requiring responsive action by the A/E. Categorization may be dependent on the language used in the Owner-A/E agreement, outlining submittal review services. If the "Action Submittals" Article is not used, the subordinate titles below should be located under the "Submittals" title.
- (b) The "Informational Submittals" Article is used to categorize submittals, not to require responsive action by the A/E. Categorization may depend on

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the language used in the Owner-A/E agreement, outlining submittal review services. If this Article title is not used, the subordinate titles below should be located below the "Submittals" Article title.

- (c) Both "Action Submittals" and "Informational Submittals" may be used. Select the Article titles below and assign them to either "Action Submittals" or "Informational Submittals."
- (d) Coordinate terminology of submittal procedures outlined in Division 01. "Action Submittals" and "Informational Submittals" should be defined and described in Division 01.

1.6.2 Product Data

- (a) Product Data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project. Product data submittals typically require action by the A/E. The general scope, size, format, and quantity of product data submittals are procedural requirements, which should be included in Division 01.

1.6.3 Samples

- (a) Samples are full-size actual products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues. Samples typically require action by the A/E. Refer to the "Quality Assurance" Article for field samples and mock-ups, which are related to workmanship. The quantity of samples to be submitted is a procedural requirement, which should be specified in Division 01.

1.6.4 Certificates

- (a) Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the contract documents. Do not repeat the requirements that must be certified, which should be specified elsewhere in Part 1, Part 2, or Part 3, as applicable. Certificates may or may not require action by the A/E.

1.6.5 Delegated Design Submittals

- (a) Describe submittals intended to demonstrate design work prepared by the Contractor's licensed professional. Describe the nature of the submittals without repeating the design criteria (which should be specified in the appropriate Articles in Part 2) or the qualifications of the Contractor's licensed professional (which should be specified in "Quality Assurance").
- (b) If necessary, identify the action to be taken on the submittal. This action may vary significantly depending on applicable regulatory requirements

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and on the provisions of the project Owner-A/E Agreement. Coordinate with procedures for deferred approvals, if any. Note that all delegated design is not necessarily subject to deferred approval.

1.6.6 Test and Evaluation Reports

- (a) Describe submittal of test reports or evaluation service reports intended to document required tests, without repeating the test requirements (which should be specified elsewhere in Part 1, Part 2, or Part 3, as applicable). Test reports may or may not require action by the A/E.

1.6.7 Manufacturers' Instructions

- (a) Describe submittals intended to document manufacturer installation, storage, and other instructions without repeating requirements that are specified elsewhere and without suggesting any control of the means, methods, or techniques of the Contractor.

1.6.8 Source Quality Control Submittals

- (a) Describe submittal of source quality control documentation, without repeating the quality control requirements (which should be specified in Part 2).

1.6.9 Field [OR] Site Quality Control Submittals

- (a) Describe submittal of field/site quality control documentation without repeating the quality control requirements (which should be specified in Part 3).

1.6.10 Manufacturer Reports

- (a) Describe submittal of manufacturer reports as documentation of manufacturer activities, without repeating the description of the activities (which should be specified in Part 1, Part 2, or Part 3).

1.6.11 Sustainable Design Submittals

- (a) Describe submittals intended to document sustainable design requirements, without repeating the actual requirements (which should be specified in Part 2 and Part 3). Procedures for submittal and review of sustainable design submittals are often different from those for other submittals. If so, ensure that such procedures are adequately specified in Division 01.

1.6.12 Special Procedure Submittals

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- (a) Describe submittals intended to document special procedures, without repeating the actual procedural requirements (which should be specified in appropriate Articles in Part 2 and Part 3).
- (b) An example of a special procedure that might require a submittal is construction staging or phasing for remodeling an existing facility while keeping it in operation (e.g., a hospital or airport); while the Contractor would normally be responsible for managing this, submittal of Contractor's plan as documentation could be specified.

1.6.13 Qualification Statements

- (a) Describe submittals intended to document the qualifications of entities employed by the Contractor, without repeating the qualifications required. Those qualifications should be specified in "Quality Assurance." Examples include contractor-employed designers (that is, not the A/E of Record or the A/E's consultants), manufacturers, fabricators, welders, installers, and applicators of products and completed work.

1.7 CLOSEOUT SUBMITTALS

- (a) Use this article to categorize submittals that occur during project closeout under an explanatory title: e.g., to identify them as closeout submittals for purpose of assigning appropriate procedures defined elsewhere. Closeout submittals typically do not require action by the A/E.
- (b) When used in conjunction with "Action Submittal" and "Informational Submittal" titles, this Article should be aligned at the same level. The subordinate titles that follow indicate types that are commonly submitted during project closeout, but some projects may require them to be submitted much earlier as action submittals or informational submittals. Determine which submittals are appropriate under this Article for the specific project.

1.7.2 Maintenance Contracts

- (a) Describe the submittal of the maintenance contract without repeating the terms of the contract (which should be specified in Part 3) or procedures for handling these submittals (which should be specified in Division 01).

1.7.3 Operation and Maintenance Data

- (a) Describe submittal of operation and maintenance data necessary for the work of the section. Operation and maintenance data may include video filming when required for "Owner's Instructions" as listed in Part 3 of the section. Operation and maintenance data submittals may or may not require action by the A/E.

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- (b) For example, on projects utilizing construction operations building information methodology and on complex industrial projects or projects requiring total project commissioning, early A/E review may be desirable.
- (c) Coordination: Section 01 78 00 - Closeout Submittals; Section 01 78 23 - Operation and Maintenance Data.

1.7.4 Bonds

- (a) Describe submittal of bonds required by the section, without repeating the terms of the bond (which should be specified elsewhere in Part 1).
- (b) Coordination: Conditions of the Contract; Section 01 78 00 - Closeout Submittals; Section 01 78 33 - Bonds.

1.7.5 Warranty Documentation

- (a) Describe submittal of warranties, without repeating the terms of the warranties (which should be specified elsewhere in Part 1). Warranty documentation may include a sample warranty, which may be an action submittal, and the final executed warranty document, which is usually not an action submittal, although it usually does require A/E review for accuracy.
- (b) Coordination: Conditions of the Contract; Section 01 78 00 - Closeout Submittals; Section 01 78 26 - Warranties.

1.7.6 Record Documentation

- (a) Describe submittal of record documentation specific to this Section. Record documentation traditionally includes items such as annotated drawings, Project Manuals, and possibly submittals and samples, marked up to indicate the actual products used and locations of concealed work or utilities. This may include periodic or final update of a Building Information Model (BIM) by the Contractor.
- (b) Coordination: Conditions of the Contract; Section 01 78 00 - Closeout Submittals; Section 01 78 39 - Project Record Documents.

1.7.7 Sustainable Design Closeout Documentation

- (a) Describe submittals intended to document sustainable design requirements that cannot be submitted until closeout, or even at a later date, without repeating the actual requirements (which should be specified in appropriate Articles in Part 2 or Part 3, or in Division 01). This description may include documentation of quantities that is not possible until all the work is complete.

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- (b) Coordination: Section 01 78 00 - Closeout Submittals; Section 01 78 53 Sustainable Design Closeout Documentation.

1.7.8 Software

- (a) Describe submittal of an extra copy of all operating system and other utility software necessary to operate and maintain the software during the expected life of the product. If it is necessary to specify the software itself, include that in Part 2 as an aspect of the product.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- (a) Use this article to categorize maintenance materials submittals requiring no A/E action other than confirmation of receipt under an explanatory heading.
- (b) When used in conjunction with "Action Submittal" and "Informational Submittal" headings, this Article should be aligned at the same level.
- (c) The subordinate headings that follow indicate types that are commonly submitted as maintenance materials. Determine which submittals are appropriate under this Article for the specific project.
- (d) Coordination: Section 01 78 00 - Closeout Submittals; Section 01 78 53 Sustainable Design Closeout Documentation.

1.8.2 Spare Parts

- (a) Describe spare parts necessary for the Owner's use in facility operation and maintenance; identify the type and quantity here, but include the actual characteristics of the spare parts in Part 2 as part of the specification of the product.

1.8.3 Extra Stock Materials

- (a) Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance. Identify the type and quantity here, but include the actual characteristics of the materials in Part 2. Some types of extra stock materials include ceiling tiles, flooring, paint, and similar products.
- (b) Coordination: Section 01 78 00 - Closeout Submittals; Section 01 78 46 - Extra Stock Materials.

1.8.4 Tools

Describe tools to be provided by the Contractor for the Owner's use in facility operation and maintenance; identify the type and quantity here, but include details of the actual tools in Part 2 under "Accessories." Tools are

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generally defined as items such as special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit.

1.9 QUALITY ASSURANCE

- (a) Include prerequisites, standards, limitations, and criteria that establish an overall level of quality for products and workmanship.
- (b) Coordination: Section 01 43 00 - Quality Assurance.

1.9.2 Regulatory Agency Sustainability Approvals

- (a) Describe specific approvals required by Authorities Having Jurisdiction relating to sustainability. Identify the approvals required here, but if the actual requirements are to be specified, include them in other appropriate locations in the section. Examples of such approvals include procedures and requirements for posting bonds, jobsite recycling procedures, minimum quotas for recycling, bonds posted to guarantee compliance with jobsite requirements, restrictions on jobsite sandblasting to prevent airborne pollution, requirements to submit a procedures plan, and securing review and approval by local authorities.
- (b) Coordination: Section 01 74 00 - Cleaning and Waste Management; Section 01 70 00 - Execution Requirements.

1.9.3 Qualifications

- (i) Use the subordinate Article titles below to list qualification requirements for the following entities where the selection is at the option of the Contractor.
- (b) Manufacturers
 - (i) Specify requirements for, and qualifications of, manufacturers of products specified.
 - (ii) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 14 Manufacturer Qualifications.
- (c) Suppliers
 - (i) Specify requirements for, and qualifications of, supplier of products specified.
 - (ii) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 16 - Supplier Qualifications.
- (d) Fabricators

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- (i) Specify requirements for, and qualifications of, fabricator of products specified.
 - (ii) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 19 - Fabricator Qualifications.
- (e) Installers / Applicators / Erectors
 - (i) Either use this Article or use the Part 3 Article, "Installers," but usually do not use both. If using both, coordinate content of this Article with the Part 3 "Installers" Article to avoid overlapping information.
- (f) Testing Agencies
 - (i) Specify requirements for and qualifications of testing agencies employed by the Contractor. Tests or inspections to be performed should be specified in the quality control headings.
 - (ii) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 26 - Testing and Inspecting Agency Qualifications.
- (g) Licensed Professionals
 - (i) Specify requirements for and qualifications of licensed professionals (such as architects or engineers) employed by the Contractor or manufacturer. Do not specify professional services to be performed.

1.9.4 Certifications

- (a) Include statements describing Contractor's certification of compliance with specification requirements. Size and tolerance variations that exceed standard tested units may require additional certificates. Include statements to certify compliance with product environmental or sustainability requirements, unless those are included under the "Sustainability Standards
- (b) Certifications" Article. Identify the specific certificates required under "Submittals" without repeating the requirements specified here.

1.9.5 Sustainability Standards Certifications

- (a) Include statements describing Contractor's certification of compliance with specification requirements that are specific to sustainability. Examples may include LEED Certifications and Chain of Custody Certifications from Forest Stewardship Council (FSC), or certification that a product contains a minimum recycled content required for LEED credits. Note that in some

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instances a certification might be in the form of a letter on official letterhead stating compliance with the certification requirement.

1.9.6 Preconstruction Testing

- (a) List testing to be performed to qualify products prior to procurement and before submitting product data submittals. These tests are usually on products or assemblies for which the Contractor has been given some responsibility for design or selection. Examples of such testing include the following:
 - (i) Mock-up testing of assemblies for which design responsibility has been delegated to the Contractor to show compliance with design criteria (e.g., curtain wall).
 - (ii) Mock-up testing of mortar mix designs in a masonry assembly to show that the Contractor's selection of mix design complies with specified performance criteria.
 - (iii) Testing of sealants for compatibility with the actual substrates to be installed.

1.9.7 Field [OR] Site Samples

- (a) Specify requirements for field samples. Field samples are usually used to state requirements for sample field applications of finishes, or other finish materials and coatings. Accepted samples may establish a minimum standard of workmanship. Coordinate terminology with contract requirements.
- (b) Examples include paving or plaster textures prepared on the project work site, cabinets or veneer paneling set up in the fabrication shop, or stone fabrications set up in the source quarry.
- (c) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 36 - Field Samples.

1.9.8 Mock-ups

- (a) Describe mock-ups required. Mock-ups are full-size erected assemblies used to ensure understanding and coordination of required construction for testing and observation and for establishing standards by which workmanship will be judged. The location and extent of mock-ups should be indicated on the drawings.
- (b) Coordination: Section 01 43 00 - Quality Assurance; Section 01 43 39 - Mock-ups.

1.10 DELIVERY, STORAGE, AND HANDLING

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- (a) This Article may be used in sections where categorizing the requirements are unnecessary.
- (b) Coordination: Section 01 66 00 - Product Storage and Handling Requirements.

1.10.2 Delivery and Acceptance Requirements

- (a) List the special delivery and acceptance requirements for the products specified, including those for Owner-furnished/Owner-supplied products or those furnished/supplied by related contracts. Relevant issues involve packing or packaging, shipping, receiving at the site, unloading, and any inspections or approvals required.
- (b) General or typical requirements should be specified in Section 01 65 00 - Product Delivery Requirements.

1.10.3 Storage and Handling Requirements

- (a) List the special storage and handling requirements for the products specified, including those for Owner-furnished/Owner-supplied products or those furnished/supplied by related contracts. Relevant issues include location, environmental conditions and security during storage, and other procedures to protect from damage, or theft.
- (b) Coordination: Section 01 66 00 - Product Storage and Handling Requirements.

1.10.4 Packaging Waste Management

- (a) List any requirements for packaging material removal and reuse by the manufacturer, used in delivery of the specified products if these requirements are different from the recycling requirements for packaging materials under provisions of construction waste management. This includes requirements for removal and reuse of packaging Owner furnished/Owner-supplied products or those furnished/supplied by related contracts.
- (b) An example of packaging waste management requirements would be the reuse and return of pallets, crates, padding, and packaging materials to the manufacturers of systems furniture or furnishings.
- (c) Requirements for waste generated at the site from demolition, construction, or cleaning should be specified in Part 3.
- (d) Coordination: Section 01 74 00 - Cleaning and Waste Management. Coordinate with sustainable design requirements specified in other Articles and related Sections.

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1.11 FIELD [OR] SITE CONDITIONS

- (a) Field vs. Site: Coordinate terminology with contract language. Usage, application, and meaning of these terms varies regionally, as well as between the various Standard Contracts. The specifier must determine the appropriate definitions of these terms and coordinate their use in the Project Manual. If the terms are not fully defined in the Standard Contracts, include definitions in "Supplementary Conditions."

1.11.2 Ambient Conditions

- (a) Describe the ambient conditions under which the work must be performed in order for the work results to provide the specified quality. Conditions may include factors such as temperature, humidity, lighting, conditions of completion of related work or substrates, atmospheric pressure, gravity, or functional state of particular facility services. Recommend avoiding the term "environmental" in this context to prevent confusion with requirements of sustainable design provisions.

1.11.3 Existing Conditions

- (a) Include statements that reference documents where information may be found pertaining to such items as existing structures or geophysical reports.
- (b) Describe condition of existing work subject to reworking or modification.
- (c) Coordination: Document 00 30 00 - Available Information; Document 00 31 19 - Existing Condition Information; Document 00 73 00 Supplementary Conditions.

1.12 WARRANTY [OR] BOND

- (a) Describe special or extended warranties or bonds covering the conformance and performance of the work of the section.
- (b) Coordination: Document 00 72 00 - General Conditions; Section 01 78 36 - Warranties.

1.12.2 Manufacturer Warranty

- (a) Describe special or unusual provisions required of the Manufacturers' Warranty to be provided, such as special inclusions, exclusions, or other considerations.
- (b) Coordination: Document 00 72 00 - General Conditions; Section 01 78 36 - Warranties.

1.12.3 Special Warranty

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- (a) Include statements specific to this Section that supplement or extend warranties contained in the Contracting Requirements.

1.12.4 Extended Correction Period

- (a) Describe requirements for Extended Correction Period for the specific work results specified, which may include periodic site visits and inspections, seasonal changeovers, or adjustment of the completed work. Extended correction period provisions may require implementation by means of editing "Supplementary Conditions," coordinated with "General Conditions" and Division 01 General Requirements. Refer to CSI's Project Resource Manual (PRM) or CSC's Manual of Practice (MOP) for further information.
- (b) Correction Period is defined in General Conditions. Coordinate these requirements with General and Supplementary Conditions.

2.0 PRODUCTS

- 2.1.1 Include information about systems, materials, manufactured units, equipment, components, and accessories; include mixes, shop fabrication, and factory finishing prior to installation or incorporation into the project. This Part may also include products furnished/supplied for incorporation under other sections.

- 2.1.2 This Part may also include items such as software and special tools.

2.2 OWNER-FURNISHED [OR] OWNER-SUPPLIED PRODUCTS

- (a) Include information about systems, assemblies, manufactured units, equipment, components, products, materials, and accessories that are provided by the Owner. This Article may also include products furnished/supplied for incorporation under other sections. Describe Owner-furnished/Owner-supplied products to provide information necessary to enable the Contractor to install them correctly, to procure related products, to match new products to the existing products, to make new products compatible with existing products, to ensure compatibility or proper system operation, or otherwise fulfill contract requirements.
- (b) Coordinate terminology with contract requirements.

2.2.2 New Products

- (a) New products furnished by the Owner do not need to be described unless the Contractor needs to know details about them in order to install them correctly, to procure related products, or to ensure compatibility or proper system operation.

2.2.3 Existing Products

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- (a) Existing or salvaged products do not need to be described unless there is some limitation that the Contractor should know about, such as a requirement to match new products to the existing products, or to make new products compatible with existing products.

2.3 [SYSTEMS] / [ASSEMBLIES] / [MANUFACTURED UNITS] / [EQUIPMENT] / [COMPONENTS] / [PRODUCT TYPES] / [MATERIALS] / [USER-DEFINED HEADING]

- (a) Each Article title within brackets may be used in any combination of the bold titles below. Repeat the bracketed Article title as many times as necessary, giving each group a specific user-defined title as required. Arrange the groups in descending order of scope or size, or any other logical order, starting with the entire system, if any.
- (b) If only one primary product or assembly is specified in the section, the Article title may be omitted and any of the subordinate titles used as a primary Article. When using MATERIALS as the Article title, do not use the subordinate Article title "Materials."
- (c) Refer to the appendixes for examples of how these Articles may be used.

2.3.2 Manufacturers

- (i) The decision to list manufacturers depends on many factors, but the two primary reasons are (1) to contractually limit the Contractor's options, and (2) to give the Contractor the information necessary to find the products specified. If manufacturers or other sources are to be listed for a particular product, use the following subordinate title "Substitution Limitations" to define the purpose of the manufacturer list.
- (ii) If a single manufacturer list is applicable to all products in the section, use "Manufacturers" as a primary Article title and include only one "Manufacturers" Article in the section. A suggested location for the Article is above the first product group.
- (b) Manufacturer List
 - (i) If desired, include an appropriate list of entities that make or sell the products specified. If the entity is a fabricator or other source (such as a quarry), that term may be used instead of manufacturer.
 - (ii) Coordination: Section 01 60 00 - Substitutions.
- (c) Substitution Limitations

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- (i) Project Manuals often include a Division 00 Document or Division 01 Section, or both, that define procedures for substitutions and what is intended by lists of manufacturers. For example, "Any manufacturer whose product complies with the specification will be acceptable." If no Division 01 Section exists, clearly state here the meaning of the list of manufacturers. Some commonly used language includes: "No substitutions," and "All other manufacturers: Submit substitution request in accordance with Section...."
- (ii) Coordination: Document 00 26 00 - Procurement Substitution Procedures; Section 01 25 00 - Substitution Procedures.
- (d) Product Options
 - (i) If the Contractor may choose from more than one mutually exclusive option in this Section, describe how the Contractor must choose. Include a statement that the indicated manufacturer, fabricator, or source is "basis of design."

2.3.3 Description

- (i) Include an overall description of the system, assembly, product, or material. Include required properties or characteristics that do not obviously belong under other titles. Examples include configuration, size, color, material composition, recycled content, rapidly renewable content, VOC content, and toxic content.
- (b) Regulatory Requirements
- (c) Sustainability Characteristics

2.3.4 Performance / Design Criteria

- (i) Include performance-related characteristics of products. Types include structural, safety, fire resistance and retardancy, acoustical, thermal, operational capacity, and durability. Performance should be capable of being verified by observations or tests and stated as: (1) a property name; (2) a value and units of measure, if applicable; and (3) a method of evaluating or verifying performance, such as a test method.
- (ii) Performance characteristics may apply to systems, assemblies, components, and materials. The term "Design Criteria" is used when describing the intended characteristics of a product for which the Contractor is assigned design responsibility.

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- (iii) Include appropriate methods of substantiating performance characteristics in other locations in the section. For example, product data and design data are Submittals; testing of the product at the manufacturer's plant is "Source Quality Control;" and testing of the installed product is "Field Quality Control."
- (iv) Examples:
- (v) "Flame Spread Rating (Wall Covering): 0, when tested in accordance with..."
- (vi) "Output Capacity (Domestic Hot-Water Heater): 50 gal/hr, when tested in accordance with..."
- (vii) "Design Criteria (Fire Suppression Sprinkler System): NFPA 13, ordinary hazard."
- (viii) Any section that specifies a product should include "Design and Performance Criteria" in Part 2. Any section that only specifies performance or design criteria not related to a product should include those criteria in Part 1.
- (ix) Refer to CSI's PRM or CSC's MOP for further information on performance specifying.
- (x) Coordination: Section 01 62 00 - Product Options.

(b) Capacities

2.3.5 Operation

- (i) Use "Operation" for equipment and moving parts.
- (ii) For systems, if the Contractor or manufacturer must make decisions as to the appropriate components, use "Operation Sequences" to describe how the parts of a system are to operate together. For equipment, describe the unit's modes of operation.

(b) Operators

(c) Controls

(d) Operation Sequences

2.3.6 Materials

- (i) Identify the material, system, assembly, or product of which it is made. If the material description is lengthy, a separate "Materials" Article may be appropriate, to be referenced by each product, assembly, or system that utilizes the same material.

GRADING

- (ii) If appropriate, include sustainable composition of products and sustainable material extraction and transportation requirements.
- (iii) When using "MATERIALS" as a primary Article title, do not use the subordinate Article title "Materials."

2.3.7 Assembly [OR] Fabrication

- (i) Use the Article title that is appropriate to the product category being specified: "Assembly" applies primarily to manufactured products, whereas "Fabrication" usually refers to shop activities.
- (b) Factory Assembly
 - (i) Factory assembly should be stated as a result.
- (c) Shop Fabrication
 - (i) Shop fabrication is preferably stated as a result, but may also include statements of required methods.
- (d) Assembly [OR] Fabrication Tolerances
 - (i) State allowable variations from specified requirements. Use the term appropriate to the product. Examples of such tolerances include flatness, warp, bow, out-of-square, and joint spacing.

2.3.8 Mixes

- (i) Mix design or proportioning may be included here or as a characteristic of the product above, under "Description." "Mixes" includes proportioning requirements, but not mixing procedures.

2.3.9 Finishes

- (i) Include requirements for factory and shop finishes and materials for field finishing, if covered by this Section. If more than one finish is described, be sure to indicate where each is to be used.
- (b) Primer Materials
 - (i) Describe factory, shop, and field primer materials unless specified in other sections.
- (c) Finish Materials
 - (i) Describe factory, shop, and field finish materials unless specified in other sections.
- (d) Shop Finishing Methods

GRADING

- (i) Factory finishing methods are usually dictated by the type of finish and the manufacturers' preference. Field finishing methods would be described in Part 3.

2.4 ACCESSORIES

- (a) Use this Article for accessory materials or products. Any of the intermediate and subordinate titles listed above may be used here as applicable. Accessories that are a portion of a unit of equipment or manufactured item should be specified with that item, not here. Common types of accessory products include fasteners, adhesives, and flashings. If tools for the product of this Section are to be delivered to the Owner, include them here as accessory products.

2.5 SOURCE QUALITY CONTROL

- (a) Tests or inspections conducted off-site at the manufacturers' or fabricators' location (i.e., factory, plant, mill, or shop). Use for the verification of characteristics of products specified in Part 2.

2.5.2 Tests and Inspections

- (a) Describe each test to be conducted, including the test method, sampling requirements, observation by independent authorities (if any), and reporting requirements. Required values should be specified above as performance requirements or other characteristics. Describe each inspection to be conducted, including method, personnel, and reporting requirements.

2.5.3 Non-Conforming Work

- (a) Describe detailed requirements for identification and correction of nonconforming work and final actions required to prepare installed products to perform properly.

2.5.4 Manufacturer Services

- (a) Describe specific services required of the manufacturer during source quality control, such as coordination requirements to achieve special inspections, including access by Authorities Having Jurisdiction or other third parties.

2.5.5 Coordination of Other Tests and Inspections

- (a) When the Owner employs testing or inspection agencies, or the code authority conducts its own tests or inspections, describe work or temporary facilities that must be provided by the Contractor. A significant example is special inspections required by many codes.

GRADING

3.0 EXECUTION

- (a) Specify on-site work and include provisions for incorporating products into the project. The products incorporated may be specified in Part 2 or may be furnished/supplied under other sections.

3.2 INSTALLERS

- (a) Under most standard forms of contract, any installer who can perform the work as specified is acceptable. The two primary reasons to list names of installers are (1) to contractually limit the Contractor's options and (2) to give the Contractor the information necessary to find an installer who can do the work specified.
- (b) Examples of work that might require limiting the Contractor's options are historical restoration work, testing and balancing of mechanical systems, and special finishes where an unusually high level of workmanship is required. When using this Article, coordinate its use with Part 1 Article "Qualifications." If installer names are listed, use the Article "Substitution Limitations" to define the purpose of the installer list.
- (c) The term "Installers" may be replaced by "Applicators," "Erectors," or "Constructors," as appropriate to the operation to be performed.

3.2.2 Installer List

- (a) If desired, include an appropriate list of entities that can install the items specified.

3.2.3 Substitution Limitations

- (a) Clearly state here the meaning of the list of installers. If the list is for information only and other installers would be acceptable, say so. If no other installers would be acceptable, or if other installers must be approved, use language similar to that commonly used for product substitutions (see "Substitution Limitations" in Part 2 under "Manufacturers"). In the latter case, it may be necessary to refer to the Division 00 Document or Division 01 Section that defines procedures for substitutions.
- (b) Coordinate with language of Standard Contract.
- (c) Coordination: Document 00 26 00 - Procurement Substitution Procedures; Section 01 25 00 - Substitution Procedures.

3.3 EXAMINATION

- (a) State actions required to determine that conditions are acceptable to receive the primary products of the section.

GRADING

- (b) Coordination: Section 01 71 00 - Examination and Preparation.

3.3.2 Verification of Conditions

- (a) State requirements for verifying suitability of conditions for installation. Include verifying that conditions are acceptable for installation/application of products to avoid latent defects in quality of work and function.

3.3.3 Preinstallation Testing

- (a) Include requirements for field testing for quality assurance. Define the tests performed in the field or at the site for verifying quality assurance for materials, systems, or assemblies. Example: Testing vapor emission and alkalinity content in concrete slabs on grade prior to the installation of non-breathable floor finishes.
- (b) Coordination: Section 0 43 00 - Quality Assurance.

3.3.4 Evaluation and Assessment

- (a) State requirements for verifying suitability of preexisting conditions to accept new work. Include verifying that preexisting conditions are acceptable and will permit proper installation/application of new products.

3.4 PREPARATION

- (a) State actions required to prepare the surface, area, or site to incorporate the primary products of the work result of the section. Describe requirements for exposure or removal of existing assemblies, components, products, or materials.
- (b) Coordination: Section 01 71 00 - Examination and Preparation.

3.4.2 Protection of In-Place Conditions

- (a) Describe methods to protect existing work. State requirements for protecting the surrounding areas and surfaces already in place before continuing with work.

3.4.3 Surface Preparation

- (a) Describe preparatory work required prior to installation / application / erection of primary products.

3.4.4 Demolition / Removal

- (a) Describe preparatory work, such as selective removal of existing work that is required prior to execution of new work. Describe requirements for exposure or removal of existing assemblies, components, products, or materials.

GRADING

3.5 ERECTION / INSTALLATION / APPLICATION / [USER-DEFINED PROCESS]

- (a) State actions required to accomplish a specified unit of work in the section. Include requirements necessary for installation of products furnished under other sections. If products are to be installed according to manufacturers' written instructions, then submittal of those instructions as evidence of those requirements should be specified under "Submittals." Include separate Articles or paragraphs for each different item as appropriate. The names of the products or the type of work may be incorporated into the Article title, in which case the wording should reflect the generic product or terminology used throughout the contract documents.
- (b) Coordination: Section 01 73 00 - Execution; Section 01 73 13 - Application; Section 01 73 16 - Erection; Section 01 73 19 - Installation.

3.5.2 Special Techniques

- (a) Describe special procedures for incorporating products. These may include spacings, patterns, or unique treatments.

3.5.3 Interface with Other Work

- (a) Include descriptions specific to compatibility and transition to other materials. This may include incorporating accessories, anchorage, and any special separation or bonding. Include descriptions outlining the relationship of new products, materials, and finishes between the work of this Section and existing work.

3.5.4 Systems Integration

- (a) Describe actions necessary to accomplish a completed integrated system, to link multiple components of a system together, and to interface with other systems. The performance and functional requirements of the system should be specified in Part 2.

3.5.5 Tolerances

- (a) Indicate allowable variations of installed dimensions, such as in application thicknesses or deviations from indicated locations.

3.6 [REPAIR] / [RESTORATION]

- (a) Describe how existing work is to be repaired, restored, and cleaned.

3.7 RE-INSTALLATION

- (a) Describe the installation or reinstallation of existing elements.

3.8 FIELD [OR] SITE QUALITY CONTROL

GRADING

- (a) Indicate requirements for quality control (and related quality assurance) for on-site activities and installed materials, manufactured units, equipment, components, and accessories. Coordinate terminology with contract requirements.

3.8.2 Field [OR] Site Tests and Inspections

- (a) Define the field tests and inspections for installed or completed work. These are different and separate from the tests and inspections required for materials and products prior to installation or application. Coordinate terminology with contract requirements.
- (b) This Article may be used to include testing of sustainable products that are required to meet specific regulatory requirements or design criteria.
- (c) Coordination: Section 01 45 00 - Quality Control.

3.8.3 Non-Conforming Work

- (a) Describe detailed requirements for identification and correction of nonconforming work, and final actions required to prepare installed products to perform properly.

3.8.4 Manufacturer Services

- (a) Describe specific requirements if manufacturers are to provide field quality control with on-site personnel for instruction or supervision of the installation/application/erection/construction of their products, training, or for startup or demonstration. Manufacturers' field reports are included under the Part 1 Article, "Submittals."
- (b) Coordination: Section 01 45 00 - Quality Control.

3.9 SYSTEM STARTUP

- (a) List actions applicable to the startup of operational systems and equipment.
- (b) Coordination: Section 01 75 00 - Starting and Adjusting; Section 01 79 00 - Demonstration and Training; Section 01 91 00 - Commissioning.

3.10 ADJUSTING

- (a) Describe final actions required to prepare installed products to perform properly. This Article may be used to include adjusting of sustainable products that are required to meet specific regulatory requirements or design criteria.
- (b) Coordination: Section 01 75 00 - Starting and Adjusting.

3.11 CLEANING

GRADING

- (a) Describe final actions to clean installed products of this Section. Overall construction cleaning should be addressed in Division 01.
- (b) This Article may be used to include final cleaning or building flush-out of sustainable products that are required to meet specific regulatory requirements or design criteria.
- (c) Coordination: Section 01 74 00 - Cleaning and Waste Management; Section 01 74 13 - Progress Cleaning.

3.11.2 Waste Management

- (a) State special measures needed to minimize waste, collect recyclable waste, and dispose of (or recycle) field-generated construction waste created during demolition, construction, or final cleaning.
- (b) Coordinate waste materials intended to be recycled with Section 01 74 00 - Cleaning and Waste Management; Section 01 74 19 - Construction Waste Management and Disposal.

3.12 CLOSEOUT ACTIVITIES

- (a) State requirements for demonstrating, instructing, and training Owner on sequence of operations, general facility operation, and facility maintenance procedures.

3.12.2 Demonstration

- (a) State requirements of the installer or manufacturer to demonstrate the proper operation of equipment.
- (b) Coordination: Section 01 79 00 - Demonstration and Training.

3.12.3 Training

- (a) State requirements of the installer or manufacturer to train the Owner's personnel in the operation and maintenance of equipment for ongoing facility management and maintenance.
- (b) Coordination: Section 01 79 00 - Demonstration and Training.

3.13 PROTECTION

- (a) Describe protection methods of completed work after installation, but prior to acceptance by the Owner. Protection of surrounding areas and surfaces during application or installation is included under the Part 3 Article, "Preparation." Include only statements unique to the particular section.
- (b) Coordination: Section 01 76 00 - Protecting Installed Construction.

3.14 MAINTENANCE

GRADING

- (a) List provisions for maintenance services as applicable to critical systems, equipment, and landscaping. Service agreements, if not paid in advance, should be separate from the construction agreement to avoid delaying the final payment and holding the contract open for extended periods.
- (b) Coordination: Section 01 78 00 - Closeout Submittals; Section 00 78 23 - Operation and Maintenance Data.

3.15 ATTACHMENTS

- (a) If desired, include attachments, such as schedules, tables, illustrations, or forms in this location, if they are not incorporated directly within the specification text. These attachments might not technically relate to Part 3 – EXECUTION, but may be placed at this location for convenience or clarity. Attachments appended following the "END OF SECTION" marker should be enumerated in an Article occurring before the "END OF SECTION" marker, and referenced clearly in the Project Manual table of contents. Items such as schedules, tables, and illustrations (including photos) may also be included or embedded directly with the related text if size, shape, and format are compatible with the page format selected. See PageFormat for more information.
- (b) Preprinted forms and similar items may be placed after the "END OF SECTION" marker. Place a reference to an external attachment within one of the Parts of the section. Locate attachments that include work results referencing more than one section as recommended in MasterFormat.

END OF SECTION

ROCK REMOVAL

1.0 GENERAL

- 1.1 Section 31 23 16.26 refers to those portions of the *Work* that require rock removal. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 References
 - 1.2.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 43 00.
- 1.3 Definitions
 - 1.3.1 Rock is defined as all solid rock in form of masses, bedrock, layers, or ledges and includes igneous rock of any sort, conglomerate, sandstone or shale that requires breaking by continuous drilling and blasting before excavation and removal and cannot be effectively loosened or broken down by mechanical ripping equipment with a minimum drawbar pull of 360kN. Rock also includes rocks having individual volumes in excess of 1.0 m3 removed by blasting or other means.
 - 1.3.2 Trench rock removal is defined as rock to be removed during excavation of utility trenches generally as shown on the *Drawings*.
 - 1.3.3 Mass rock removal is defined as rock to be removed during roadway excavation, site grading or other excavation work, generally but not necessarily, in larger quantities, and not within the more confining limits of excavation specified for trench excavation.
 - 1.3.4 Dense tills, hardpan, partially cemented material, clay or frozen materials which do not require breaking by continuous drilling and blasting before excavation and removal are not classified as rock.
- 1.4 Qualifications
 - 1.4.1 Retain licensed explosives expert holding a valid Blasters Certificate to supervise and program blasting work, and to determine precautions, preparation and operations techniques.
- 1.5 Blasting Operation Proposal

ROCK REMOVAL

- 1.5.1 Submit to *Consultant* and/or local authorities having jurisdiction for approval, written proposal of operations for removal of rock by blasting.
- 1.5.2 Indicate proposed method of carrying out *Work* in proposal, types and quantities of explosives to be used, loading charts and drill hole patterns, type of caps, blasting techniques, blast protection measures for items such as flying rock, vibration, dust and noise control. Include details on protective measures, time of blasting and other pertinent details.
- 1.5.3 Review of the blasting operation proposal by the *Consultant* or local authorities shall not relieve the *Contractor* of his responsibility for his means and methods, procedures, and safety measures.
- 1.5.4 No blasting to proceed without written approval of *Consultant*.
- 1.6 Seismic Survey and Monitoring
 - 1.6.1 Arrange for assessment of adjacent buildings and structures to determine existing condition and provide building and structure owners with proposed blasting procedures and copies of assessment reports and seismic recording operations.
 - 1.6.2 Visit owners of adjacent buildings to describe blasting and seismic recording operations and obtain permission for setting up seismographs, where required.
- 1.7 Protection
 - 1.7.1 Prevent damage to surroundings and injury to persons. Post guards, sound warnings, and display signs when blasting to take place.

2.0 PRODUCTS

Not used.

3.0 EXECUTION

- 3.1 Blasting and Vibration Control
 - 3.1.1 Complete all blasting before any structural elements are installed within 15m from blast holes.

ROCK REMOVAL

- 3.1.2 Minimize ground vibrations which may damage structures or shatter or damage rock mass to remain.
- 3.1.3 Blasting not permitted within distance of 30m of concrete or grout less than 24 hours after pouring.
- 3.1.4 Maintain complete and accurate record of all drilling and blasting operations. Submit records to *Consultant* at end of each shift.
- 3.2 Rock Removal
 - 3.2.1 Strip rock of all earth.
 - 3.2.2 Notify *Consultant* within reasonable time to enable *Consultant* to obtain necessary measurements.
 - 3.2.3 Do blasting operations in accordance with local and provincial codes, and requirements of authority having jurisdiction.
 - 3.2.4 Remove rock to alignments, profiles, and cross-sections as shown on *Drawings*.
 - 3.2.5 Locations where explosive blasting is not permitted, if applicable, are shown on *Drawings*.
 - 3.2.6 Use methods, techniques and procedures for control of all factors affecting operations in order to produce smooth and sound peripheral surfaces of all completed excavations, to minimize overbreak, and to avoid damage to adjacent structures.
 - 3.2.7 Excavate trenches in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling and to section shown on Standard Detail Drawings.
 - 3.2.8 Excavate rock for concrete walls, columns and footings to horizontal surfaces not exceeding slope shown on *Drawings*. Scale, pressure wash and broom clean rock surfaces to assist concrete bond.
 - 3.2.9 Except as specified otherwise or as directed by *Consultant* employ pre-shearing, cushion blasting or other smooth wall drilling and blasting techniques to achieve final excavation surfaces.
 - 3.2.10 Remove boulders and fragments which may slide or roll into excavated areas.

ROCK REMOVAL

3.2.11 Correct unauthorized rock removal at no extra cost, in accordance with backfilling requirements specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3 Rock Disposal

3.3.1 Dispose of surplus removed rock off-site.

END OF SECTION

CONSTRUCTION DEWATERING

PART 1 GENERAL

1.1 Basis of Design:

.1 [REDACTED].

1.2 Description:

.1 Removal and disposal of excessive water during construction operations.

1.3 Performance and Design Requirements:

.1 Delegated Design Responsibility:

.1 Contractor: Design and maintenance of facilities for construction dewatering.

END OF SECTION

CONTROLLED DENSITY FILL

1.0 GENERAL

- 1.1 Section 31 23 23 refers to those portions of the work that are unique to the supply and placement of Controlled Density Fill. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 This specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structure requiring site specific structural or geotechnical engineering design.
- 1.3 Except where stated otherwise, all materials and methods in this Section to conform to requirements of the latest version of CAN/CSA A23.1 & 2.
- 1.4 Other names that Controlled Density Fill (CDF) may be referred to include: Controlled Low Strength Material (CLSM), Unshrinkable Fill (USF), Fillcrete, Low Density CLSM (LD-CLSM), or Fluidized Thermal Backfill.
- 1.5 Related Work
 - 1.5.1 Aggregate and Granular Materials Section 31 05 16
 - 1.5.2 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.5.3 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.5.4 Waterworks Section 33 11 01
- 1.6 References
 - 1.6.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in References - Section 01 45 00.
- 1.7 Samples
 - 1.7.1 Samples may be required.
- 1.8 Measurement for Payment
 - 1.8.1 Payment for all work performed under this Section will be incidental to payment for work described in other sections.

2.0 PRODUCTS

- 2.1 Materials
 - 2.1.1 Portland Cement: CAN/CSA-A300, A3001 - 03 Type HS - High Sulphate Resistant Hydraulic Portland Cement.
 - 2.1.2 Fly Ash: Type F Fly Ash to CAN/CSA A23.5
 - 2.1.3 Water: to CAN/CSA A23.1
 - 2.1.4 Aggregate: to CAN/CSA A23.1
 - 2.1.5 Air entraining admixture: to CAN/CSA A266.1

CONTROLLED DENSITY FILL

- 2.1.6 Chemical admixtures: to CAN/CSA A266.2. *Consultant* to approve accelerating or set retarding admixtures during cold and hot weather placing.
- 2.2 Mixes
 - 2.2.1 Proportion Controlled Density Fill to specific design criteria specified on Contract Drawings.
 - 2.2.2 Controlled Density Fill that must be excavatable in future to have maximum unconfined compressive strength of 0.5 MPa (500 kPa) at 28 days and maximum cement content of 25 kg per m³.
 - 2.2.3 Controlled Density Fill requiring minimal initial settlement to have fly ash and water reducing admixtures in mix design.
- 2.3 Forms
 - 2.3.1 Where forms or bulkheads are required: conform to CSA S269.3 Formwork.

3.0 EXECUTION

- 3.1 General
 - 3.1.1 Fill excavation with Controlled Density Fill up to underside of pavement or landscaping materials and strike off roughly level.
- 3.2 Formwork
 - 3.2.1 Formwork to conform to shape, lines and dimensions shown on Contract Drawings.
 - 3.2.2 Formwork to be substantial, sufficiently tight to prevent leakage of Controlled Density Fill and braced and tied to maintain position and shape.
 - 3.2.3 Formwork to be unlined unless specified otherwise.
- 3.3 Workmanship
 - 3.3.1 Obtain *Consultant's* approval before placing Controlled Density Fill. Provide minimum 24-hour notice prior to placing of Controlled Density Fill.
- 3.4 Placing
 - 3.4.1 Place material using methods which do not lead to segregation.
 - 3.4.2 Begin spreading material on crown of pipe or on high end of sloped trench.
 - 3.4.3 Place material to full width in uniform layers not exceeding 300mm thickness until material reaches crown of pipe. After that material can be placed full depth. Where formwork or bulkheads are used, 300mm layers not be exceeded except when authorized by *Consultant*.
 - 3.4.4 Pumping of Controlled Density Fill is permitted with approval of *Consultant*.

CONTROLLED DENSITY FILL

- 3.4.5 Internal vibrators or other methods of consolidation may be used to ensure that any undercut areas of pavement are fully supported.
- 3.4.6 Temporary plating or other means of supporting traffic loads to be used to provide safe driving surface for traffic until pavement material is replaced.
- 3.4.7 Protect freshly placed Controlled Density Fill from heavy rain to prevent washout.
- 3.4.8 Do not place load upon new Controlled Density Fill until authorized by *Consultant*.
- 3.5 Compaction
 - 3.5.1 No compaction is required
- 3.6 Field Quality Control
 - 3.6.1 Inspection and testing of Controlled Density Fill will be carried out by a CSA certified laboratory designated by *Contractor*.
 - 3.6.2 *Owner* will pay costs for inspection and initial testing.

END OF SECTION

EXCAVATING, TRENCHING AND BACKFILLING

1.0 GENERAL

- 1.1 Section 31 23 33.01 refers to those portions of the Work that are unique to excavating, trenching, and backfilling. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Electrical Division 26
 - 1.2.2 Rock Removal Section 31 23 16.26
 - 1.2.3 Waterworks Section 33 11 01
 - 1.2.4 Environmental Procedures Section 01 35 43
 - 1.2.5 Controlled Density Fill Section 31 23 23
 - 1.2.6 Topsoil Placement and Grading Section 32 91 19.3
- 1.3 Definitions
 - 1.3.1 Rock: Either single boulders, pieces of concrete or masonry with a volume in excess of 1.0 cubic metre, or any material that cannot be removed by an excavator of 50,000 to 62,300 Kg-m with ripper teeth, and which requires for its removal, drilling and blasting or breaking up with a power operated hand tool.
 - 1.3.2 Common Excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, partially cemented materials, clay or frozen materials which can be ripped and excavated with heavy construction equipment.
 - 1.3.3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping, and seeding.
 - 1.3.4 Waste Material: Material unsuitable for use in the Work or surplus to requirements.
 - 1.3.5 Borrow Material: Material obtained from borrow areas identified by the *Consultant* and required for construction of embankments or for other portions of the *Work*.
 - 1.3.6 Embankment (engineered fill): Material derived from usable excavation and placed above original ground or stripped surface up to subgrade elevation.
 - 1.3.7 Import Granular Fill: Approved granular material, supplied by the *Contractor* and obtained from offsite sources to be used for embankment fill up to Subgrade Elevation as determined by the *Consultant*.
 - 1.3.8 Import Fill: Approved engineered fill, supplied by the *Contractor* and obtained from offsite sources to be used for embankment and placed above original ground or stripped surface up to subgrade elevation.

EXCAVATING, TRENCHING AND BACKFILLING

- 1.3.9 Pavement Structure: combination of layers of unbound or stabilized granular subbase, base, and asphalt or concrete surfacing.
- 1.3.10 Prepared Subgrade Surface (Subgrade Elevation): Surface immediately below the finished pavement structure.
- 1.4 Existing Utilities
 - 1.4.1 The existence and location of all utilities and structures, including underground, surface and overhead utilities shown on the *Drawings* is not guaranteed, nor is it guaranteed that all utilities which may be encountered are shown. Notwithstanding any other provisions of this *Contract*, the *Contractor* shall be solely responsible for locating all the utilities and paying for any damage caused by the *Contractor*.
 - 1.4.2 No additional compensation will be made to the *Contractor* for delays in the locating of utility structures or for the tunnelling under or supporting of them during construction. The Contractor may not claim for lost production as a result of delays brought about by unforeseeable alignment conflicts, grade conflicts, or scheduling conflicts with other utilities.
 - 1.4.3 At no extra cost to the *Owner*, the Contractor shall, prior to commencing any installation work, confirm by test excavation, the elevation and location of any utility which may cross the alignment of the proposed work. This work shall be carried out a minimum of seven days in advance of installation in the immediate vicinity of the existing utility. Allow *Consultant* access to exposed utilities to record crowns or inverts.
 - 1.4.4 The *Owner*, shall pay for any relocation of existing underground utilities which, in the opinion of the *Consultant*, are considered to be in direct conflict with the alignment or profile of the new work and require relocating, provided however, that the Contractor cooperates with the provisions found in the preceding section for establishing locations of existing utilities. Authorization for the method of relocating and the arrangements for payment shall be given in writing by the *Consultant*.
 - 1.4.5 All hydrants under pressure, valve box covers, valve boxes, curb stop boxes, fire or police call boxes, and all other utility controls and warning systems, shall be left unobstructed and accessible during the construction period.
 - 1.4.6 Where existing utilities such as water, sewer, electricity, telephone, and gas, are serving the public while construction is in progress, it shall be the responsibility of the *Contractor* to plan and execute his activities such that disruption to existing utilities is held to a minimum. When it is necessary to valve-off a water utility, the *Consultant*, the Fire Department and the individual water consumers affected by the shut-off, shall be notified by the *Contractor* at least one day prior to shut-off, unless an emergency situation involving life or property necessitates immediate action.

EXCAVATING, TRENCHING AND BACKFILLING

- 1.4.7 The *Contractor* shall protect, and support all underground and surface structures and all utilities, utility services, and appurtenances and all other obstructions, that may be encountered during the construction of the project, at no cost to the *Owner*.
- 1.5 Existing Buildings and Surface Features
 - 1.5.1 Conduct, with *Consultant*, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by Work.
 - 1.5.2 Protect existing buildings and surface features which may be affected by Work from damage resulting from Work.
 - 1.5.3 Where excavation necessitates root or branch cutting, do so only as approved by *Consultant*.
- 1.6 Shoring, Bracing, Underpinning
 - 1.6.1 Comply with applicable municipal regulations to protect existing features.
 - 1.6.2 Trench shoring to be designed and installed in accordance with the regulations of the Workers Compensation Act of Alberta.
 - 1.6.3 Sides of trenches or other excavations to be adequately supported. Trench stability and safety procedures to meet or exceed minimum requirements of "Accident Prevention Regulations" current issue of the Workers' Compensation Board of Alberta. All works to be carried out in strict compliance with above mentioned regulations.
 - 1.6.4 Prefabricated cages or shields may be used, at the discretion of the *Consultant*, to supplement or replace conventional shoring, provided they conform with all applicable safety requirements and permit the proper placing and tamping of bedding and fill material under and around the pipe.
 - 1.6.5 *Contractor* shall have any required shoring, underpinning and bracing designed by a professional engineer that is registered in the Province of Alberta. Provide the *Consultant* with copies of sealed drawings detailing such supports.
- 1.7 Blasting
 - 1.7.1 Refer to Section 31 23 16.26
- 1.8 Disposal
 - 1.8.1 Unless noted otherwise in the *Contract Documents*, *Contractor* to be responsible for off-site disposal of all surplus soil from excavations. Suitability of excavated material for use as native bedding or trench backfill will be governed by Article 2 within this Section. Dumping of spoil on private property will be permitted only upon written

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approval from property *Owner* and provided all necessary permits, testing and approvals have been obtained, including that of *Consultant*.

- 1.8.2 Where a specific disposal site owned, operated, or arranged by the *Owner* is designated in the *Contract Documents*, all material destined for the site shall become the property of the *Owner*.

1.9 Measurement and Payment

- 1.9.1 Work performed under this section will be incidental to work involved in other sections of these specifications.
- 1.9.2 Trench rock excavation and imported backfill will be measured and paid for in accordance with Section 01 01 30 - Measurement and Payment.

2.0 PRODUCTS

2.1 General

- 2.1.1 Unless shown otherwise on *Contract Drawings* or Standard Detail Drawings, the materials specified in 2.2 following are approved for their respective uses.

2.2 Use of Specified Material

- 2.2.1 Backfill for over-excavated trench or structure excavations to be:

2.2.1.1 Drain Rock (only where approved by the *Consultant*)

2.2.1.2 Granular Pipe Bedding and surround material

2.2.1.3 Pit Run Sand

2.2.1.4 Concrete

2.2.1.5 Controlled Density Fill

- 2.2.2 Pipe bedding and surround: See applicable Sections:

2.2.2.1 Electrical

Division 26

2.2.2.2 Waterworks

Section 33 11 01

- 2.2.3 Trench and excavation backfill to be:

2.2.3.1 Approved Native Material

2.2.3.2 Pit Run Gravel

- 2.2.4 Surface treatment to be:

2.2.4.1 Restoration to match existing conditions

2.2.4.2 Subgrade, subbase and base for works described in other Sections

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2.2.4.3 Topsoil, grass, sod, or requirements for landscaping works described in other Sections

2.3 Materials

- 2.3.1 Refer to Section 31 05 16 - Aggregates and Granular Materials for specifications for approved granular materials.
- 2.3.2 Concrete: to be minimum 30 MPa or as indicated on the Structural drawings and Division 03 Concrete.
- 2.3.3 Other granular materials: granular materials approved for roadwork (subbase, base) also acceptable for trench backfill subject to approval of *Consultant*.
- 2.3.4 Anchor blocks: where specified or required by *Consultant* provide anchor blocks as shown on Standard Detailed Drawings. All concrete anchor blocks to be carried at least 150 mm into undisturbed ground on bottom and sides of trench. Concrete to be of type indicated in these specifications.

3.0 EXECUTION

3.1 Site Preparation

- 3.1.1 Remove all brush, weeds, grasses, stumps, and accumulated debris from site.
- 3.1.2 Cut pavement or sidewalk neatly along limits of proposed excavation as shown on Standard Detail Drawings in order that surface may break evenly and cleanly. Cut beyond limits shown only if approved by *Consultant*.
- 3.1.3 Where trench passes through a lawn, neatly cut and remove sod before trench excavation. Save sod for replacement upon backfilling trench. Keep sod in moist condition in preparation for reinstallation.
- 3.1.4 Strip topsoil after area has been cleared and stockpile in locations as directed by *Consultant*. Stockpile height not to exceed 2 m. Avoid mixing topsoil with subsoil. Dispose of unused topsoil as directed by *Consultant*. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

3.2 Stockpiling

- 3.2.1 Stockpile fill materials in areas designated by *Consultant*. Stockpile granular materials in manner to prevent segregation.
- 3.2.2 All excavated material shall be piled in a manner that will not endanger persons, the work or adjacent properties and will avoid obstructing roads, surface drainage ditches, sidewalks, driveways, hydrants and control devices. Gutters, ditches, and culverts shall be kept clear or other satisfactory provisions shall be made by the Contractor for drainage.

3.3 Excavation

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- 3.3.1 Connection to existing mains:
 - 3.3.1.1 Prior to or at commencement of construction, check existing main for line and elevation at point of connection. If found different from *Contract Drawings* report such difference to *Consultant* immediately, and cease construction pending instructions from *Consultant*.
 - 3.3.1.2 Connections to existing system to be made by *Contractor* under direct supervision of utility. Make all necessary arrangements with utility to schedule work to prevent construction delays.
 - 3.3.1.3 To prevent damage to existing utilities, excavate last 300 mm over utility by hand.
- 3.3.2 Surface drainage: provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.
- 3.3.3 Excavation to grade: excavate trenches to allow pipe to be laid to alignment and grades required with allowance for specified pipe bedding.
- 3.3.4 Excavation below grade: when bottom of excavated trench at subgrade is unstable and in opinion of *Consultant*, cannot adequately support pipe, install pipe using bedding as shown on *Contract Drawings* or over-excavate trench to suitable subgrade or as directed by *Consultant*. Backfill over-excavation with specified materials and compact to minimum 98% Standard Proctor Density in compliance with ASTM D698.
- 3.3.5 Trench width: excavate trench to section and dimensions shown on Standard Detail Drawings. If width exceeds maximum allowable, *Contractor* may be required to demonstrate that specified pipe is still adequate or provide pipe with approved higher strength class or provide approved higher class of bedding. All additional requirements as a result of excessive trench width to be to *Contractor's* cost.
- 3.3.6 Hand excavation: excavate by hand if necessary to preserve or minimize damage to existing trees, shrubs, buildings and all similar existing features or facilities
- 3.3.7 Trench bottom conditions: remove disturbed or softened material and protruding or loose rocks from trench bottom before placing bedding material. Maintain trench free from water and soft materials during placement of pipe bedding, pipe installation and trench backfill to ensure proper compaction of granular materials.
- 3.3.8 Trench drainage:
 - 3.3.8.1 During pipe laying, jointing, bedding, and backfilling, keep trench free of water by pumping or other appropriate means. Pumps and dewatering equipment to be provided and precautions taken to prevent any damage to

EXCAVATING, TRENCHING AND BACKFILLING

adjoining buildings, structures, roads or land from prolonged or excessive pumping by installing shoring, sheeting, or other supportive measures. Water to be discharged from excavations in such a manner as not to cause nuisance, injury, loss or damage. *Contractor* to be responsible for any claims or actions arising from such discharge of water.

3.3.8.2 Keep bell holes free from water during jointing. Diverting trench water through newly laid system not allowed, unless authorized by *Consultant*.

3.3.8.3 In wet conditions, where the *Contractor* desires to use drain rock bedding in place of the bedding specified he may do so only with the written permission of the *Consultant* and the incremental cost of such drain rock bedding shall be solely at the *Contractor's* expense. The *Consultant* will review the *Contractor's* request after the *Consultant* has assured himself that the *Contractor* has made every reasonable effort within the requirements of this Contract to keep the trench free of water.

3.3.9 Disposal of surplus soil: Side-casting not allowed in restricted areas where, in opinion of the *Consultant*, side-casting would create interference with flow of traffic. In such case, materials to be temporarily stored or disposed of on approved site.

3.3.10 Roads used for transporting materials and equipment to be maintained in clean condition. Clean, flush and/or sweep on daily basis and more frequently if directed by *Consultant*.

3.3.11 Unless otherwise authorized by *Consultant* in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

3.4 Pipe Installation

3.4.1 Related work: Pipe installation, including bedding, pipe laying, and granular surround to be in accordance with the following sections:

3.4.1.1 Electrical Division 26

3.4.1.2 Waterworks Section 33 11 01

3.4.2 Concrete encasement: where specified or required by *Consultant* provide concrete encasement of pipe as shown on Standard Detail Drawings. Do not place backfill materials until concrete has taken its initial set and in no case less than 1 h.

3.4.3 Rock excavation in trenches shall provide a minimum clearance of 150 mm below the pipe, including the pipe bell.

3.5 Backfill and Compaction

3.5.1 General

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- 3.5.1.1 Do not proceed with trench backfilling operations until *Consultant* has inspected and approved installations.
- 3.5.1.2 Ensure trenches are free from debris, snow, ice, and water.
- 3.5.1.3 Do not use backfill material which is frozen or contains ice, snow, or debris.
- 3.5.1.4 Do not backfill around or over cast-in-place concrete within 24 h after placing.
- 3.5.1.5 Place layers simultaneously on both sides of installed work to equalize loading.
- 3.5.1.6 During backfill and compaction of trench, remove shoring or cages in such a manner as to allow proper compaction and to prevent trench walls from collapsing. Remove all bracing and/or shoring from trench.
- 3.5.1.7 Place backfill by rolling down a slope or lowering by machine. Prevent backfill from dropping vertically on to the pipeline installation.
- 3.5.2 Backfill Materials above pipe zone
 - 3.5.2.1 Boulevards and easements: for trenches in boulevards, easements, or other areas not subject to vehicle loading and outside of ditchlines, backfill to be native material, except as shown otherwise on *Contract Drawings* or directed by the *Consultant*.
 - 3.5.2.2 Roads, driveways and shoulders: for trenches in paved or gravelled roads, driveways, shoulders or other areas subjected to vehicle loading, backfill to be approved native material, or imported material as specified on the *Contract Drawings* or directed by the *Consultant*.
 - 3.5.2.3 Ditches: backfill to be approved native material or imported material as specified on the *Contract Drawings* or directed by the *Consultant*.
 - 3.5.2.4 *Consultant* may permit native material for all above uses subject to suitability of native material for said use.
- 3.5.3 Compaction
 - 3.5.3.1 Place backfill and compact to following Standard Proctor densities in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).
 - 3.5.3.1.1 To a minimum 98% Standard Proctor Density for depths greater than 1.5 from subgrade elevation and or as otherwise specified on the *Contract Drawings*.
 - 3.5.3.1.2 To a minimum 98% Standard Proctor Density for depths within the top 1.5m from the subgrade elevation or as otherwise specified on the *Contract Drawings*.

EXCAVATING, TRENCHING AND BACKFILLING

3.5.3.1.3 Use caution in pipe zone to ensure no damage to pipe.

3.5.3.1.4 Maximum thickness of lift not to exceed 200mm in compacted state for granular soils, 150mm for non-granular soils.

3.5.3.1.5 Where additional water is required to obtain the specified density, it shall be applied in such a manner to maintain uniform moisture content. Cost of additional water supply and application shall not be in considered for separate payment.

3.5.3.1.6 Motorized compaction equipment shall be used with extreme caution to prevent damage to public or private property or to the new installation.

3.6 Inspection and Testing

3.6.1 Testing of materials and compaction to be carried out by testing laboratory designated by *Consultant*. Frequency of tests to be determined by *Consultant*.

3.6.2 *Owner* to pay costs for inspection and initial testing.

3.6.3 If initial test determine materials or compaction not as specified, *Contractor* to take all steps necessary to correct deficiencies. Subsequent testing to *Contractor's* cost.

3.7 Surface Restoration

3.7.1 General:

3.7.1.1 Restore all disturbed surfaces to condition at least equal to that which existed prior to construction.

3.7.1.2 Make good any damage to adjacent lands or improvements.

3.7.1.3 Resolve all reasonable claims arising from *Contractor's* actions and obtain written releases from landowners following restoration.

3.7.2 Boulevards and easements:

3.7.2.1 Surface restoration to be minimum 150mm depth.

3.7.2.2 Restore unimproved surfaces with material equal to that removed at surface.

3.7.2.3 Restore gardens with topsoil.

3.7.2.4 Restore lawns with topsoil and sod to match existing lawn.

3.7.2.5 Restore gravel surfaces with granular base material.

3.7.2.6 Complete final restoration immediately upon completion of trench backfilling.

3.7.3 Gravelled roads and driveways:

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- 3.7.3.1 Restore surface with minimum 100mm granular road base material.
- 3.7.3.2 Compact to minimum 100% Standard Proctor Density.
- 3.7.3.3 Complete final restoration immediately upon completion of trench backfilling.
- 3.7.4 Ditches:
 - 3.7.4.1 Shape ditch to specified lines, grades, and sections and restore surface with minimum 300mm of native material to ensure stability of ditch slopes and bottom.
 - 3.7.4.2 Compact to minimum 98% Standard Proctor Density.
 - 3.7.4.3 Complete final restoration immediately upon completion of trench backfilling.
- 3.7.5 Sub-base and base preparation for paved surfaces:
 - 3.7.5.1 Paved surfaces to include all paved roads, driveways, sidewalks, and parking areas.
 - 3.7.5.2 If native material used for backfill, minimum 300mm granular road subbase materials and additional as required to match existing depth of sub-base in excess of 300mm or provide specified depth of sub-base as shown on *Contract Drawings* in accordance with Section 32 11 16.01, (Granular Sub-base).
 - 3.7.5.3 Place granular base material to specified depth as shown on *Contract Drawing* and in accordance with Section 32 11 23 (Granular Base) once sub-base layer has been inspected and approved by *Consultant*.
- 3.7.6 Permanent pavement restoration:
 - 3.7.6.1 Install permanent pavement within 14 days of placement of pipe installation.
 - 3.7.6.2 Sawcut original pavement minimum of 300mm from edge of broken or cracked pavement as well as any paved areas showing settlement.
 - 3.7.6.3 Remove pavement from within limits of sawcut and dispose off-site.
 - 3.7.6.4 Remove underlying granular road base materials as required to permit placement of specified thickness of permanent pavement. Ensure remaining base meets specified thickness of road base to Granular Base - Section 31 11 23.
 - 3.7.6.5 Compact base to minimum 100% Standard Proctor Density.
 - 3.7.6.6 Clean edges of cut pavement to remove all loose material. If thickness of existing pavement permits, mill 25mm depth along saw cut edge of

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pavement. Dry if necessary and paint clean, dry edge with asphalt emulsion (tack coat).

3.7.6.7 Place and compact hot-mix pavement material to minimum thickness as shown on *Contract Drawings*.

3.7.6.8 Material and placement of hot-mix pavement to Hot-Mix Asphalt Concrete Paving - Section 32 12 16.

3.7.6.9 Restored surface to be smooth and matching with grade of adjacent pavement.

3.7.6.10 Maintain restored pavements in complete repair during the Contract Maintenance Period. Effect repairs within 14 days from receipt of written notice from City or immediately if so directed by *Consultant* if dangerous situation exists.

3.7.7 Landscape restoration

3.7.7.1 Restoration of planted areas, either in private or public places, to consist of restoration to original condition by replacement of original depth of topsoil (minimum of 100mm of imported topsoil), sodding of grassed areas and replacement of any killed or removed plants or shrubs by ones of equal quality, type, and maturity to originals. Should restored item fail to grow successfully either throughout work area, or in patches, it is to be redone so that a successful regrowth is established over entire area.

3.7.7.2 Replacement trees and shrubs to be planted at a suitable time of year in accordance with good horticulture practice, to provide maximum assurance of plant survival. Trees or shrubs close to, but not actually within excavated area, which show signs of dying during maintenance period to be replaced by new trees of a similar variety, age and size, up to limits of maximum available size, if tree has died as a result of environmental disturbance, cutting of roots, or other cause directly attributable to *Contractor's* work.

3.7.8 Restoration acceptance: no restoration work to be considered satisfactory until acceptance by *Consultant* and in case of properties not owned by the *Owner*, until a written and signed statement of release from property *Owner* has been obtained by *Contractor* and provided to *Consultant*.

3.7.9 Settlement of the constructed areas occurring prior to the end of the maintenance period as a result of error or negligence on the part of the *Contractor*, shall be corrected by the *Contractor* at no extra cost to the *Owner*. Any damages to the works as a result of settlement shall be restored or repaired by the *Contractor* to the *Owner's* approval and at no additional cost to the *Owner*. Any deficiency in the quantity of material for backfilling or filling depressions caused by settlement shall be supplied and placed by the *Contractor*.

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END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

SUBGRADE PREPARATION

1.0 GENERAL

1.1 Description

1.1.1 This section specifies requirements for working and compacting subgrade soil.

1.2 Definition

1.2.1 Prepared subgrade: soil immediately below the granular sub-base, base course, pavement structure or concrete slab, pad or curb & gutter, and boulevards, compacted to a minimum depth of 300 mm or as specified on the drawings.

1.3 Quality Assurance

1.3.1 Refer to Section 01 43 00 – Quality Assurance.

1.4 Quality Control

1.4.1 Maximum Density: the dry unit mass of a sample of soil at optimum moisture content as determined according to ASTM-D698 method A.

1.4.2 Required Densities:

1.4.2.1 Minimum of 100% of SPMDD for each 150 mm lift of subgrade under pavement structures, concrete; curb & gutter, curb ramps, alley and access crossings

1.4.2.2 Minimum of 98% of the maximum density for each 150 mm lift of subgrade under concrete sidewalks, asphalt trails.

1.4.2.3 Minimum of 95% of the maximum density for each 150 mm lift of subgrade under turf areas, planting beds and disturbed areas.

1.4.3 Testing Frequency to ASTM-D2169 or to ASTM-D2922:

1.4.3.1 Subgrade – one for each 1,000 m² of compacted lift.

1.4.3.2 Fill – one for each 2,000 m² of compacted lift.

1.4.4 Proof Rolling: a proof roll of the finished subgrade will be required to confirm adequate bearing capacity of the subgrade soil. Proof rolling will be done using a single axle dual wheel truck loaded to a minimum 9,100 kg on the rear axle. Tires to be inflated to a minimum 275 KPa.

1.4.5 The *Contractor* shall perform as many tests as are necessary to ensure that the work conforms to the requirements of the *Contract* regardless of the minimum number specified.

SUBGRADE PREPARATION

2.0 PRODUCTS

2.1 Materials

- 2.1.1 Use only compacted subgrade soil with no deleterious material approved by the *Consultant*.

2.2 Equipment

- 2.2.1 Use various pieces of equipment designed for diskings, scarifying, spreading, spraying water, compacting and trimming material to specified depth and cross section and proof rolling.

3.0 EXECUTION

3.1 Subgrade Preparation

- 3.1.1 Loosen subgrade material to a minimum of 150 mm. Work subgrade material with cultivating and mixing equipment until it is pulverized into pieces no larger than 25 mm maximum, exclusive of all rock.
- 3.1.2 The required compaction can generally best be achieved if the subgrade material is dried or moistened at + 3% to - 3% of the optimum moisture content prior to compacting.
- 3.1.3 Leave the surface of the compacted subgrade slightly higher than required elevation; then trim to the required elevation.
- 3.1.4 Leave the finished surface even and free of depressions, humps, loose debris and foreign material.
- 3.1.5 Finished subgrade shall be within 6 mm above the specified elevation or within 25 mm below the specified elevation.

3.2 Tolerances

- 3.2.1 Trim high spots and refinish surface to within tolerance.
- 3.2.2 Add approved material to low areas, scarify and blend to full subgrade depth re-compact to required density and refinish surface at the *Contractor's* expense. Fill low areas with extra thickness of subsequent granular sub-base or base course at the *Contractor's* expense
- 3.2.3 If a density test result is less than the required density, the test result is discarded and 3 retests shall be performed on the area represented by the failed test. The average of the 3 tests shall represent the density of that area. If this average is less than the required density, the area shall be reworked to the full depth of the

SUBGRADE PREPARATION

lift, the soil moisture altered as necessary and re-compacted to the required density. If the area is not retested but is reworked and re-compacted the area shall be tested at the normal testing frequencies.

- 3.2.4 The *Contractor* shall assume the risk of uncovering and reworking the subgrade if it is covered before the *Consultant* has accepted the test result.

3.3 Protection of finished *Work*

- 3.3.1 Do not permit vehicle traffic over prepared subgrade.
- 3.3.2 If the subgrade floods, drain immediately by natural flow or by pumping into catch basins, manholes or ditches. This *Work* shall be done at the *Contractor's* expense.
- 3.3.3 Maintain protection of the prepared subgrade until subsequent granular sub-base or base course is placed. Repair and retest as required by the *Consultant* if damaged.

END OF SECTION

GRANULAR SUBBASE

1.0 GENERAL

- 1.1 Section 32 11 16.01 refers to those portions of the Work that are unique to the supply and placement of granular subbase materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
- | | | |
|-------|---|---------------------|
| 1.2.1 | Aggregates and Granular Materials | Section 31 05 16 |
| 1.2.2 | Excavating, Trenching and Backfilling | Section 31 23 33.01 |
| 1.2.3 | Roadway Excavation, Embankment and Compaction | Section 31 24 13 |
| 1.2.4 | Granular Base | Section 32 11 23 |
- 1.3 The abbreviated standard specifications for testing materials, fabrication, and supply referred to herein, are fully described in Quality Assurance - Section 01 45 00.

2.0 PRODUCTS

2.1 Granular Sub-base

Material for granular road sub-base to be in conformance with Section 31 05 16 - Aggregates and Granular Materials, for Materials Specification.

3.0 EXECUTION

3.1 Inspection of Existing Subgrade Surface

- 3.1.1 Place granular sub-base after sub-grade is inspected and approved by the *Consultant*.

3.2 Placing

- 3.2.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- 3.2.2 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- 3.2.3 Place material to full width in uniform layers not exceeding 150mm compacted thickness. *Consultant* may authorize thicker lifts if specified compaction can be achieved.
- 3.2.4 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- 3.2.5 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 Compaction Equipment

- 3.3.1 Compaction equipment must be capable of obtaining required densities in materials on project.

GRANULAR SUBBASE

3.4 Compacting

- 3.4.1 Compact to density of not less than 100% Standard Proctor Maximum Dry Density in accordance with ASTM D698.
- 3.4.2 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- 3.4.3 Apply water as necessary during compaction to obtain specified density. If sub-base is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- 3.4.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by *Consultant*.

3.5 Finish Tolerances

- 3.5.1 Finish compacted surface to within plus or minus 10mm of established grade and cross section but not uniformly high or low.
- 3.5.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.6 Proof Rolling

- 3.6.1 For proof rolling use roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 915mm maximum.
- 3.6.2 *Consultant* may authorize use of other acceptable proof rolling equipment.
- 3.6.3 Proof roll at level in sub-base as indicated. If alternative proof rolling equipment is authorized, *Consultant* will determine level of proof rolling.
- 3.6.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- 3.6.5 Where proof rolling reveals areas of defective subgrade:
 - (a) Remove sub-base and subgrade material to depth and extent as directed by *Consultant*.
 - (b) Backfill excavated subgrade with approved common material and compact in accordance with Section 31 24 13 - Roadway Excavation, Embankment and Compaction.
 - (c) Replace sub-base material and compact.
- 3.6.6 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.

GRANULAR SUBBASE

3.7 Maintenance

- 3.7.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by *Consultant*.

END OF SECTION

GRANULAR BASE

1.0 GENERAL

- 1.1 Section 32 11 23 refers to those portions of the Work that are unique to the supply and placement of granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Aggregates and Granular Materials Section 31 05 16
 - 1.2.2 Roadway Excavation, Embankment and Compaction Section 31 24 13
- 1.3 References
 - 1.3.1 The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance - Section 01 43 00.

2.0 PRODUCTS

- 2.1 Granular Base
 - 2.1.1 Material for granular base to be in conformance with Section 31 05 16 - Aggregates and Granular Materials, for material specifications.

3.0 EXECUTION

- 3.1 Inspection of Subgrade Surface
 - 3.1.1 Do not place granular base until subgrade surface is inspected and approved by *Consultant* as outlined in Section 31 24 13 – Roadway Excavation, Embankment and Compaction.
 - 3.1.2 Road surface shall be shaped to the proper grade, crown and super elevation as shown on the *Contract Drawings* or as directed by the *Consultant*.
 - 3.1.3 The *Contractor* shall advise the *Consultant* at least 48 hours prior to commencement of gravel surfacing operations to allow inspection of the prepared subgrade surface.
- 3.2 Placing
 - 3.2.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice.

GRANULAR BASE

- 3.2.2 Place material to full width in uniform layers not exceeding 200mm compacted thickness. *Consultant* may authorize thicker lifts if specified compaction can be achieved.
- 3.2.3 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- 3.2.4 Remove and replace that portion of layer in which material becomes segregated during spreading.
- 3.3 Compaction Equipment
 - 3.3.1 Compaction equipment must be capable of obtaining required densities in materials on project.
- 3.4 Compacting
 - 3.4.1 Compact to density not less than 100% Standard Proctor Density in accordance with ASTM D698.
 - 3.4.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - 3.4.3 Apply water as necessary during compacting to obtain specified density. If materials is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
 - 3.4.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by *Consultant*.
- 3.5 Finish Tolerance
 - 3.5.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.
 - 3.5.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- 3.6 Maintenance
 - 3.6.1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by *Consultant*.
- 3.7 Acceptance
 - 3.7.1 The *Contractor* shall notify the *Consultant* upon completion of the granular base course prior to paving work.
 - 3.7.2 The *Consultant* will review the granular base course for acceptance prior to paving work.

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GRANULAR BASE

END OF SECTION

CHAIN LINK FENCING

1.0 GENERAL

1.1 Description

- .1 This section specifies requirements for chain link fencing.

1.2 Related Work

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

1.3 Location

- .1 The location of the fence terminal posts, and gates is shown on the *Drawings*.

1.4 Quality Assurance

- .1 Fence layout details to be approved on site by the *Consultant* prior to installation.
- .1 Fence erection shall be carried out by experienced fence construction personnel.
- .2 Supply materials to CGSB-138.1.

2.0 PRODUCTS

2.1 Fabric

- .1 Fabric height as indicated on *Drawings*.
- .2 Chain Link 50 mm x 9 gauge wire finished as indicated on *Drawings*; knuckled selvage top and bottom
- .1 Galvanized to CAN/CGSB-138.1
- .2 Vinyl coated to 0.045 mm dry film thickness minimum

2.2 Wire

- .1 Tension wire – single strand 4.5 mm galvanized steel.
- .2 Wire Ties - 5 mm aluminum or 3 mm galvanized steel
- .3 Barbed wire – 2 mm diameter galvanized steel with 4-point barbs at 150 mm spacing to ASTM-A121

2.3 Posts and Rails

- .1 Schedule 40 galvanized steel pipe to CAN/CGSB-138.2

CHAIN LINK FENCING

- .2 Line Posts - 60 mm O.D. c/w tops.
 - .1 Terminal Posts - for ends, gates and corners - 90 mm with gate posts as specified in Article 2.5.
 - .2 Top Rail - 42 mm O.D.
 - .3 Bracing - 42 mm O.D.
 - .3 Posts heights to be suitable for hole depths, specified height of posts to match the height indicated on the *Drawings*, and barbed wire overhang, if indicated.
- 2.4 Fittings
- .1 Top rail ends, brace bands, tension bars, arms, tops, sleeves, hinges and latches in accordance with *Drawings*.
 - .2 All fittings to be hot dipped galvanized steel or cast aluminum.
 - .3 Terminal and gate posts to have dome tops.
 - .4 Stretcher Bars - min 5 x 20 steel.
- 2.5 Gates
- .1 Gates to be framed with steel pipe ASTM-A120 standard weight galvanized after welding. Use 42 mm O.D. pipe for outside frame and 35 mm O.D. pipe for bracing.
 - .2 Gate fabric to be the same as fence fabric.
 - .3 Gate posts to conform to the following:

<u>Opening</u>	<u>Gate Post O.D.</u>
Single to 3.0 m and Double to 6.0 m	90 mm
Single from 3.0 to 4.2 m Double to 8.5 m	114 mm
Single from 4.3 m to 7.6 m Double from 8.5 m to 12 m	170 mm
 - .4 Gate hardware to include galvanized malleable iron hinges, lockable latch and latch catch accessible from both sides of gate.
 - .5 Double gates to have centre rest with drop bolt for closed position and chain hook to hold gate in open position.

CHAIN LINK FENCING

- .6 Gate braces to be 45 mm O.D. galvanized steel.

2.6 Concrete

- .1 Compressive strength 20 MPa at 28 days.
- .2 Use type 50 sulphate resistant cement.

3.0 EXECUTION

3.1 General

- .1 Install fence to CGSB-138.3.

3.2 Grading

- .1 Remove debris and grade between posts to provide ground clearance between 40 mm and 70 mm.

3.3 Post Setting

- .1 Line post holes to be 1060 mm deep, 250 mm diameter.
- .2 Terminal post holes to be 1220 mm deep, 300 mm diameter.
- .3 Line posts to be spaced maximum 3.0 m.
- .4 Set posts in line and plumb so that the fence forms a straight line between corner posts.
- .5 Set posts in concrete and extend concrete 40 mm above grade for drainage.
- .6 Install straining posts at equal intervals not exceeding 150 m spacing, and at top and bottom of sharp grade changes.
- .7 Install corner post where change in alignment exceeds 10°.
- .8 Install end posts at end of fence runs, at buildings and at changes in fence height.
- .9 Install gate posts at both sides of gate.

3.4 Fence Erection

- .1 Allow concrete to cure sufficiently before erecting fence - minimum 5 days.
- .2 Set braces between end posts, gate posts and line posts.
- .3 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate

CHAIN LINK FENCING

and straining posts with turnbuckles and tension bar bands.

- .4 Lay out fabric, stretch tightly to tension recommended by manufacturer and secure to end, corner, gate and straining posts with tension bar secured to posts with tension bar bands at 375 mm spacing.
- .5 Install top rail and fasten to posts with caps.
- .6 Secure fabric with tie wires at 450 mm intervals to top and line posts and to tension wire.

3.5 Gate Installation

- .1 Locations and sizes of gates are shown on the *Drawings*.
- .2 Level grade between gateposts and set gate bottom 40 mm above ground surface.
- .3 Determine location for centre gate rest for double gate and cast concrete gate rest with domed top and cast-in pipe to take drop bolt.

3.6 Cleanup

- .1 Touch up damaged galvanized by cleaning with a wire brush and applying two (2) coats of organic zinc-rich paint for galvanized metal.
- .2 Clean up debris and earth removed from posts holes and trim areas disturbed.

END OF SECTION

HYDRAULIC SEEDING

1.0 GENERAL

Section 32 92 19.16 refers to those portions of the *Work* that are unique to the supply and application of grass seed by hydraulic seeding. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 References

- 1.1.1 Canada Seed Act
- 1.1.2 British Columbia Landscape Standard
- 1.1.3 Canadian System of Soil Classification

1.2 Scheduling

- 1.2.1 Schedule all operations to ensure optimum environmental protection, grading, growing medium or topsoil placement, planting and seeding operations as outlined in these Specifications. Organize scheduling to ensure minimum movement and compaction of topsoil or growing medium and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.
- 1.2.2 Schedule seeding after frost has left ground and before July 1st, or between August 15th and September 15th.
- 1.2.3 Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet requirements of living plant material.
- 1.2.4 Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants.

1.3 Handling and Storage

- 1.3.1 All seed, mulch, fertilizers and related materials, where required, to be stored in dry, weatherproof storage place and to be protected from damage by heat, moisture, rodents or other causes until time of seeding. Labels or other identification to not be removed or defaced.

1.4 Drainage Control

- 1.4.1 Provision to be made for proper water management and drainage of site during construction. To include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period.

1.5 Quality Control

HYDRAULIC SEEDING

- 1.5.1 All products and materials used in work to be subject to testing when *Consultant* determines that testing is necessary to ensure specified standards are met.
- 1.5.2 Provide *Consultant* with tag or label printed by seed supplier for original container of each different seed mix delivered.
- 1.6 Site Examination
 - 1.6.1 No seeding to be carried out in areas or over surfaces that are not properly prepared. *Contractor* to examine site before starting work to verify all surfaces are properly prepared.

2.0 PRODUCTS

- 2.1 Grass and Legume Seed
 - 2.1.1 Grass seed to meet requirements of Canada Seed Act for Canada No. 1 seed. Where specified, all nurse crop seed to meet requirements of Canada Seed Act for Canada No. 1 seed.
 - 2.1.2 Seed mixtures or indicated on the drawings to be approved by *Consultant* and to be suited to climate, terrain, establishment and maintenance conditions under which they are to be grown. Mixture to be mixed and supplied by recognized seed house.
 - 2.1.3 Legume seed to be supplied with appropriate type and quantity of Rhizobium inoculant. Add inoculant to seed mixture immediately before seeding.
 - 2.1.4 Seed to be packed and delivered in original containers clearly showing:
 - (a) Name of supplier.
 - (b) Analysis of seed mixture
 - (c) Percentage of pure seed
 - (d) Year of production
 - (e) Net weight (mass)
 - (f) Date and location of bagging
 - 2.1.5 Seed to have a minimum germination rate of 75% and minimum purity of 97% except where otherwise required by professional selecting seed mixture.
- 2.2 Mulch Material
 - 2.2.1 Specially prepared wood cellulose and/or textile fabric of a type commonly used and approved for hydraulic mulching.

HYDRAULIC SEEDING

- 2.2.2 Capable of dispersing in water to form a homogenous slurry and remaining in such state when agitated or mixed with other specified materials. When applied, hydraulic mulch to be capable of forming absorptive mat, which will allow moisture to percolate into underlying soil and to contain no growth or germination inhibiting factors. Mulch to be dry free of weeds and all other foreign material and to be supplied in packages bearing manufacturer's label clearly indicating weight and product name.
- 2.2.3 Capable of forming an absorptive mat ground cover allowing water percolation but not inhibiting seed germination and growth.
- 2.2.4 Material to be clean, weed free and contain a non-toxic green dye to aid in visual inspection after application.
- 2.3 Tackifier
 - 2.3.1 Mulch may contain a colloidal polythacuride (or equivalent) tackifier, which is to be adhered to mulch to prevent separation during shipment and to avoid chemical agglomeration during mixing in hydraulic mulching equipment.
- 2.4 Water
 - 2.4.1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
- 2.5 Erosion Control Blanket
 - 2.5.1 Nilex C125 or approved equal.

3.0 EXECUTION

- 3.1 Workmanship
 - 3.1.1 Take care to prevent spraying items such as structures, utilities and plant materials.
- 3.2 Preparation
 - 3.2.1 Verify that grades are correct and prepared in accordance with Section 31 24 13 – Roadway Excavation, Embankment and Compaction and do not commence work until instructed by *Consultant*.
 - 3.2.2 Do not perform work under adverse field conditions such as winds greater than 10 km per hour, frozen soil, hot and arid conditions, excessively wet or dry soil or soil covered with snow, ice or standing water.
 - 3.2.3 Remove and dispose of weeds; debris; soil contaminated by oil, gasoline and other deleterious material; to approved off-site disposal area.

HYDRAULIC SEEDING

- 3.2.4 Scarify or rake the soil surface perpendicular to the slope to provide a surface that will enhance the germination of seed.
- 3.2.5 Finish grade smooth to extent required for class of seeding to be carried out, firm against footprints, loose textured, and free of all stones, roots, branches, etc. larger than diameter required for removal for class of seeding to be carried out.
- 3.3 Seeding – General
 - 3.3.1 Scheduling: carry out seeding during periods that are most favourable for establishment of healthy stand of grass. Seed only during calm weather and on soil that is free of frost, snow and standing water, when seasonal conditions are likely to ensure successful germination and continued growth of all varieties of seed in grass mix.
 - 3.3.2 Rates of Application: rates of application of fertilizers, seed mixtures, mulch and other components to be based on analysis of season, climate, terrain, soil and establishment and maintenance conditions affecting project.
- 3.4 Equipment
 - 3.4.1 All hydraulic seeding/mulching equipment to equipment and not to be removed or altered.
 - 3.4.2 Hydraulic seeder/mulching to be capable of sufficient agitation to mix materials into homogeneous slurry and to maintain slurry in homogeneous state until application. Discharge pumps and gun nozzles to be capable of applying material uniformly over designated areas.
- 3.5 Protection
 - 3.5.1 Carry out hydraulic seeding with care to ensure fertilizer in solution does not come in contact with foliage of any trees, shrubs or other susceptible vegetation. Do not spray seed or mulch on objects not expected to grow grass.
 - 3.5.2 Protect existing site equipment, roadways, landscaping, reference points, monuments, markers and structures from damage.
 - 3.5.3 Promptly rectify any overspray or damage that occurs during hydraulic seeding.
- 3.6 Slurry Application
 - 3.6.1 Combine seed mixture, mulch material, tackifier and fertilizer at rate as specified on drawing or in specification. Add water and thoroughly mix to form a homogenous slurry.
 - 3.6.2 Use sufficient water to suspend the components in the slurry and provide a uniform coverage of the soil surface at the specified rates.

HYDRAULIC SEEDING

- 3.6.3 Measure quantities of each material to be charged into hydraulic seeder/mulcher tank accurately either by mass or by commonly accepted system of mass-calibrated volume measurements. Add material to tank while it is being filled with water and in following sequence: seed, fertilizer, and where applicable, mulch. Thoroughly mix materials into homogeneous water slurry and distribute uniform over surface area with hydraulic seeder/mulcher. Uniformly apply slurry mixture over areas requiring hydroseeding in a minimum of two passes and a maximum of three passes.
- 3.6.4 Keep seeds for grass and legumes in separate containers prior to seeding.
- 3.6.5 If required, add legume seed to grass mixture at time of seeding. Inoculate legume seed with standard product humus culture before mixing with grass seed. Protect inoculated seed from exposure to sunlight for periods of over one-half hour. Use seed within eight hours from inoculation or to be re-inoculated.
- 3.6.6 After charging, do not add water or other material to mixture in hydraulic mulcher.
- 3.6.7 Do not leave seed, fertilizer, mulch and water slurry in tank for more than 4 h. Slurry left in tank of maximum time to not be used for seeding, dispose off-site.
- 3.6.8 If required, apply wild flower seed following grass hydroseeding.
- 3.6.9 Blend applications into adjacent grass to form uniform surfaces. Clean sprayed slurry mixture from hard surfaces, utilities, site furniture, signs and other structures.
- 3.7 Erosion Control Blanket
 - 3.7.1 Apply blanket over designated areas in accordance with manufacturer's instructions.
 - 3.7.2 Anchor blanket in accordance with manufacturer's recommendations which are to be used as minimum standard and ensure that blanket is held down to maintain firm contact with soil.
- 3.8 Clean-up
 - 3.8.1 Remove all materials and other debris resulting from seeding operations from job site.
- 3.9 Maintenance and Protection
 - 3.9.1 Begin maintenance for seeded areas immediately after seeding has been completed, and continue until issuance of *Total Performance of the Work*.
 - 3.9.2 Include all measure necessary to establish and maintain grass in a vigorous growing condition, including, but not limited to, following:

HYDRAULIC SEEDING

- (a) Mow at regular intervals as required, to maintain grass at maximum height of 100 mm. Do not cut more than 1/3 of blade at any one mowing. Neatly trim edges of seeded areas. Remove heavy clippings immediately after mowing and trimming.
- (b) Water when required and with sufficient quantities to prevent grass and underlying soil from drying out.
- (c) Roll when required and with sufficient quantities to prevent grass and underlying soil from drying out.
- (d) Undertake weed control when density of weeds reaches 10 broadleaf weeds or 50 annual weeds or weedy grasses per 40 m² and reduce density of weeds to zero.
- (e) Immediately repair seeded area that show deterioration or bare spots. Top-dress all areas showing shrinkage due to lack of watering and seed with seed mix that matches original seed mix.
- (f) Protect all seeded areas with warning signs, temporary wire or twine fences, or other necessary means.

3.10 Conditions for *Total Performance of the Work*

3.10.1 *Consultant* will issue *Notice of Total Performance of the Work* only when the following conditions exist:

- (a) Growing medium quality, fertility levels, depths and surface condition are as specified in the *Contract Documents*.
- (b) Grasses are required varieties, free of varieties other than those specified.
- (c) Grass areas are relatively free of weeds, containing no more than two broadleaf weeds or ten annual weeds or weedy grasses per m².
- (d) Grass is sufficiently established that its roots are growing into underlying growing medium.
- (e) Seeded areas have been mown at least three times, last mowing being within 48 h of inspection for acceptance.
- (f) Grasses established in sufficient density that no surface soil visible when mown to height of 38 mm.
- (g) Specified maintenance procedures have been carried out.

3.11 Guarantee / Maintenance

HYDRAULIC SEEDING

- 3.11.1 Customary one year guarantee period for construction industry will apply as standard for landscape work. *Contractor* to guarantee all materials and workmanship for a period of one full year from date of *Total Performance of the Work* unless specified otherwise in the *Contract Documents*.
- 3.11.2 Guarantee includes replacing all seeded areas determined by *Consultant* to be dead or failing at end of guarantee period. Replacements to be made at next appropriate season, and conditions of guarantee will apply to all replacement seeding for one full growing season.
- 3.11.3 Guarantee will not apply to seeded areas damaged after date of *Total Performance of the Work* by causes beyond *Contractor's* control, such as vandalism, "acts of God", 'excessive wear and tear', or abuse. *Contractor* is responsible for *Work* until *Total Performance of the Work*.

END OF SECTION

DIVISION 33 - UTILITIES

CCTV INSPECTION OF PIPELINES

1.0 GENERAL

- 1.1 Section 33 01 30.1 refers to those portion of the *Work* that are unique to the requirements for inspecting new and existing sanitary sewers, storm and combined sewers and pipe culverts by closed circuit television.
- 1.2 Related Work
 - 1.2.1 Cleaning of Sewers Section 33 01 30.02
- 1.3 References
 - 1.3.1 These specifications must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
 - 1.3.2 Reference standards, specification or publications.
 - 1.3.2.1 Water Research Centre (WRC) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.
 - 1.3.3 Nomenclature
 - 1.3.3.1 NAAPI – North American Association of Pipeline Inspectors)
 - 1.3.3.2 CCTV – Closed Circuit Television
 - 1.3.3.3 JPEG – Joint Photographic Experts Group
 - 1.3.3.4 MPEG – Movie Photographic Experts Group
 - 1.3.3.5 S-VHS – Super VHS format
 - 1.3.4 Submission of Certification
 - 1.3.4.1 Cleaning of Sewers Section 33 01 30.02
 - 1.3.5 Submission of Certification
 - 1.3.5.1 Submit copy of the CCTV operator's training certification to the *Prime Consultant* at least one week prior to the start of the CCTV inspection operations.
 - 1.3.5.2 Submit copy of certificate for each CCTV operator working on the contract.

CCTV INSPECTION OF PIPELINES

1.3.6 Work Regulations

1.3.6.1.1 Work to conform to all applicable regulations of the Alberta Government and OH&S Standards. Confirm training compliance in the following:

1.3.6.1.2 Confined space entry

1.3.6.1.3 Ventilation

1.3.6.1.4 Atmospheric monitoring

1.3.6.1.5 Personal protective equipment

1.3.6.2 .2 Provide written confirmation to the *Prime Consultant* that workers have knowledge of confined space entry practices and of equipment required for confined space entry.

1.3.7 Scheduling of Work

1.3.7.1 Schedule work to minimize interruptions to existing services.

1.3.7.2 Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11).

2.0 PRODUCTS

2.1 Equipment

2.1.1 Survey Vehicle to contain a separate area for viewing, recording and controlling the CCTV operation.

2.1.1.1 Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation to be provided to enable one person in addition to the operator to clearly view the monitor screen.

2.1.1.2 All equipment utilized within the pipeline to be stored outside the viewing, recording and control area.

2.1.1.3 Vehicle to be equipped with a telephone for communication with the *Prime Consultant* for the duration of the work.

2.1.1.4 Electrical power for the system to be self-contained. External power sources from public or private sources not permitted.

CCTV INSPECTION OF PIPELINES

- 2.1.2 Survey Equipment to have sufficient cables to view the lengths of pipe as specified.
 - 2.1.2.1 Survey unit to be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
 - 2.1.2.2 Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
 - 2.1.2.3 Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.
- 2.1.3 Camera to be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - 2.1.3.1 Camera to be "Pan & Tilt" and have the capability of panning the pipe at 360° with tilt capability of 270°.
 - 2.1.3.2 Live picture to be visible with no interference and capable of registering a minimum number of 400 lines of resolution at the periphery.
 - 2.1.3.3 Focus and iris adjustment to allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150 mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - 2.1.3.4 Camera to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.
- 2.1.4 Digital video files shall be MPEG2 and conform to the following requirements:
 - 2.1.4.1 Picture Size: NTSC 704 x 480 at 29.97 frames per second
 - 2.1.4.2 Digital video files to be stored on new, unused DVD media.
- 2.1.5 Photographs to be colour, minimum image size 90 mm x 70 mm and reproduced on premium glossy ink jet paper when required, as specified in the Agreement.

CCTV INSPECTION OF PIPELINES

3.0 EXECUTION

3.1 CCTV Inspection

- 3.1.1 CCTV operator to have received training by NAAPI or NASSCO.
- 3.1.2 Submit sample of inspection reports, video in DVD format together with corresponding digital data file for review within one week of receipt of notice to proceed with contract. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent inspection report submissions.
- 3.1.3 No inspection surveys to be carried out under this contract until an acceptable sample inspection report has been approved by the *Prime Consultant*.
- 3.1.4 Flow in the pipeline not to exceed approximately 20% of the pipe diameter. Notify *Prime Consultant* of excessive flows, inspect using flow reduction method (See Clause 3.11).
- 3.1.5 Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.
- 3.1.6 Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.
- 3.1.7 Inspection video image to be produced in MPEG2 format:
 - 3.1.7.1 Create separate digital file for each individual Manhole to manhole inspection report.
- 3.1.8 Set zero chainage at face of every manhole or on entrance into pipe or start or pipe culvert.
- 3.1.9 Report and record on full length of pipeline from inside face to inside face between manhole or outlet end of pipes and from one end of pipe culvert to the other.
- 3.1.10 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- 3.1.11 Data generator to electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information prior to the start of each run:

CCTV INSPECTION OF PIPELINES

- 3.1.11.1 Manhole (from-to) / pipe length reference numbers.
- 3.1.11.2 Pipeline dimensions
- 3.1.11.3 Pipe material (i.e. vitrified clay, concrete, PVC etc.)
- 3.1.11.4 Type or use of pipe (i.e. sanitary, storm or combined sewer)
- 3.1.11.5 Date of survey (yyyy.mm.dd)
- 3.1.11.6 Road name/location
- 3.1.11.7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
- 3.1.11.8 Inspection (report) number
- 3.1.11.9 Verbal description of all the above on screen information.
- 3.1.12 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- 3.1.13 Data generator to continuously electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following ~~minimum~~ information during each run:
 - 3.1.13.1 Automatic update of the camera's metre reading position from adjusted zero.
 - 3.1.13.2 Manhole/pipe length reference numbers.
 - 3.1.13.3 Type or use of pipe (i.e. sanitary, storm or combined sewer)
 - 3.1.13.4 The unique inspection/report number of the run.
 - 3.1.13.5 Display digital information such that it will not interfere with the video image on the screen.
- 3.1.14 Stop camera at each defect, change of condition of pipe and service connection to record defect in accordance with WRC codes.
- 3.1.15 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
- 3.1.16 Immediately notify the *Prime Consultant* of any blockage or obstruction that will not allow passage of survey equipment.

CCTV INSPECTION OF PIPELINES

3.1.17 Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by the *Prime Consultant*.

3.2 Recording Resolution

3.2.1 At the beginning of each video tape, day of inspection or when a substitute camera is introduced perform necessary checks to ensure recording resolution satisfies these specifications.

3.3 Site Coding Sheets

3.3.1 Each pipeline length to be recorded according to the MSCC. Any variation from the manual to be noted in the survey report.

3.3.2 Standard coding form shown on page 14 of MSCC to be modified as follows:

3.3.2.1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day)

3.3.2.2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds)

3.3.2.3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC

3.4 Camera Position

3.4.1 Position camera lens centrally in the pipeline with a positioning tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned $\frac{2}{3}$ the height of the pipe measured from the invert.

3.4.2 Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

3.5 Camera Travel Speed

3.5.1 Travelling speed of the camera in the pipeline to be as follows:

3.5.1.1 6 m/min for pipeline of diameter less than 200 mm.

3.5.1.2 9 m/min for diameters 200 mm and larger but not exceeding 310 mm:
and

3.5.1.3 12 ~~m/min~~ m/s for diameters exceeding 310 mm.

CCTV INSPECTION OF PIPELINES

3.6 Camera Position Chainage Device

3.6.1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera

3.6.1.1 Chainage information to be transmitted electronically to control area and displayed on the monitor.

3.6.1.2 Chainage device to be accurate to within 0.3 m up to the first 50 m and within $\pm 1\%$ for lengths exceeding 50 m.

3.6.1.3 Chainage tolerance to be checked at the start of contract and a minimum of once every two weeks thereafter or every 5,000 m of pipeline inspected, whichever is greater.

3.6.1.4 Provide audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.

3.7 Photographs and/or Digital Images

3.7.1 Photograph all major defects as defined by condition codes: B, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X

3.7.2 Overlay on photographs the following data in alpha-numeric form such that it will not interfere with the defect condition reported:

3.7.2.1 Report/job number

3.7.2.2 .2 Metre reading position (chainage)

3.7.2.3 .3 Manhole/pipe length reference numbers (from - to)

3.7.2.4 .4 Photograph number

3.7.2.5 .5 WRC. condition defect code

3.7.2.6 .6 Date of survey (yyyy.mm.dd)

3.7.3 Capture photograph and alpha-numeric data as a digital image in a JPEG file format if required, as specified in the Agreement.

3.7.4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.

3.8 Inspection Reporting Hard copies & Digital Format

CCTV INSPECTION OF PIPELINES

- 3.8.1 Submit reports to the *Prime Consultant* within ten (10) working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
- 3.8.2 Present machine printed (hard copy) and computer generated data base reports according to the MSCC format.
 - 3.8.2.1 Each binder to commence with an index of all survey inspection reports contained within.
 - 3.8.2.2 Hard copy reports to be presented in tabular form in accordance with WRc MSCC
 - 3.8.2.3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the *Agreement*.
 - 3.8.2.4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
 - 3.8.2.5 Digital information to be presented in tabular configuration in accordance with the Municipality's standard file format in Microsoft ACCESS (.MDB)
 - 3.8.2.6 Provide CD ROM of digital photographs. Disk to be labelled with photo and contract numbers.
 - 3.8.2.7 .7 Include Municipality supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
- 3.8.3 Present report in 215 mm x 280 mm three ring (D type) binder. DVD's containing relevant CCTV inspections surveys to be included in the binder.
- 3.8.4 Attach computer disks in three hole plastic diskette sheet holder in back of binder.
- 3.8.5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
- 3.8.6 All dimensions and chainages in the reports to be metric.
- 3.9 Cleaning
 - 3.9.1 Clean pipelines to Section 33 01 30.2 immediately prior to CCTV inspection survey, unless otherwise specified in the *Agreement*.
- 3.10 Root Cutting & Removal

CCTV INSPECTION OF PIPELINES

3.10.1 Remove roots to Section 33 01 30.2 for condition codes RT and RM where required, to allow for CCTV equipment to pass.

3.11 Flow Reduction

3.11.1 Reduce flow in pipeline to approximately 20% of pipe diameter to allow CCTV inspection by combination of the following:

3.11.2 Schedule work for off peak flow times.

3.11.3 Plug or block flow at upstream manhole.

3.11.3.1 Plug designed to either plug all flow or impede flow ("flow through" plug) to the approximate 20% of pipe diameter.

3.11.3.2 Obtain the *Prime Consultant's* approval prior to plugging or impeding any flow.

3.11.3.3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.

3.11.4 Temporary bypass pump flow around inspection section when *Contractor* demonstrates that off peak inspection, plugging and /or the use of sewer cleaning equipment cannot effectively reduce flow levels to specified levels. Bypass pump plugs to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain the *Prime Consultant's* approval prior to setting up temporary bypass pump system.

3.12 Coding Accuracy

3.12.1 Coding accuracy to be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:

3.12.1.1 header accuracy - 95%

3.12.1.2 detail accuracy - 85%

3.12.2 *Contractor* to implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the *Contractor* on a random basis on a minimum of 10% of the inspection reports. The *Prime Consultant* to be

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entitled to review the accuracy verification system and results and be present when the assessments are being conducted.

- 3.12.3 A minimum of two accuracy verifications to be performed for each operator for each working week. Coding not satisfying the accuracy requirements to be re-coded and the accuracy of the inspection report immediately preceding and following the non-compliant inspection to be verified. Process to be repeated until the proceeding and subsequent inspections meet accuracy requirements.

END OF SECTION

WATERWORKS

1.0 GENERAL

- 1.1 Section 33 11 01 refers to those portions of the Work that are unique to the supply and installation of watermains, hydrants, valves and valve boxes, service connections and related appurtenances. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the works described herein.
- 1.2 All details of waterworks facilities not specifically covered in this Section to comply with appropriate AWWA and National Sanitation Foundation (NSF) standards and/or manuals of practice as specified in the Contract Documents.
- 1.3 Related Work:
 - 1.3.1 Concrete Reinforcement Section 03 20 00
 - 1.3.2 Cast-in-Place Concrete Section 03 30 00
 - 1.3.3 Excavating, Trenching and Backfilling Section 31 23 33.01
 - 1.3.4 Water Utility Tracer Wire Section 33 11 01.01
- 1.4 References
 - 1.4.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 43 00.
- 1.5 Samples
 - 1.5.1 Samples may be required.
- 1.6 Material Certification
 - 1.6.1 Products having CSA certification to be used where readily available. Products to be certified to CSA standard(s) by an approved independent third body accredited by the Standards Council of Canada and that is acceptable to the *Consultant*. Products to be marked with certification body logo and CSA standard markings.
 - 1.6.2 At least two weeks prior to commencing work, submit manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this section. Include manufacturer's drawings where pertinent.
- 1.7 Shop Drawings and Technical Data
 - 1.7.1 *Contractor* to submit shop drawings and technical data for all waterworks products, and associated components.
- 1.8 Record Drawings

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- 1.8.1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions.
- 1.9 Scheduling of Work
 - 1.9.1 Schedule work to minimize interruptions to existing services.
 - 1.9.2 Submit schedule of expected interruptions to *Consultant* for approval and adhere to approved schedule.
 - 1.9.3 Notify *Consultant*, affected residences and businesses minimum of 24 hours in advance of any interruption in service.
 - 1.9.4 Notify fire department of any planned or accidental interruption of water supply to hydrants.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 Pipe material as shown on *Contract Drawings*.
 - 2.1.2 All products are specified by reference to approved specifications and/or standards. Refer to *Contract Drawings* for specified or approved manufacturers or trade names.
 - 2.1.3 All waterworks products shall have a minimum operating pressure of 1380 kPa (200 psi) and be capable of withstanding a hydrostatic test pressure of 2068 kPa (300 psi) for a minimum of 5 hours.
 - 2.1.4 All waterworks products shall be approved for potable water use to NSF 61.
 - 2.1.5 Metallic fittings to be coated with fusion bonded epoxy to AWWA C213.
- 2.2 Mainline Pipe, Joints, and Fittings
 - 2.2.1 Ductile Iron Pipe
 - 2.2.1.1 Not applicable.
 - 2.2.2 Polyvinyl Chloride (PVC) Pressure Pipe – Not Used.
 - 2.2.3 High Density Polyethylene Pipe – To compile for 100% design submission.
 - 2.2.4 Steel Pipe – To compile for 100% design submission.
 - 2.2.5 Pre-Stressed Concrete Pressure Pipe:
 - 2.2.5.1 Not applicable.
 - 2.2.6 Fittings

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- 2.2.6.1 Gray-iron (cast iron) fittings to AWWA C110/A21.10-93 suitable for 1,035 kPa minimum pressure rating or higher as specified in *Contract Documents*. Where specified in *Contract Documents*, to be cement mortar lined and externally seal coated, both to AWWA C104/A21.4.
- 2.2.6.2 Ductile iron fittings to AWWA C110 suitable for pressure rating of 1,720 kPa, cement mortar lined to AWWA C104/A21.4.
- 2.2.6.3 Compact ductile iron fittings to AWWAC153/A21.53.94 suitable for pressure rating of 2,415 kPa, cement mortar lined to AWWA C104/A21.4.
- 2.2.6.4 PVC Injection-moulded fittings shall be DR18 conforming to AWWA C907 and certified to CSA B137.3. PVC compound is 1245B according to ASTM D1784. PVC fittings shall only be used when specified as acceptable or where specifically indicated in *Contract Documents*.
- 2.2.6.5 PVC Fabricated fittings shall conform to AWWA C900 and be certified to CSA B137.3. Fabricated fittings to be made from CSA certified PVC pipe of the same pressure class or pressure rating as the pipe.
- 2.2.6.6 Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints: to AWWA C111. All push-on joint hubs to be equipped with tie-rod lugs.
- 2.2.6.7 Fabricated HDPE mitred fittings to AWWA C906 suitable for pressure rating specified in *Contract Documents*. Fittings to be butt fused, thermofused fitting/couplings or equipped with flanged adapters.
- 2.2.6.8 Flanged Joints:
 - 2.2.6.8.1 Flat faced conforming to the face dimension and drilling of ANSI B16.1, Class 125.
 - 2.2.6.8.2 On AWWA C119 fittings to AWWA C110 with minimum pressure rating of 1,035 kPa or higher as specified in *Contract Documents*.
 - 2.2.6.8.3 On AWWA C153 fitting to AWWA C153 with minimum pressure rating of 1,723 kPa or higher as specified in *Contract Documents*.
- 2.2.6.9 Flange Gaskets:
 - 2.2.6.9.1 Flange gaskets to be manufactured from black natural rubber 3.175 mm thick with layer of cotton both sides.
 - 2.2.6.9.2 Gaskets to be natural or SBR type rubber.
- 2.2.6.10 Bolts and Nuts:

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- 2.2.6.10.1 Bolts to be carbon steel, Grade B to ASTM 307, heavy hex style, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
- 2.2.6.10.2 Nuts and washers: Nuts to be carbon steel, Grade A to ASTM A563. Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
- 2.2.6.11 Tie Rods and Nuts:
 - 2.2.6.11.1 Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Tie rod sizes to be minimum 19mm diameter or greater as shown on Contract Drawings.
 - 2.2.6.11.2 Nuts and internally threaded couplings to be heavy hex finish to ASTM A563. Washers to be flat hardened steel to ASTM F436. Zinc plated to ASTM B633 or cadmium plated to ASTM B766.
- 2.2.6.12 Fabricated steel pipe fittings: to AWWA C200 and AWWA C208, and AWWA C207 if flanged, interior and exterior protected with hot applied coal tar enamel to AWWA C203 or liquid epoxy coating to AWWA C210.
- 2.2.6.13 Couplings and Flanged Coupling Adapters:
 - 2.2.6.13.1 General Requirements:
 - 2.2.6.13.1.1 Suitable for pressure rating specified in *Contract Documents*.
 - 2.2.6.13.1.2 Flanges and full face flange gaskets where applicable to 2.2.6 (h) and (i) of this Section.
 - 2.2.6.13.1.3 To AWWA C219.
 - 2.2.6.13.1.4 Anti-corrosion coating of interior and exterior centre sleeve and rings to AWWA C210, C219, C213 or AWWA C550 as specified in *Contract Documents*.
 - 2.2.6.13.1.5 Compression gaskets to AWWA C219.
 - 2.2.6.13.1.6 Bolts and nuts high strength low alloy steel AWWA C111, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts, as specified in *Contract Documents*. Rolled threads, fit and dimensions to AWWA C111.

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- 2.2.6.13.1.7 Ductile iron castings to ASTM A536, Grade 65-45-12.
- 2.2.6.13.2 Plain end or transition coupling as specified in *Contract Documents*.
- 2.2.6.13.3 Flanged coupling adapters as specified in *Contract Documents*.
- 2.2.6.14 Joint Resistant Devices: General Requirements
 - 2.2.6.14.1 Ductile iron castings to ASTM A536.
 - 2.2.6.14.2 Anti-corrosion coating of ductile iron castings to AWWA C219, AWWA C210, AWWA C213 or AWWA C550 as specified in *Contract Documents*.
 - 2.2.6.14.3 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in *Contract Documents*, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
 - 2.2.6.14.4 Tie rods to 2.2.6 (k) of this Section.
 - 2.2.6.14.5 Restrainers for ductile iron pipe with mechanical joint fittings as specified in *Contract Documents*.
 - 2.2.6.14.6 Restrainers for PVC pipe conforming to 2.2.2 of this Section with mechanical joint fittings as specified in *Contract Documents*.
 - 2.2.6.14.7 Restrainers for ductile iron pipe with push-on joint fittings with tie rod lugs as specified in *Contract Documents*.
 - 2.2.6.14.8 Restrainers for PVC conforming to 2.2.2 of this Section with push-on joint fittings with tie rod lugs as specified in *Contract Documents*.
 - 2.2.6.14.9 Restrained harnesses or integral restraint systems manufactured as part of the pipe joint as specified in *Contract Documents*.
 - 2.2.6.14.10 Restrainers for bell joints in PVC pipe conforming to 2.2.2 of this Section.
 - 2.2.6.14.11 All joint restraint systems for PVC pipe shall be approved by the PVC pipe manufacturer confirming that they are to be used

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on PVC pipe and that they do not reduce the pipe manufacturer's recommended working pressures.

2.2.6.15 Tapping Sleeves for Branch Connections 75mm and Larger:

2.2.6.15.1 Not applicable.

2.2.6.16 Repair clamps shall be constructed of 18-8 stainless steel passivated for corrosion resistance. Stainless steel components shall be Type 304 or 304L. All surfaces including weld areas shall be thoroughly cleaned of scale, grease or other contaminants. Welding must be performed in a controlled environment to prevent sensitization.

2.3 Lubricants

2.3.1 Joint lubricants must be certified for potable water use in accordance with NSF Standard 61 and must:

2.3.1.1 Impart no taste or odour to potable water containing free or combined chlorine disinfectants;

2.3.1.2 Create no turbidity in potable water;

2.3.1.3 Promote no bacterial growth; and

2.3.1.4 be compatible with rubber and neoprene gasket materials.

2.4 Insulation and Water Proofing

2.4.1 As shown on *Contract Drawings*.

2.5 Valves and Valve Boxes

2.5.1 Mainline Valves - General Requirements:

2.5.1.1 Valves to open counter-clockwise.

2.5.1.2 All valves to have manufacturer's name, year of manufacturer, size and working pressure on the bonnet or body.

2.5.1.3 Gate valves larger than 400 mm to have gear operating operators.

2.5.1.4 Provide extension where depth to top of operating nut is greater than 1.5 m.

2.5.1.5 Install resilient wedge gate valves unless specified otherwise.

2.5.2 Mainline Gate Valves:

2.5.2.1 Locations of solid wedge or double disc valves and resilient-seated valves as shown in *Contract Documents*.

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- 2.5.2.2 To AWWA C500: 75 to 300 mm to working pressure 1,380 kPa; 400 mm and larger to working pressure 1,035 kPa, gray cast iron or cast ductile iron body, bronze mounted solid wedge, or double disc, non-rising stem, hub or flanged ends.
- 2.5.2.3 To AWWA C509: 75 to 300 mm to working pressure 1,380 kPa; gray cast iron or cast ductile iron body, resilient seated, non-rising stem, hub or flanged ends.
- 2.5.2.4 Stem seal to be O-ring type.
- 2.5.2.5 Hydrant Valves – to be as specified for mainline gate valves.
- 2.5.2.6 Valves to be complete with 50 mm square operating nut for underground service.
- 2.5.3 Mainline butterfly valves to AWWA C504 Class 150B, as specified in *Contract Documents*.
- 2.5.4 Blowdown or Blowoff Valves: 50 mm to AWWA C800 for working pressure 1,380 kPa threaded ends, 75 mm to 300 mm as specified for mainline gate valves.
- 2.5.5 Air Release, Air/Vacuum and Combination Air Valves
 - 2.5.5.1 Air and Vacuum Release Valves: To NSF 61. Valves to expel air at high rate during filling, low rate during operation, and to admit air while line being drained. Valves to be suitable for 1724kPa working pressure. Valves to be “direct bury” ARI D-090-P complete with insulation and internal frost protection
- 2.5.6 Mainline Valve Boxes:
 - 2.5.6.1 To be as specified in *Contract Documents*: telescoping, cast iron, top flange type service box:
 - 2.5.6.1.1 Rectangular type to be as specified in *Contract Documents*.
 - 2.5.6.1.2 Circular type to be as specified in *Contract Documents*.
 - 2.5.6.2 Valve box riser pipe to be 150 mm diameter PVC DR35 or better.
- 2.5.7 Service Valve Boxes:
 - 2.5.7.1 Curb stop valve boxes on 25mm diameter or smaller services to be telescoping assembly comprised of threaded cast iron top with bronze pentagon centre plug, 25 NPS iron pipe, cast iron base allowing threaded insertion of 25 NPS pipe and accommodation for curb stop valve (cast iron base section may thread onto curb stop valve) and 14 mm diameter steel

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operating rod attached to curb stop valve with bronze cotter pin, as specified in *Contract Documents*.

2.5.7.2 Curb stop valve boxes on 32 mm dia. to 50 mm dia. services to be assembly specified in 2.5.7 (a) except with 19 mm dia. steel operating rod, or as specified in *Contract Documents*.

2.5.7.3 Curb stop valve boxes on services 75 mm dia. and larger as specified for Mainline Valve Boxes.

2.5.7.4 Corporation stop valve boxes (at mainline tees or tapplings) on services 75 mm dia. and larger as specified for Mainline Valve Boxes.

2.5.8 Check Valves

2.5.8.1 Not applicable.

2.6 Valve and Meter Chambers

2.6.1 Materials and installation for Cast-in-place chambers to Section 33 44 01 - Manholes and Catchbasins.

2.6.2 Concrete and reinforcing steel: to Section 03 20 00 - Concrete Reinforcement and Section 03 30 00 - Cast-in-Place Concrete.

2.6.3 Precast concrete sections to ASTM C478. Ladder rungs be cast integral with unit; field installation not permitted. Precast concrete lids to H20 loading conditions.

2.6.4 Joining materials:

2.6.4.1 Manufacturer's rubber ring gaskets,

2.6.4.2 Mastic joint filler,

2.6.4.3 Cement mortar or,

2.6.4.4 Combination of above types.

2.6.5 Mortar: aggregate to CAN/CSA A82.56, masonry cement to CSA A3002.

2.6.6 Ladder rungs for valve chambers: minimum 20 mm diameter, for 76 mm minimum embedment in precast or cast-in-place concrete, minimum rung length 250 mm, minimum projection 100 mm, maximum vertical spacing 300 mm, minimum design liveload 1,334 N, cold rolled steel to CAN/CSA-G40.20, hot-dip galvanized after fabrication to CAN/CSA G164 or aluminium alloy #6061-T6 to CAN3-S157 and NBC 1990. Rungs to be safety pattern. Hand holds at top entry to conform to minimum design liveload and dimensions.

2.6.7 Valve chamber frames and covers: as specified in *Contract Documents*.

2.7 Service Connections, Pipe, Joints, and Fittings

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- 2.7.1 Pipe diameter 19 mm to 75 mm to be Polyethylene to AWWA C901, Pressure Class 200 tubing certified to CSA B137.1, or Type K annealed copper, to ASTM B88M, or Polyethylene/Aluminium/Polyethylene composite pipe certified to CSA B137.9 or CSA B137.10, as shown on the *Contract Drawings*.
- 2.7.2 Pipe diameter 100 mm and larger to be of material specified for mainline pipe.
- 2.7.3 Service saddles:
 - 2.7.3.1 Tapping threads to be tapered to AWWA C800.
 - 2.7.3.2 Saddles for ductile iron pipe:
 - 2.7.3.2.1 Not applicable.
 - 2.7.3.3 Saddles for PVC Pipe to AWWA C900 PVC Pipe:
 - 2.7.3.3.1 Not applicable.
 - 2.7.3.4 Saddles for HDPE pipe:
 - 2.7.3.4.1 As shown on *Contract Drawings*.
 - 2.7.3.5 Copper tubing joints to be suitable for 1,380 kPa working pressure.
- 2.8 Hydrants
 - 2.8.1 Approved Products: CLOW, M-67 Brigadier 150mm, AWWA C502 or as specified on *Contract Drawings*.
 - 2.8.2 Hydrants to: AWWA C502, standard specifications for dry barrel Fire Hydrants for ordinary waterworks service; typical fire hydrant detail drawing and National Fire Code with following supplementary details:
 - 2.8.2.1 Shut-Off: compression type as per *Contract Documents*.
 - 2.8.2.2 Inlet Connection: to be 150 mm nominal diameter, bell type with harness lugs.
 - 2.8.2.3 Bury Length: 2.7m nominal bury length or as shown on *Contract Drawings*.
 - 2.8.2.4 Self draining hydrants or as specified on *Contract Drawings*.
 - 2.8.2.5 Delivery Classification: two hose nozzles and one pump nozzle. Each outlet nozzle to be locked or screwed in place to safeguard against blowing out, turning or backing out.
 - 2.8.2.6 Hose and Pump Nozzle:

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- 2.8.2.6.1 Hose nozzles to be 65 mm (2.5") nominal diameter with threads on nozzle ends to suit Alberta Mutual Thread
- 2.8.2.6.2 Pump nozzles to be 114 mm (4.5") nominal diameter and fastened by a thread connection with 100mm Storz connection
- 2.8.2.7 Nozzle Cap Gasket: to be provided with each nozzle cap.
- 2.8.2.8 Opening Direction: counter-clockwise.
- 2.8.2.9 Operating Nut and Cap Nuts: to AWWA C502 Standard for fire hydrants.
- 2.8.2.10 Working parts to be removable without disturbing barrel or base of hydrant and without excavation. Main operating stem to be non-rising. Hydrants to be so designed that its top section may, without excavation, be rotated at any angle relative to the inlet pipe if desired and bolted or locked in place without decreasing its strength or causing it to leak when under pressure.
- 2.8.2.11 Hydrants to be subjected to hydrostatic pressure test of 2,068 kPa in compliance with AWWA C502. Provide "Affidavit of Compliance" if requested by *Consultant*.
- 2.8.3 Colour: Hydrants to be painted as specified below:
 - 2.8.3.1 Draining hydrants: yellow body with blue caps and blue top
- 2.8.4 Approved standard 150 mm Fire Hydrants are as specified in *Contract Documents*.
- 2.9 Underground Service Line Valves and Fittings
 - 2.9.1 Underground service line valves and fittings 19 mm to 50 mm to AWWA C800 suitable for 1,380 kPa working pressure.
 - 2.9.2 Corporation Stops:
 - 2.9.2.1 19 mm to 50 mm: bronze to ASTM B62, AWWA thread inlet, compression type outlet.
 - 2.9.3 Curb Stops:
 - 2.9.3.1 19 mm and 25 mm to be bronze to ASTM B62; inverted key, ball or cylinder type construction utilizing rubber O-ring seals.
 - 2.9.3.2 37 mm and 50 mm to be bronze to ASTM B62; ball or cylinder type construction utilizing rubber O-ring seals.
 - 2.9.3.3 To be full flow, full port, as specified in *Contract Documents*.
 - 2.9.3.4 Fittings: to be compression type for underground services.

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2.9.3.5 All fitting and valve connections on polyethylene to have solid fluted stiffening liners manufactured from stainless steel to ANSI T304 designed for the appropriate type and inside dimension of pipe, warranted by the manufacturer for that use.

2.9.3.6 Underground service line valves 75 mm and larger to 2.5.1 and 2.5.2 of this Section.

2.10 Tracer Wire

2.10.1 Refer to Section 33 11 01.01 – Water Utility Tracer Wire for specifications.

2.11 Granular Pipe Bedding and Surround Material

2.11.1 As shown on *Contract Drawings*.

2.11.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for materials specifications.

2.12 Backfill Material

2.12.1 As shown on *Contract Drawings*.

2.12.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for material specifications.

3.0 EXECUTION

3.1 General

3.1.1 Pipe bedding details, including granular surround (pipe cushion) and material specifications to be shown on *Contract Drawings*.

3.2 Preparation

3.2.1 Clean pipe, fittings, valves, hydrants, and appurtenances of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.3 Trenching

3.3.1 Do trenching in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3.2 Trench alignment and depth as shown on *Contract Drawings* or as otherwise approved by *Consultant*.

3.4 Horizontal Directional Drilling

3.4.1 Do horizontal directional drilling in accordance with Section 33 05 28 – Horizontal Directional Drilling Installation.

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3.5 Concrete Bedding and Encasement

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

3.6 Granular Bedding

- 3.6.1 Fill over-excavation below design elevation of bottom of specified bedding with granular bedding placed and compacted in accordance with 3.5.2 and 3.5.5. Drain rock may be used for backfill of over-excavation only with *Consultant's* approval.
- 3.6.2 Place granular bedding material across full width of trench bottom in uniform layers to depth shown on Contract Drawings.
- 3.6.3 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.
- 3.6.4 Shape transverse depressions in bedding as required to suit joints.
- 3.6.5 Compact each layer full width of bed to minimum 95% Standard Proctor Density in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).
- 3.6.6 Place water main pipe and water service tubing on prepared flat bottomed trench free of rock in excess of 50 mm without bedding and backfill with approved native or imported material and compact as specified. Use hand tools to compact material under 'haunch' area of pipe and around fittings and other materials.
- 3.6.7 Use imported bedding material when native material is deemed unsuitable for backfill by *Consultant* or when trench has been excavated in rock.
- 3.6.8 Use imported bedding material when using pipe materials other than ductile iron or copper.
- 3.6.9 Use imported bedding when proposed work is installed through paved areas, when native material is deemed unsuitable for backfill by *Consultant* or when trench has been excavated in rock.

3.7 Pipe Installation

- 3.7.1 Handle pipe in accordance with pipe manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

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- 3.7.2 Pipe to be shipped from supplier with both ends capped or bagged.
- 3.7.3 Cap for bags to remain on ends of pipe until lowered into trench and is about to be installed.
- 3.7.4 Each pipe is to be visually inspected internally. If dusty or dirty, pull foam pig through pipe.
- 3.7.5 In the trench wipe clean pipe ends before joining.
- 3.7.6 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. PE/HDPE pipe to Plastics Pipe Institute Handbook of Polyethylene Pipe and AWWA Manual M55.
- 3.7.7 Horizontal Tolerance for pipe installed by open cut: plus or minus 50 mm from specified alignment.

Vertical Tolerance: plus or minus 25 mm from specified grade.

Horizontal tolerance for pipe installed by horizontal directional drilling: refer to 33 05 28 – Horizontal Directional Drilling Installation.
- 3.7.8 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- 3.7.9 Do not exceed one-half maximum joint deflection recommended by pipe manufacturer.
- 3.7.10 Keep jointing materials and installed pipe free of dirt, water, and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.
- 3.7.11 Position and join pipes with equipment and methods specified in 3.7.6.
- 3.7.12 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe or its coating and leave smooth end at right angles to axis of pipe.
- 3.7.13 Joints:
 - 3.7.13.1 Install gaskets as recommended by manufacturer.
 - 3.7.13.2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - 3.7.13.3 Align pipes carefully before joining.
 - 3.7.13.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.

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- 3.7.13.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
- 3.7.13.6 Complete each joint before laying next length of pipe.
- 3.7.13.7 Minimize each joint deflection before laying next length of pipe.
- 3.7.13.8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- 3.7.13.9 For ductile iron pipe, do not install bronze wedges or other conductivity devices unless specified in *Contract Documents*.

3.7.14 Fused joints

- 3.7.14.1 Fusing of pipe shall be undertaken by a factory qualified technician with a current fusion ticket (obtained or renewed within the last 12 months). Documentation shall be provided to the *Consultant* prior to project commencement.
- 3.7.14.2 Two fusions under field conditions shall be performed by the technician prior to construction commencement. A minimum of two successful fusions shall be witnessed by the *Consultant*.
- 3.7.14.3 For HDPE pipe, the pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and the manufacturer's recommendations. Perform all heat fusion joints in the presence of the *Consultant* as requested.
- 3.7.14.4 Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine.
- 3.7.14.5 Pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipe so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 16 m and no shorter than 6 m.
- 3.7.14.6 For HDPE, polyethylene flange adapters at pipe material transitions or valve connections shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel to ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation apply a bitumastic coating to bolts and nuts.

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- 3.7.14.7 Only appropriately sized and outfitted fusion machines that have been approved by the manufacturer shall be used for fusion processes. Fusion machines must, at minimum, incorporate the following:
- 3.7.14.7.1 Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition.
- 3.7.14.7.2 The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines. Dedicated heat plates should be used for various types of pipe.
- 3.7.14.7.3 The carriage shall travel smoothly with no binding at less than 350 kPa. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
- 3.7.14.7.4 Machine body shall show no obvious defects, missing parts, or potential safety issues during fusion.
- 3.7.14.7.5 Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of thermoplastic pipe. The software shall register and/or record the required parameters and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.
- 3.7.14.7.6 The most current version of the pipe supplier's recommended and compatible software shall be used. Data logging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110 V power source shall be available to extend battery life.
- 3.7.14.7.7 Pipe rollers shall be used for support of pipe to either side of the machine and for the full length of the fused pipe.
- 3.7.14.7.8 A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, wet and/or windy weather, or as directed by the *Consultant*.

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- 3.7.14.7.9 Facing blades specifically designed for cutting the pipe shall be used.
- 3.7.15 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as specified otherwise.
 - 3.7.16 When any stoppage of work occurs, restrain pipes in an approved manner to prevent 'creep' during down time.
 - 3.7.17 Recheck components assembled above ground after placing in trench to ensure that no movement of joints has taken place.
- 3.8 Valve Installation
 - 3.8.1 Install valves to manufacturer's recommendations at locations shown on *Contract Drawings*.
 - 3.8.2 Support valves located in valve boxes or valve chambers by means of concrete blocks, located between valve and solid ground. Valves not to be supported by pipe.
 - 3.8.3 Valves to be installed in vertical position with actuating stem plumb.
- 3.9 Valve Chambers
 - 3.9.1 Use cast-in-place or precast units as shown on Contract Drawings. Precast units to be in accordance with Section 33 44 01 - Manholes and Catchbasins. Cast-in-Place units to be in accordance with Section 03 20 00 - Concrete Reinforcement and Section 03 30 00 - Cast-in-Place Concrete.
 - 3.9.2 Construct units as shown on *Contract Drawings* plumb and centred over valve nut, true to alignment and grade. Valve chambers not to rest on pipe.
 - 3.9.3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details shown in *Contract Drawings* and in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - 3.9.4 Cast bottom slabs for precast units directly on undisturbed ground or when permitted by *Consultant*, set precast concrete slab on 150mm minimum of compacted granular material.
 - 3.9.5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab. Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
 - 3.9.6 Clean surplus mortar and joint compounds from interior surface of valve chambers as work progresses.
 - 3.9.7 Plug lifting holes with precast concrete plugs set in non-shrink non-staining grout or non-shrink, non-staining mortar.

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- 3.9.8 Set frame and cover to required elevation on at least two and not more than four courses of brick or precast concrete riser rings. Make brick or riser ring joints and join brick or riser rings to frame with cement mortar, parge and trowel smooth.
- 3.9.9 Cover to be marked as specified in *Contract Drawings*.
- 3.9.10 Clean valve chambers of debris and foreign materials, remove fins and sharp projections.
- 3.9.11 Set valve boxes centrally over valve nut. Set valve boxes and any other boxes around appurtenances and complete backfill within 24 hours of setting appurtenance.
- 3.9.12 Install sump drainer assemblies to manufacturer's instructions and to AWWA C510 and AWWA C511.
- 3.10 Under-crossing
 - 3.10.1 Not applicable.
- 3.11 Service Connection Installation
 - 3.11.1 Install service connections to 3.7 of this Section and as shown on *Contract Drawings* or as directed by *Consultant*.
 - 3.11.2 Construct service connections at right angles to watermain unless otherwise directed. Locate curb stops as shown in *Contract Documents*.
 - 3.11.3 Complete service connections before pressure testing of watermains
 - 3.11.4 Tap main as shown on *Contract Drawings*, not closer to a joint or closer to adjacent service connections than recommended by manufacturer, or 1m, whichever is greater. No two adjacent connections on same pipe length to be on same plane of pipe.
 - 3.11.5 Leave corporation stop valves fully open.
 - 3.11.6 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
 - 3.11.7 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
 - 3.11.8 Install curb stop with corporation box on services 50mm or less in diameter. Equip larger services with a gate valve and cast iron box. Set box plumb over stop or valve and adjust top flush with final grade elevation. Leave curb stop valves fully closed.
 - 3.11.9 Place temporary location marker at ends of plugged or capped unconnected water lines. Each marker to consist of 40 x 90mm stake extending from pipe end at pipe

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level to 600mm above grade. Paint and mark exposed section of stake with blue waterproof paint, with designation "WATER".

3.12 Tapping Sleeve Installation

3.12.1 Thoroughly clean the exterior of the main to be tapped. Grind or file any protrusions or irregularities in the pipe exterior which may interface with uniform seating of gaskets or clamping bands. In accordance with Section 10 of AWWA C651, dust interior surface of the tapping sleeve annulus with calcium hypochlorite powder before attaching to main.

3.13 Hydrants

3.13.1 Install hydrant assemblies at locations shown on *Contract Drawings*.

3.13.2 Install hydrant assemblies in accordance with AWWA Manual of Practice No. M17 and in accordance with *Contract Drawings*.

3.13.3 Set hydrants plumb, with hose nozzles parallel with edge of pavement or curb line, with pumper nozzle facing roadway at right angles to road centreline and with body flange set at elevation of 150mm above final grade or as shown on *Contract Drawings*.

3.13.4 Place concrete thrust blocks as shown and specified ensuring that drain holes are unobstructed.

3.13.5 To provide proper draining for each hydrant, excavate a pit as shown and backfill with coarse gravel or crushed stone to a level 150mm above drain holes.

3.13.6 For hydrants not in service, place an orange painted sign, 30 x 30cm, lettered 'Not in Service' on the main port. Remove when water main is accepted by *Consultant*.

3.14 Thrust Blocks

3.14.1 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as shown on *Contract Drawings* or as directed by the *Consultant*.

3.14.2 Place 6 mil polyethylene between interface of concrete and fitting.

3.14.3 Where shown on *Contract Drawings*, install joint restraint devices to 2.2.6 (n) of this Section.

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

3.14.5 Keep joints and couplings free of concrete.

3.14.6 Do not backfill over concrete within 24 h of placing.

3.15 Corrosion Protection:

3.15.1 Where specified, provide corrosion protection measures as shown on *Contract Drawings*.

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3.16 Pipe Surround

- 3.16.1 Upon completion of pipe laying and after the *Consultant* has inspected work in place, surround and cover pipes as shown on *Contract Drawings*.
- 3.16.2 Hand place surround material in uniform layers simultaneously on both sides of pipe. Do not dump material within 1m of exposed pipe.
- 3.16.3 Compact each layer from pipe invert to underside of backfill to minimum 95% Standard Proctor Density.
- 3.16.4 Install concrete encasement where shown on *Contract Drawings* or as directed by *Consultant*. For PVC mainline or service pipe, install high deflection PVC coupling 0.3m minimum to 0.5m maximum from end of encasement. For ductile iron mainline or service pipe ensure hub joint occurs 0.3m minimum to 0.5m maximum from end of encasement.

3.17 Backfill

- 3.17.1 Place and compact backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 3.17.2 Backfill requirements, including type of material and compaction requirements, as shown in *Contract Drawings*.

3.18 General Procedure Flushing, Testing and Disinfection

- 3.18.1 All cleaning, flushing, pressure and leakage testing, disinfection and final flushing to be done by *Contractor*. All testing to be done by *Contractor* at his cost. Testing costs deemed to be included in Contract Price.
- 3.18.2 Perform all testing, disinfection, flushing and water sampling in presence of *Consultant*. Notify *Consultant* 24 h in advance of proposed test.
- 3.18.3 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- 3.18.4 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.
- 3.18.5 Comply with *Contract Documents* regarding environmental requirements relative to discharge of flushing water.
- 3.18.6 Provide *Consultant* with all required approvals prior to discharging flushing water.
- 3.18.7 *Contractor* shall submit a written Testing, Pigging and Disinfection plan for approval by the *Consultant* a minimum of 2 weeks in advance of performing the work.

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3.19 Cleaning and Swabbing

- 3.19.1 Make arrangements with *Consultant* for scheduling of testing and disinfection of mains. Testing and disinfection to be witnessed by *Consultant*.
- 3.19.2 Isolation of existing water system where required will be performed by Municipality. Do not operate any valves without *Consultant*'s authorization.
- 3.19.3 *Contractor* shall obtain potable water at *Contractor*'s cost from a source approved by the *Consultant*. *Contractor* to provide confirmation of source of testing water 2 weeks in advance of loading the pipe.
- 3.19.4 Remove foreign material from pipe and related appurtenances by swabbing. Load main with water and then swab by pushing soft density foam pigs through the main. The main shall be swabbed at a minimum in pairs or more as required until the water discharged immediately in front of and behind the pigs is clean and clear to the *Consultant*'s satisfaction.
- 3.19.5 Foam pigs to be sized a minimum of 50 mm larger than inside diameter of main.
- 3.19.6 Foam pigs to be spaced approximately 20 m apart while swabbing is under way and the space between shall be filled with potable water.
- 3.19.7 Do not dispose of water containing chlorine or volatile or waste materials, such as mineral spirits and paint thinner, into any surface waterway or storm or sanitary sewer. All discharges must comply with all applicable Acts, Regulations, Bylaws and Standards. This requirement may be relaxed only if written approval to exceed the limit concerned, from the authority having jurisdiction over the waterway or sewer, is provided to the *Consultant*.

3.20 Testing Procedure

- 3.20.1 Upon completion of construction of any section, which shall be defined as that pipeline and appurtenances located between any two adjacent line valves, make section ready for testing.
- 3.20.2 Before pipe is filled with water, pipe bedding, concreting of all valves and fittings and backfilling to be completed as required in this specification. Fill each section of pipe and allow to remain full of water for a period of at least 24 hours, and bleed off any trapped air prior to commencement of any pressure tests. Submit pipeline to a test pressure of 1.5 x working pressure (2070 kPa/300 psi) applied at the lowest elevation in the section under test.
- 3.20.3 For the initial expansion phase of the test, add make-up water as necessary to maintain test pressure for 4 hours. During the testing phase, reduce the test

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pressure by 10 psi (69.0 kPa) and monitor pressure for 1 hour. Do not increase pressure or add make-up water.

- 3.20.4 If the test pressure cannot be reached, or if it takes an unreasonably long time to reach the test pressure, there may be a leak, entrapped air, an open valve, or the pressurizing equipment may be inadequate for the size of the test section. Correct these issues before continuing.
- 3.20.5 If no visual leakage is observed, and the pressure during the test phase remains steady (within 5% of the starting test pressure) for one hour, this will result in a passing test.
- 3.20.6 If retesting is necessary, depressurize the test section by reducing pressure or releasing test liquid at a controlled rate to prevent water hammer. Do not attempt to correct any issues or leaks with the pipeline while it is under pressure. Let the test section relax for at least 8 hours before re-pressurizing.
- 3.20.7 Should any test disclose excessive leakage, repair or replace defect and retest section until specified testing requirements is achieved.
- 3.21 Disinfection, General
 - 3.21.1 After *Consultant* has certified that pipes and appurtenances have passed all specified tests, flush and disinfect pipes and appurtenances.
 - 3.21.2 Disinfect, flush, and bacteriological test in accordance with AWWA C651 and 3.22 of this section.
- 3.22 Disinfection and Flushing Procedures
 - 3.22.1 Do not use granular hypochlorite for disinfection of PVC pipe with solvent welded joints, due to explosive reaction potential.
 - 3.22.2 Slug chlorinate with potable water in accordance with AWWA C651, Slug Chlorination Method. One foam pig shall precede the chlorinated slug. All interior surfaces of the watermain and fittings shall be exposed to a free chlorine concentration of 100 mg/L for at least 3 hours. *Contractor* to monitor free chlorine concentration as the slug moves down the pipeline. At no point can the concentration drop below 50 mg/L. Submit outline of proposed disinfection procedure accompanied by marked up schematic drawings to *Consultant* for approval 48h in advance of commencement of disinfection.
 - 3.22.3 After completion of chlorination, flush chlorinated water from system, hydrants and services until chlorine concentration in remaining water is less than 0.3mg/L chlorine residual. Water with a concentration greater than 1mg/l shall be de-chlorinated prior to discharge to storm sewers or water courses. Release rate not to exceed downstream capacity of receiving system.

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- 3.22.4 After final flushing, and no more than 72 hours before the new water main is connected to the distribution system, two consecutive sets of water samples taken at least 24 hours apart, shall be collected from the new main. Samples shall be taken at each blowoff valve, plus one set from each end of the line. Samples shall be tested at the *Contractor's* expense for total coliforms and *Escherichia coli* by a laboratory approved by the *Consultant* and the Provincial Health authority (in accordance with their list of approved laboratories). Sampling and analysis shall be done in accordance with Standard Methods for the Examination of Water and Wastewater. The following water quality parameters must be measured and found to be within the limits specified in the table below:

Parameter	Value	Unit
E.Coli	Absence	
Total Coliform	Absence	
Residual Chlorine	1.0 to 2.4	mg/L
Free Chlorine	< 0.1	mg/L
pH	7.3 to 8.3	
Turbidity	0 to 3.0	NTU
Colour	0 to 2.0	TCU
V.O.Cs	< 0.010 (GCDWQ MACs for components)	mg/L
Pipe Lubricant	Negative	
Taste and Odour	Inoffensive	
UV Scan	Negative vs. Plant Water	

- 3.22.5 The test has failed if any of the above parameters are outside the limits presented.
- 3.22.6 Upon completion of disinfection and flushing, *Contractor* shall remove test and bleed out apparatus and shall backfill and complete any work required prior to placing waterworks systems into service.

3.23 Connections to Existing Mains

- 3.23.1 Connections to existing waterworks systems will be made by the *Contractor* unless noted otherwise in the *Contract Documents*. Make all necessary arrangements with *Consultant* and utility to schedule work to prevent construction delays.

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- 3.23.2 Final connections to existing mains and services shall be swab disinfected with 1% - 5% chlorine in accordance with AWWA C651, Section 4.6. Disinfection and final connections shall be witnessed by the *Consultant*.

END OF SECTION

UTILITY TRACER WIRE

1.0 GENERAL

- 1.1 Section 33 11 01.01 refers to those portions of the *Work* that are unique to the supply and installation of tracer wire. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Waterworks Section 33 11 01
- 1.3 Submittals
 - 1.3.1 Contractor to submit shop drawings and technical data for all products and materials associated with the tracer wire system to the *Prime Consultant* for review and approval prior to installation.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 This section refers to the supply and installation of tracer wire
 - 2.1.2 All tracer wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.
- 2.2 Tracer Wire
 - 2.2.1 Open Trench - Tracer wire shall be Copper Clad Steel, High Strength with minimum 2 kN (450 lb.) break load, with minimum 0.762 mm (30 mil) HDPE insulation thickness.
 - 2.2.2 Trenchless Installation - Tracer wire shall be Copper Clad Steel, Extreme Strength with a minimum 15.6 kN (3500 lb.) break load, with minimum 1.143 mm (45 mil) HDPE insulation thickness.
- 2.3 Connectors
 - 2.3.1 Three wires shall be joined using a single 3-way lockable connector. Four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
 - 2.3.2 Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
 - 2.3.3 Non locking friction fit, twist on or taped connectors are prohibited.
 - 2.3.4 Direct bury of connectors is not permitted. All connectors must be installed at-grade within a test station manhole with single wire connected and ran to access box as outlined in the following sections.
 - 2.3.5 A minimum of 500 mm of excess/slack wire is required in all test station manholes or valve boxes after meeting final elevation for each wire.

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2.4 Termination/Access

2.4.1 All tracer wire termination points must utilize a tracer wire above ground access box, approved by the *Prime Consultant*, and mounted to the warning sign post 1 m above ground.

2.4.2 Termination points are to be located on the sign post at each valve location, or location where a connector is used as approved by the *Prime Consultant*.

2.5 Grounding

2.5.1 Tracer wire must be properly grounded at all dead ends/stubs.

2.5.2 Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 6 m (20 ft) of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 2.3 kg (0.5 lb.)) specifically manufactured for this purpose, and buried at the same elevation as the utility.

2.5.3 When grounding the tracer wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the tracer wire, at the maximum possible distance.

2.5.4 When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the tracer wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to tracer wire with a mainline to lateral lug connector.

2.5.5 Where the anode wire will be connected to a tracer wire access box, a minimum of 0.6 m (2 ft.) of excess/slack wire is required after meeting final elevation.

2.6 Prohibited Products and Methods

2.6.1 Uninsulated tracer wire

2.6.2 Tracer wire insulations other than HDPE.

2.6.3 Non locking, friction fit, twist on or taped connectors

2.6.4 Brass or copper ground rods

2.6.5 Wire connections utilizing taping or spray-on waterproofing

2.6.6 Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another

2.6.7 Tracer wire wrapped around the corresponding utility

2.6.8 Brass fittings with tracer wire connection lugs

2.6.9 Wire terminations within valve boxes or manholes

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2.6.10 Connecting tracer wire to existing conductive utilities

3.0 EXECUTION

3.1 General

- 3.1.1 Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal for distances in excess of 1,000 m, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- 3.1.2 Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- 3.1.3 Connectors are only permitted for use at valves, couplers, private services, or intersections of 3 or more mainline pipe. All other tracer wire must be continuous and splice free unless otherwise approved by the *Prime Consultant*.
- 3.1.4 All connectors must be installed at-grade within a test station manhole. Underground installation of connectors is not permitted. The connector shall connect mainline tracer wires, and shall have a single wire that runs from the test station manhole and up the warning sign post into a termination access box mounted to the sign post. This tracer wire shall be installed in conduit that runs up the sign post and into the access box.
- 3.1.5 Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- 3.1.6 Tracer wire shall be installed at the north springline of the pipe and secured (taped/tied) at 3 m intervals.
- 3.1.7 Tracer wire must be properly grounded as specified.
- 3.1.8 Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access box located on the service sign post (See Tracer wire Termination/Access).
- 3.1.9 At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the tracer wire. (See Grounding).
- 3.1.10 Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the tracer wire.
- 3.1.11 In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall

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be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

- 3.1.12 Above-ground tracer wire access boxes will be installed at all locations where a connector has been used and will be mounted to the warning sign of each post at each location.

3.2 Testing

- 3.2.1 All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, completed by a third party locating agency, selected by the *Contractor* and approved by the *Prime Consultant*. Testing shall be witnessed by the *Contractor* and *Prime Consultant* prior to acceptance.
- 3.2.2 *Contractor* shall pay costs for trace wire locating and testing.
- 3.2.3 Continuity testing in lieu of actual line tracing shall not be accepted.

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION/INTERCONNECTIONS

COMMON REQUIREMENTS FOR PROCESS PIPING SYSTEMS

1.0 GENERAL

1.1 Summary

- 1.1.1 This Section specifies general requirements for the supply and installation of process piping, valves, fittings and related appurtenances associated with the *Work*. More detailed requirements are contained in other Sections. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* describe herein.
- 1.1.2 Design, select, locate and provide expansion joints, pipe guides and anchors required for final piping layout. Typical details, anchors, and thermal expansion allowance shown on the *Drawings* are provided only for general guidance.
- 1.1.3 All materials not specifically listed or specified, but required to complete the installation are the responsibility of the *Contractor*.
- 1.1.4 Related Requirements
 - (a) Section 40 05 07: Supports, Anchors and Seismic Bracing for Process Piping and Conveyors
 - (b) Section 40 05 23.24: 304 Stainless Steel Piping
 - (c) Section 40 05 63.33: Metallic Ball Valves
 - (d) Section 40 05 63.34: Butterfly Valves
 - (e) Section 40 05 63.35: Check Valves
 - (f) Section 40 05 63.35: Plug Valves
 - (g) Section 40 05 63.37: Pressure Relief Valves
 - (h) Section 40 05 67.01: Pressure Sustaining Valves
 - (i) Section 40 05 63.38: Air Valve
 - (j) Section 40 05 61.43: Knife Gate Valve
 - (k) Section 40 33 01: Chemical Piping, Valves and Fittings

1.2 References

1.2.1 Definitions

- (a) Process Piping: Piping systems that are any of the following;

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1. Located above ground
 2. Located inside facilities
 3. Located below ground within 1 m of facilities or from the facility to the first transition coupler, whichever is longer
 4. Process air piping and fittings inside and outside of facilities.
- (b) Maximum working pressure: The greatest continual pressure at which the piping system operates.
- (c) Test pressure: The hydrostatic pressure used to determine system compliance.
- (d) Interior: Within an environmentally controlled enclosure where the temperature is maintained above 5 °C.
- (e) Submerged: Regularly or occasionally immersed in liquid; inside covered tanks and/or channels, and within 3 m above maximum water level of open tankage. Also includes pipes and appurtenances within manholes, vaults and channels.
- (f) Outdoor: Exposed, above ground, outside or within an enclosure that is not environmentally controlled.
- (g) Buried: Placed directly in soil and/or granular fill.
- (h) *Contractor's Engineer*: A professional engineer registered in the Province of British Columbia qualified to do detailed piping thermal expansion design at the *Contractor's* cost.

1.2.2 Reference Standards

- (a) Conform to the most recent version of all standards referenced in this Section.
- (b) ANSI B1.1: Unified Inch Screw Threads, UN and UNR Thread Form
- (c) ANSI/AWWA C606: Grooved and Shouldered Joints
- (d) ASME B31.3: Power Piping
- (e) ASTM B16.21: Non-metallic Flat Gaskets for Pipe Flanges
- (f) ASTM A193: Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

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- (g) ASTM A194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- (h) ASTM A307: Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
- (i) ASTM A354: Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
- (j) ASTM A563: Carbon and Alloy Steel Nuts
- (k) ASTM B32: Solder Metal
- (l) ASTM B633: Electrodeposited Coatings of Zinc on Iron and Steel
- (m) ASTM B766: Electrodeposited Coatings of Cadmium
- (n) ASTM F436: Hardened Steel Washers Inch and Metric Dimensions
- (o) AWWA C110: Ductile-Iron and Gray-Iron Fittings
- (p) AWWA C200: Steel Water Pipe, 6 In. (150 mm) and Larger
- (q) AWWA C227: Bolted, Split-Sleeve Restrained and Non-restrained Couplings for Plain-End Pipe
- (r) AWWA C228: Stainless Steel Pipe Flange Joints for Water Service – Sizes 2 IN. Through 72 IN. (50 mm through 1,800 mm)
- (s) AWWA C651: Disinfecting Water Mains
- (t) AWWA M11: Steel Pipe – A Guide for Design and Installation.
- (u) CSA G164: Hot Dip Galvanizing of Irregularly Shaped Articles
- (v) CSA W47.1: Fusion Welding of Steel Company Certification
- (w) CSA W48: Electrode and Filler Metals Certification
- (x) EJMA Standards: Standards of the Expansion Joint Manufacturers Association
- (y) SSPC SP-1: Solvent Cleaning
- (z) SSPC SP-3: Power Tool Cleaning
- (aa) SSPC SP-6: Commercial Blast Cleaning

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- 1.3.1 Prior to construction, coordinate with other divisions to locate openings and place sleeves or spools in cast in place concrete and/or masonry.
- 1.3.2 Prior to demolition, coordinate with other divisions to locate pipe, sleeve and duct penetrations through existing structures.
- 1.4 Submittals - For Review
 - 1.4.1 Before fabrication, provide manufacturer data for each type of pipe material and for each fitting, valve, coupling, and all specified appurtenances used to complete the *Work* covered in this section.
 - 1.4.2 For all piping systems greater than 25 mm in diameter provide isometric drawings to indicate assembly details; pipe size, welds, flanges, couplings, valve placement, vents and drains, cathodic protection, seismic restraint system, expansion joints, guides, anchors, supports and provisions for thrust restraint, wall penetrations, as well as any other pertinent details.
 - 1.4.3 Provide details of any shop fabricated fittings.
 - 1.4.4 Where directed by the *Consultant*, provide mill test results or product samples.
 - 1.4.5 For expansion joints provide manufacturer's catalog data, *Shop Drawings* and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details.
 - 1.4.6 If requested, the piping fabricator shall submit a demonstrated fillet and butt weld on a test sample of pipe to be examined and approved by a certified inspection company. The test specimens will be submitted to the *Consultant's* inspection company at the *Owner's* expense. Any retesting required by the *Owner* shall be completed at the *Contractor's* expense.
 - 1.4.7 Bacteriological testing results following disinfection of raw and potable water piping.
 - 1.4.8 Provide a copy of this specification section and all referenced sections with each paragraph check-marked to show compliance or highlighted with notes indicating deviation.
- 1.5 Submittals - For Information Only
 - 1.5.1 Submit copies of all original submittals and all related correspondence made as part of regulatory submissions required by the British Columbia Power Engineers

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and Boiler Pressure Vessel Safety Act and Regulations and any submissions required by other regulatory authorities.

- 1.5.2 Provide anchor and thermal expansion design details including locations, load information, design calculations and illustrative drawings, and calculations to substantiate expansion joint selection and amount of pre-compression, stamped and signed by the *Contractor's* Engineer.
- 1.5.3 Current and complete documentation of welder's qualifications prior to the commencement of any welding. All welders who work on this project must provide the correct documentation.
- 1.5.4 Radiographic weld test and other shop inspection and test results.
- 1.5.5 Prior to commencing any welding of stainless steel pipe, submit a Welding Procedure Specification (WPS) including a written description of welding techniques including but not limited to materials, methods, and quality control. Certify that the technique is acceptable for the intended service condition. Written procedures to be signed and sealed at the *Contractor's* cost by a professional engineer registered in BC qualified for welding design.
- 1.6 Submittals – For Operation and Maintenance Manuals
 - 1.6.1 Provide manufacturer's data, supplier contact information, and *Shop Drawings* for:
 - (a) Expansion joints
 - (b) Couplings
- 1.7 Quality Assurance
 - 1.7.1 Provide complete, fully tested and operational process piping systems.
 - 1.7.2 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this *Work*.
 - 1.7.3 Complete all regulatory submissions as required by the BC Power Engineers and Boiler Pressure Vessel Safety Act and Regulations, and all other submissions as required by other regulatory authorities.
 - 1.7.4 All welding of pipe and fittings shall be undertaken by welders certified for pipe welding for each applicable pipe welding procedure through the BC Industry Training Authority (ITA) and holding a Level A or Level B Interprovincial Red Seal Ticket.

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- 1.7.5 Where pressure piping falls under the BC Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation, welders shall also be pressure pipe certified with the BC Safety Authority for each applicable weld procedure.
- 1.7.6 The fabricator shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.
- 1.7.7 All pipe fabrication and welding shall be in accordance with ASME B31.3 normal fluid service code for pressure piping or where applicable Section IX of the Boiler and Pressure Vessel Code.
- 1.7.8 Perform visual examinations of all welding to reveal any surface or root defects, unacceptable weld fit-ups, arc strikes, weld spatter, or insufficient heat tint removal. Perform visual examination of shop welding before shipping.
- 1.7.9 Provide radiographic inspections required to meet the welding standards cited in this Section. At the discretion of the *Consultant*, 5% of welds may be subject to radiographic inspection in the shop, the cost of which will be borne by the *Owner* unless tests prove the weld defective, then the cost to correct the defective *Work* plus the cost of additional radiographic inspection shall be borne by the *Contractor*.
- 1.7.10 Spot-radiographic inspection of welds, or alternative method, may be conducted at the option and at the expense of the *Owner*. The *Consultant* will designate such company to carry out inspection of welds at the site of erection, and the *Contractor* shall fully co-operate with the *Consultant* and representatives in supply such labour and working space as may be required. Welding judged unacceptable shall be repaired using a method satisfactory to the *Consultant* at no additional cost to the *Owner*. The *Contractor* shall pay for the spot-radiographic inspection of all welds which are judged unacceptable.
- 1.7.11 For each defective weld, two additional radiographic inspections at locations identified by the *Consultant* will be required, plus a radiograph of the repair. Costs for such additional radiographic inspections including the radiograph of the repair shall be borne by the *Contractor*.
- 1.7.12 The *Consultant* may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. Any weld test specimen coupons submitted shall clearly identify the welder(s).
- 1.8 Delivery, Storage and Handling
 - 1.8.1 Protect pipe and pipe coatings from damage.

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- 1.8.2 Store on site as recommended by materials manufacturer to prevent damage, undue stresses, or weathering. Store materials a minimum of 200 mm above ground with sufficient supports to prevent bending.
- 1.8.3 Protect non-UV light inhibited plastic materials from sunlight.
- 1.8.4 Provide shipping devices to maintain the face-to face dimension of each expansion joint during shipment, storage and installation.

2.0 PRODUCTS

2.1 Bolts, Studs, Washers, and Tie-rods

2.1.1 Bolts and Studs

- (a) Provide hex head bolts and studs, threads to ANSI B1.1, standard coarse thread series.
- (b) Connecting stainless: Grade B8 ASTM A193, C1.1.
- (c) Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
- (d) Connecting steel, or unless otherwise specified: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
- (e) Axial stress in bolts shall not exceed 40% or material yield strength based on unthreaded body area.

2.1.2 Nuts and Washers

- (a) Provide hex head nuts, threads to ANSI B1.1, standard coarse thread series. Greater than 25 mm, provide heavy hex.
- (b) Connecting stainless steel: Provide nuts to ASTM A194 Grade 8.
- (c) Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be cadmium plated to ASTM B766. Always include washers.
- (d) Connecting steel, or unless otherwise specified: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to

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ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.

2.1.3 Tie-rods

- (a) Provide tie-rods continuously threaded to ASTM A354 and fabricated in accordance with B1.1 (screw threads, coarse thread series). Tie rods to be steel cadmium plated in accordance with ASTM B766.

2.2 Expansion Joints

2.2.1 Design and fabricate expansion joints in accordance with EJMA standards and to meet the requirements of this Section.

2.2.2 Expansion joint types are indicated. Alternative types may be considered if recommended by the *Contractor's Engineer*, and approved by *Consultant*.

2.2.3 Elastomer Expansion Joints

- (a) Conform to the requirements of the Fluid Sealing Association, rubber Expansion Joint Division.
- (b) Provide control rods to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Manufacturer to determine number and sizes of control rods.
- (c) Up to and including 200 mm diameter, face to face dimension 150 mm, nominal. Greater than 200 mm diameter and less than or equal to 300 mm diameter, face to face dimension 200 mm nominal.
- (d) Provide 304 stainless steel backup rings.
- (e) Elastomer spool type: resilient arch, constructed of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body. Comes with split type backup rings. On fluids containing solids, provide filled arch type. Neoprene elastomer cover and elastomer tube liner.
- (f) Elastomer spherical moulded: construct of multiplied plies of nylon tire cord fabric, and neoprene elastomer.
- (g) Acceptable manufacturers: Red Valve, Senior Flexonics, Proco.

2.3 Fittings

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- 2.3.1 Provide fittings with wall thickness equal to or greater than the pipe, of the same, material, coating, lining and pressure rating as pipe or better.
- 2.3.2 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.
- 2.3.3 Provide concentric reducers in vertical lines unless indicated otherwise.
- 2.3.4 Provide smooth flow long radius elbows for liquid service unless otherwise specified.
- 2.3.5 Provide smooth flow standard radius elbows for process air service unless otherwise specified.
- 2.4 Joints – Flanges
 - 2.4.1 Flanges for mating to equipment or valves must be compatible with those items. In all situations similar faced flanges only shall be mated. Companion flanges for connection to cast iron or ductile iron or PVC equipment or valve flanges shall be flat faced and flush with the equipment or valve flange.
 - 2.4.2 Vanstone style flanges are not permitted.
 - 2.4.3 Class 150 – flat faced with full face gaskets, unless mating to raised face valves, lap joint flanges or equipment.
 - 2.4.4 Class 300 – Not used.
 - 2.4.5 If not specified or shown otherwise use slip-on flanges.
 - 2.4.6 Provide flange isolation kits where dissimilar metals are joined.
 - 2.4.7 Gaskets
 - (a) Conform to ASTM B16.21 and AWWA C228 Table 1.
 - (b) Minimum gasket thickness 3.175 mm.
 - (c) Provide full face gaskets for flat faced flanges
 - (d) Provide ring type gaskets for raised face flanges.
 - (e) Provide gasket materials suitable for the temperature, pressure and corrosivity of the fluid conveyed in the pipeline.
 - (i) Provide liquid service gaskets of EPDM or neoprene.

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- (ii) Provide air service gaskets of compressed Kevlar with neoprene binder, suitable for service conditions.

2.5 Joints – Threaded Couplings

- 2.5.1 Provide screwed joints with American Standard threads.
- 2.5.2 Provide Teflon tape suitable for pipe material and service.

2.6 Joints – Grooved Joint Couplings

- 2.6.1 Provide pipe grooving, couplings and gaskets conforming to ANSI/AWWA C606. Victaulic, Shurjoint, Gruvlok or approved equal.
- 2.6.2 Provide flexible style couplings for buried service pipe, and adjacent to pump or blower suction and discharge where used for noise and vibration control. Provide rigid type couplings in other applications unless noted otherwise on *Drawings*. Only use flexible style couplings for PVC pipe.
- 2.6.3 Body Material as follows:
 - (a) Carbon Steel Pipe – Provide ductile iron body. Buried or submerged installations to be epoxy coated to AWWA C116.
 - (b) Stainless Steel Pipe – Provide stainless steel body.
- 2.6.4 Gaskets
 - (a) Provide for liquid service Victaulic Grade “E” EPDM flush seal gasket or approved equal.
 - (b) Provide for gas service Victaulic Grade “L” gasket or approved equal.
- 2.6.5 For steel pipe provide cut grooves on schedule 40, standard wall or thicker pipe, roll grooves for Sch. 10 and Sch. 5.
- 2.6.6 For plastic pipe provide roll grooves for schedule 40 piping. Provide roll grooves for schedule 80 and 120 piping smaller than or equal to 200 mm in diameter. Provide cut grooves for schedule 80 and 120 piping for 250 mm diameter and larger.
- 2.6.7 Grooved joint flange adapters shall be used only where specifically indicated.

2.7 Joints – Flexible Couplings

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- 2.7.1 Provide cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts. Robar, Dresser or equal.
- 2.7.2 If joint restrained add restraining rods and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure, as recommended by the manufacturer.
- 2.7.3 Provide gasket suitable for service conditions.
- 2.8 Joints – Welding
 - 2.8.1 Use welding materials conforming to CSA W48.
 - 2.8.2 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.
- 2.9 Joints – Soldered
 - 2.9.1 Use only lead free solder conforming to ASTM B32 and the BC Plumbing Code.
- 2.10 Lining and Coating
 - 2.10.1 Do not paint stainless steel pipe.
 - 2.10.2 Provide factory applied linings and coatings as specified for specific pipe services
 - 2.10.3 Galvanizing: Hot dip zinc coat to CSA G164, minimum 440 g/m³.
- 2.11 Piping
 - 2.11.1 Piping materials will be clearly marked to indicate size, type, class/schedule and coatings.
- 2.12 Piping Identification
 - 2.12.1 Label pipes with commodity code and flow direction arrows.
 - 2.12.2 Labels and tags: legend and arrows printed on vinyl coated pressure sensitive cloth tape.

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- 2.12.3 Colours for identification materials: to CSA B53 – Code for identification of Piping Systems
- 2.12.4 For pipes 75 mm dia. (outside surface) and larger:
 - (a) legend – 40 mm high characters
 - (b) arrows – 40 mm wide (maximum)
- 2.12.5 For pipes under 75 mm dia. (outside surface):
 - (a) legend – 20 mm high characters
 - (b) arrows – 20 mm wide (maximum)
- 2.12.6 For ducts:
 - (a) legend – 65 mm high characters
 - (b) arrows – 65 mm wide (maximum)
- 2.12.7 Pipe and duct duties and arrow directions will be provided by *Consultant*.
 - (a) Duties shall be spelt out in full.
 - (b) Duties for HVAC ducting shall read: "Supply", "Return", or "Exhaust" respectively.
- 2.12.8 *Contractor* shall mark-up *Drawings* with proposed flow arrow and text locations and submit to the *Consultant* with a sample of the proposed labels for approval before installing.
- 2.13 Component Tagging and Identification
 - 2.13.1 Tag all valves and equipment with 304 stainless steel tags with 12 mm high engraved letters and numbers. Numbers and letters shall be filled with black paint. Attach to valve with 304 SS chain around valve shaft. For other equipment, glue or fasten tag to equipment as needed. Inscription shall contain P&ID identification tag, size, manufacturer and model number.
- 2.14 Pressure Gauges
 - 2.14.1 Pressure gauge liquid seal diaphragm of the continuous type equal to "Ashcroft" or "Tterice" shall be furnished.
 - 2.14.2 Ball valves shall be provided for isolation of these gauges with diaphragms.

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- 2.14.3 Gauge shall read to pressure indicated on *Drawings*, with a dial diameter not less than 100 mm.
- 2.14.4 Supply gauges, complete with pressure snubbers, diaphragm protection seals, and full vacuum protection.

3.0 EXECUTION

3.1 Preparation

- 3.1.1 Prior to installation, inspect and field measure to ensure that previous *Work* is not prejudicial to the proper installation of piping.
- 3.1.2 Make all minor modification to suit equipment and structural element locations and elevations, at no expense to the *Owner*.
- 3.1.3 Advise the *Consultant* of all modifications. Indicate all piping modifications on the *Shop Drawings* submitted prior to fabrication or installation. Do not commence *Work* on related piping until the *Consultant's* approval has been received.
- 3.1.4 Prior to valve and pipe appurtenance installation, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that valve location and orientation provides suitable access to all valve operators. Ensure that sufficient easily disassembled joints are provided to allow for removal and replacement of all valves and pipe appurtenances.

3.2 Pipe Handling

- 3.2.1 Inspect each pipe, fitting and piping appurtenance prior to installation. Do not install damaged material or materials with damaged linings or coatings.
- 3.2.2 Repair pipe with damaged protective coatings in accordance with coating manufacturer's directions and to the satisfaction of the *Consultant*.
- 3.2.3 Remove all foreign matter from inside of piping and piping appurtenances prior to installation.
- 3.2.4 Use proper implements, slings, tools and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

3.3 Conflicts

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- 3.3.1 Confirm the pipework routing with the *Consultant* prior to commencement of fabrication and installation. Advise the *Consultant* of any conflicts with existing services, structures, or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict, as instructed by the *Consultant*.
- 3.4 Interior and Outdoor Pipe Installation
 - 3.4.1 Piping installed in interior building spaces shall be fabricated and installed in accordance with the ASME Pressure Vessel Code.
 - 3.4.2 Make adequate provision in piping runs for expansion, contraction, slope and anchorage.
 - 3.4.3 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag and stress.
 - 3.4.4 Provide temporary supports as necessary during construction to prevent overstressing equipment, valves or pipe.
 - 3.4.5 Accurately cut all piping for fabrication to field measurements.
 - 3.4.6 Install pipes in straight alignment. Variance from the true alignment shall not exceed 10 mm in any direction or as required in ASME B31.3 whichever is less.
 - 3.4.7 Fabricate and assemble pipe runs to ensure that pipework is not stressed to achieve the designed alignment and that no stresses are transferred to equipment or equipment flanges. "Springing" of pipework to ensure alignment is not permitted. The *Contractor* shall undo and subsequently remake all pipework connections where so instructed by the *Consultant* to ensure that springing does not occur. Take care not to damage equipment, piping appurtenances, valves, flanges, or other joints.
 - 3.4.8 Do not cut or weaken the building structure to facilitate installation unless specifically detailed on the *Drawings* or approved by the *Consultant* in writing.
 - 3.4.9 Slope process air piping to condensate drains.
- 3.5 Connections to Equipment and Existing Piping
 - 3.5.1 Verify fit and materials at each connection prior to making the connection.
 - 3.5.2 Where joining piping to existing equipment, confirm flange type on the equipment and install matching pipe flanges to suit.

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- 3.5.3 Modifications to either new or existing materials required to make connections shall be approved by the *Consultant* in writing prior to the connections being made.

3.6 Pipe Joints

3.6.1 General

- (a) Provide joints that can be readily disassembled at the minimum within 1.0 m of any connection to equipment, on both sides of structural penetrations, and within 0.6 m of all threaded end valves.
- (b) Allow a minimum of 150 mm to face or 75 mm to edge of flanges or grooved joint couplings from wall, floor or ceiling unless otherwise shown.

3.6.2 Threaded

- (a) Unless specifically noted on the *Drawings*, threaded couplings shall only be used on piping with nominal diameters less than 65 mm.
- (b) Ream the ends of all pipes to remove all burrs and cuttings when fabricating threaded joints.
- (c) Clean out pipe prior to joining.
- (d) Apply Teflon tape to male threads and join pipe. Do not use extra tape to make up for slack in the joint.
- (e) Install threaded pipe with as few joints as possible. Short lengths of pipe coupled tighter shall not be used, except where a union is specifically shown on the *Drawings*.
- (f) If it is necessary to back off a screwed joint after it is made, the thread shall be cleaned and new compound applied.
- (g) Threads shall not be caulked.
- (h) Bushings shall not be used.
- (i) Nipples in threaded piping shall be shoulder nipples. Close nipples shall not be used unless specifically indicated.

3.6.3 Flanged

- (a) Clean flanges and gaskets prior to connection.

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- (b) Lubricate gaskets with soapy water and apply anti-seize compound to stainless steel bolts.
- (c) Bring flanges into close parallel and lateral alignment.
- (d) Tighten bolts progressively, proceeding from side to side of the flange. Wrenches used for tightening bolts shall be in good condition and properly sized to prevent rounding of nut and bolt heads. Apply manufacturer's torque recommendations when connecting to valves and equipment. Do not over torque bolts.
- (e) Do not use washers to take up excess bolt length.
- (f) Bolt projection beyond nuts shall be approximately two full threads.
- (g) Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place strain on equipment.
- (h) Install flange adapters in accordance with manufacturer's recommendations.
- (i) Install lap joint flanges in vibration free service only. Do not install in buried or submerged environments.

3.6.4 Grooved Joint Couplings

- (a) Install grooved joints and grooved joint flange adapters as recommended by manufacturer using manufacturer's recommended lubricants on gaskets.
- (b) All grooving tools and accessories to be manufactured by grooved product supplier.

3.6.5 Solvent Cemented

- (a) Refer to specification 40 05 31.13.

3.7 Expansion Joints

- 3.7.1 Accurately align pipelines to receive expansion joints before installing the joint or connector. Do not stretch, compress, misalign or offset the joint or connector to fit the piping.

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- 3.7.2 Align and install each expansion joint in accordance with EJMA standards, and in accordance with manufacturer's written instructions.
- 3.7.3 Properly guide and anchor all expansion joints.
- 3.7.4 Provide sufficient bends and expansion joints to allow for thermal movement of piping allowing for both the operating temperature range as defined by the specific pipe specifications, and the ambient temperature range.
 - (a) Indoor temperature range: 0°C to 40°C
 - (b) Outdoor temperature range: -42°C to 35°C
- 3.8 Welding – General
 - 3.8.1 All piping is to be shop welded.
 - 3.8.2 Metal surfaces in and adjacent to the welding groove shall be dry before welding commences and kept dry and free from dirt, loose scale, slag, grease or any other foreign contaminant.
 - 3.8.3 All welds after welding is complete must be cleaned and surface prepared as required for the final coating, finish or passivation method to be applied.
 - 3.8.4 The end of each pipe shall be carefully fitted to butt accurately with proper gap to the preceding pipe or fitting. Before placing the pipe in position, the ends of the pipe shall be made truly circular by an approved method and, if necessary, for large pipes "spiders" shall be placed in each to keep them truly circular.
- 3.9 Field Welding
 - 3.9.1 In general field welding is not acceptable. Field welding may be performed only under exceptional circumstances and with the prior written consent of the *Consultant*.
 - 3.9.2 Field welding shall conform to the general requirements of AWWA C206 "Field Welding of Steel Water Pipe Joints", and the quality requirements under "Welding-General" in this specification.
 - 3.9.3 Field welding shall not be done under conditions that would impair the completed weld including but not limited to: moisture; blowing sands or dust; high winds; low temperatures. If, in the *Consultant's* opinion, protection from prevailing weather conditions is necessary, then all welding shall cease until this protection is provided at the *Contractor's* cost, and welds done under poor conditions shall

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be re-made. The *Contractor* shall be prepared for such events and will not be compensated for downtime associated with delays of this nature.

3.9.4 When the ambient temperature is below 0°C all welding operations shall cease unless an appropriate welding procedure has been submitted. Written procedures to be signed and sealed at the *Contractor's* cost by a professional engineer registered in BC qualified for welding design.

3.9.5 In general, field welds shall be butt type, suitably bevelled to the satisfaction of the *Consultant*.

3.9.6 Pipes cut in the field for closing pieces and other field joints shall be cut to a smooth uniform level. Edges shall be smooth and not serrated and shall be ground smooth if they are rough after cutting.

3.10 Pipe Structural Penetrations

3.10.1 Coordinate with other divisions to locate and place sleeves or cast-in-place pipe sections prior to the construction of concrete and masonry building elements.

3.10.2 For pipe grouted or cast into concrete or block walls, provide anchor rings in accordance with AWWA M11.

3.11 Drains, Vents, Flushing Connections, Sample Points

3.11.1 Provide manual air vents at the high points of each reach of pipeline. Refer to the Standard Details. Pipe air vents to the nearest floor.

3.11.2 Provide manual drains at the low points of each reach of pipeline. Refer to the Standard details. Pipe drains to a sump, gutter floor drain, or other approved collection point.

3.11.3 Mount drain and vent isolation valves in a location accessible from floor level and no greater than 1.2 m above the floor.

3.11.4 Install flushing connections as shown.

3.12 Pipe Coating and Lining

3.12.1 Coat and line all fittings and joint types to match the pipe in which they are installed.

3.12.2 In general, field lining and coating in the field is not allowed, except to repair damaged coating and lining.

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- 3.12.3 Prepare all coated or shop primed surfaces in the field by cleaning in accordance with SSPC SP-1 (Solvent cleaning). Clean damaged areas of shop primed surfaces in accordance with SSPC SP-3 (Power Tool Cleaning). Repaint as recommended by coating manufacturer with primer for shop primed surfaces, or sealer for coated surfaces.
- 3.12.4 Prepare bare metal surfaces in accordance with SSPC SP-6 (Commercial Blast).
- 3.12.5 Apply primer and finish coats in accordance with manufacturer's recommendations.
- 3.13 Testing
 - 3.13.1 All piping shall be pressure tested, and witnessed by the *Consultant*.
 - 3.13.2 Give *Consultant* 24 hours' notice of testing.
 - 3.13.3 Thoroughly clean all piping prior to pressure testing.
 - 3.13.4 Prior to pressure testing ensure piping is adequately restrained.
 - 3.13.5 Do not insulate, bury, concrete surround or otherwise conceal *Work* until piping systems are tested and accepted.
 - 3.13.6 Supply all equipment, gauges and materials including fluids for pressure testing.
 - 3.13.7 Install fittings for air relief, gauges and drainage as needed to complete testing. After testing remove and plug fittings.
 - 3.13.8 Cap and plug all lines that are normally open ended. Remove on completion of testing.
 - 3.13.9 Isolate all low pressure equipment or pipeline appurtenances during testing to protect the equipment or pipeline appurtenances from damage.
 - 3.13.10 Repair and replace any defective *Work* using new material.
 - 3.13.11 Testing Piping Carrying Liquid Commodities
 - (a) Test welded metal piping to AWWA C200.
 - (b) There shall be no loss of pressure during testing, and no visual evidence of leakage.
 - (c) Test duration: 2 hours.

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- (d) Test pressure: 1.5 times the maximum working pressure or 250 psi.
Confirm system working pressure with *Consultant* prior to pipe testing.

3.13.12 Testing Piping Carrying Gaseous Commodities

- (a) Use dry air or commercial grade nitrogen for testing.
- (b) All tests shall include a preliminary check out of no more than 200 kPa or half the test pressure, whichever is less. Pressure shall be gradually increased in steps.
- (c) All joints shall be wetted using a mixture of soap and water. There shall be no loss of pressure not associated with changes in temperature, and no obvious evidence of leakage.
- (d) Test duration: 4 hours
- (e) Test pressure: 1.5 times the maximum working pressure. Review test pressures with *Consultant* prior to proceeding with test.

3.14 Cleaning and Flushing

3.14.1 Flush and drain liquid pipes after pressure tests.

- (a) Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline. Remove instrumentation or piping appurtenances that may be damaged by this procedure and replace after cleaning. Give lines smaller or equal to 150 mm an initial flush or purge.
- (b) If recommended by equipment supplier, install temporary screens with visible locator tabs in the suction piping of equipment. Maximum opening size – 25 mm.
- (c) Dispose of flushing water in a manner which causes no damage to buildings or site-works in a manner approved by the *Consultant*.

3.14.2 Purge piping with air before testing. Upon completion of testing, drain and dry the piping with a dry air stream.

3.15 Disinfection

3.15.1 Piping intended for raw and potable water service shall be flushed, disinfected and bacteriologically tested in accordance with AWWA C651.

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- (a) Do not use calcium hypochlorite for disinfection of solvent cemented PVC pipe.
- 3.15.2 Bacteriological testing and reporting to include total coliforms, fecal coliforms and background colonies on the total coliform plate.
- 3.15.3 Maximum acceptable count of coliform and background colony forming units: 200 CFU. The presence of any coliform bacteria or background bacteria over the maximum allowable limit shall constitute a failed test.
- 3.16 Operations and Maintenance Manuals
 - 3.16.1 Include copies of all manufacturer's information provided in *Shop Drawing* submittals for all piping appurtenances in the operations and maintenance manuals.
 - 3.16.2 Include name and contact information of supplier for each piping appurtenance in the operations and maintenance manuals.

END OF SECTION

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PIPING

1.0 GENERAL

1.1 Summary

- 1.1.1 This Section specifies the supply and installation of piping supports, anchors, thrust restraints and seismic bracing. This includes piping supports, anchors, thrust restraints and seismic bracing for Process Piping (including piping inside tanks). This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.2 Design, select, locate and provide pipe hangers, supports, anchors, thrust restraints and seismic bracing.
- 1.1.3 No attempt has been made to indicate all necessary pipe supports, anchors, thrust restraints and seismic bracing in the *Drawings*. Details provided are intended as a general guide for quality only. The intent has been to indicate general arrangements and typical spacing, but does not relieve the *Contractor* of the responsibility of designing and supplying a complete support system.
- 1.1.4 Related Requirements
 - (a) Section 40 05 01: Common Requirements for Process Piping Systems.
 - (b) Section 40 05 23.24: 304 Stainless Steel Piping
 - (c) Section 40 33 01: Chemical Piping, Valves and Fittings

1.2 References

1.2.1 Definitions

- (a) *Contractor's Engineer*: A professional engineer registered in the Province of British Columbia qualified to do detailed piping structural design at the *Contractor's* cost.
- (b) *Service loads*: All static and dynamic loads which must be resisted by pipe hangers and supports including but not limited to:
 - (i) Weights of pipes, valves, fittings, insulating materials, suspended hanger components, normal fluid contents.
 - (ii) Weight of hydrostatic test fluid or cleaning fluid
 - (iii) Reaction forces due to operation of all valves
 - (iv) Wind, snow or ice loadings on outdoor piping
 - (v) Loads from future piping shown on *Drawings*

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PIPING

- (vi) Vibration
- (vii) Thrust forces caused by moving liquids and internal pressure
- (viii) Forces resulting from thermal expansion/contraction due to commodity and ambient temperature fluctuations
- (c) *Design Loads:* That combination of service loads producing the maximum load effects to be resisted by the pipe hangers and supports in accordance to the B.C. Building Code.
- (d) *Seismic Loads:* In accordance to the B.C. Building Code.
- (e) *Allowable Load:* the maximum design load as recommended by the manufacturers: maximum allowable stress levels not to exceed those listed in MSS SP-58.

1.2.2 Reference Standards

- (a) Conform with the most recent version of all standards referenced in this Section.
 - (i) B.C. Building Code
 - (ii) B.C. Plumbing Code
 - (iii) ANSI/ASME B31.3 Process Piping
 - (iv) MSS SP-89 – Pipe Hangers and Supports: Fabrication and Installation Practices
 - (v) MSS SP 58, Pipe Hangers and Supports – Materials, Design and Manufacture
 - (vi) MSS SP-60 – Pipe Hangers and Supports – Selection and Application
 - (vii) SMACNA – Guidelines for Seismic Restraints

1.3 Submittals - For Review

- 1.3.1 Details including precise location and factored design loads where piping is supported by any proposed supplementary structural members. Review by *Consultant* will be for support by the existing structure. Sizing of proposed supplementary structural members will remain the responsibility of the *Contractor's Engineer*.
- 1.3.2 Manufacturer's pipe hanger and support cut sheets.

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- 1.3.3 Details of pipe thrust restraints and harnesses. Sizing of proposed thrust restraints and harnesses remain the responsibility of the *Contractor's Engineer*.
- 1.4 Submittals – For Information Only
 - 1.4.1 Before commencement of installation, provide hanger, support, anchor and seismic restraint system design details including dimensions, dimensioned locations, load information, design calculations and illustrative drawings, stamped and signed by the *Contractor's Engineer*.
- 1.5 Delivery, Storage and Handling
 - 1.5.1 Deliver materials and unload at site using methods which do not damage coatings or any parts.
 - 1.5.2 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.
- 1.6 Site Conditions
 - 1.6.1 $S_a(0.2) = 0.28$, $S_a(0.5) = 0.17$, $S_a(1.0) = 0.094$, $S_a(2.0) = 0.056$, $PGA = 0.073$, Site Class D.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 Design pipe support systems to support *Design Loads* with a factor of safety of 4.0 or as required for seismic bracing, whichever is greater.
 - 2.1.2 Provide seismic restraints to resist pipe movements and loads occurring as a result of seismic events.
 - 2.1.3 Where structural bearings are not in suitable locations, provide supplementary structural members.
 - 2.1.4 Support plastic piping with at least 50 mm measured around the pipe perimeter and 50 mm longitudinal smooth bearing surface in contact with the pipe.
- 2.2 Maximum support spacing for horizontal straight runs of pipe is as listed in the following table. Provide additional supports as required to support the design loads.

Pipe Size	Stainless Steel (m)	PVC SCH. 80 (m)
	Liquid Service	Liquid Service
25 mm	2.1	1.8
38 mm		2.0
50 mm	3.0	2.1
65 mm		2.3

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PIPING

75 mm	3.7	2.4
100 mm	4.3	2.7

2.2.1 Space plastic pipe supports to allow for expansion and contraction as recommended by manufacturers at elbows and changes in direction.

- (a) Where spacing for thermal expansion and contraction cannot be achieved provide expansions loops in accordance with manufacturer recommendations on straight pipe runs.

2.3 Materials

2.3.1 304 stainless steel: For all steel pipe supports.

2.3.2 Type 304 Stainless steel nuts, bolts, washers and threaded rods.

2.3.3 Reinforced cast in place concrete.

2.3.4 Provide isolation to prevent contact between dissimilar metals.

2.3.5 Isolate copper tubing from supports with a double thickness of Plycoflex 310 on Greenline accessory tape between the copper pipe and the supports.

2.3.6 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located less than 2,300 mm above the floor.

2.4 Manufactured Pipe Hangers and Supports

2.4.1 Acceptable Manufacturers:

- (a) Unistrut or approved equal
(b) B-Line, Myatt, Standon or approved equal

2.4.2 Acceptable Types:

- (a) Pipe stanchion with saddle and yoke
(b) Pipe stanchion with adjustable roller hanger
(c) Riser Clamp
(d) Offset Pipe Clamp
(e) Framing Channel Pipe Strap
(f) Framing Channels and Connection Fittings
(g) Framing Channel Post Base

2.5 Thrust restraints

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PIPING

- 2.5.1 Prevent transmission of pipe movement and thrust forces onto equipment flanges or connections.
- 2.5.2 Where thrust restraints are used to prevent pipe movement and the transmission of thrust forces onto equipment flanges or connections:
 - (a) Design pipe thrust restraints for thrust loads developed by 1.5 times the maximum pipe test pressure.
 - (b) Provide compression coupling joints with rod type thrust harnesses anchored in accordance with AWWA M11.
 - (c) Minimum tie-rod diameter – 19 mm.
- 2.6 Anchors
 - 2.6.1 Anchor locations shown on the *Drawings* are preliminary only. Provide number and location of anchors as determined by *Contractor's Engineer*.
 - 2.6.2 Reinforce piping as required at anchor locations to withstand applied forces.
- 2.7 Seismic Restraints
 - 2.7.1 Unless otherwise required by local building codes, seismic restraints may be omitted from:
 - (a) Compressed air piping less than 25 mm diameter.
 - (b) All piping suspended by individual hangers 300 mm or less in length from the top of the pipe to the bottom of the support for the hanger.
 - 2.7.2 Do not brace piping systems to dissimilar points of a building or to dissimilar building systems that may respond in a different mode during an earthquake.
 - 2.7.3 Size restraints to fit the outside diameter of insulation, where insulation is specified.
 - 2.7.4 Do not use branch lines to brace main lines.
 - 2.7.5 Do not limit thermal expansion and contraction of the piping system by seismic bracing.
 - 2.7.6 Provide a means to reduce noise and vibration transmission between linked fitting parts.

3.0 EXECUTION

- 3.1 Provide pipe support system to adequately secure the pipe and prevent undue vibration, and stress, and to prevent the transmission of forces to equipment and tanks.

SUPPORTS, ANCHORS, AND SEISMIC BRACING FOR PROCESS PIPING

- 3.2 Support piping in accordance with the pipe manufacturer's recommendations.
- 3.3 Support piping so that no pockets will be formed in the span due to sagging of the piping between supports.
- 3.4 Support piping so that temporary supports will not be required when removing parts of the piping system for equipment maintenance.
- 3.5 Provide hangers and or base supports within 1 metre of each change in direction on each piping leg, on one side of each valve, and on the first spool piece or fitting from a piece of equipment.
- 3.6 Secure supports to elbows where elbows change the run of a horizontal pipe to a vertical direction.
- 3.7 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.
- 3.8 Do not support piping from masonry wall construction.
- 3.9 Do not support piping from equipment or other pipes.
- 3.10 Do not drill or burn holes in the building structural steel without prior written permission from the *Consultant*.
- 3.11 Do not use hanger components for rigging and erection purposes.
- 3.12 When fabricating products under this specification, use welding procedures to minimize distortion and avoid damage to finished work or bonded materials. Finished products to be true to line, free from twists, bends, open joints, sharp corners and sharp edges.
- 3.13 Recoat cut ends of galvanized framing channel with zinc dust-zinc oxide coating.
- 3.14 Hanger and support components in contact with plastic pipe to be free of burrs and sharp edges.
- 3.15 Rollers to roll freely without binding.
- 3.16 Locate any cast in place concrete supports to prevent encasement in concrete of valves, pipe appurtenances or easily disassembled pipe joints.
- 3.17 Finished floor beneath base plates and framing channel post bases to be roughed prior to grouting. Grout between base plate and floor to be free of voids and foreign material.
- 3.18 Adjust stanchions to obtain required pipe slope and elevation prior to grouting of baseplates.
- 3.19 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

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- 3.20 Locate the first seismic restraint on a piping system not more than 3.0 m from the main riser, entrance to a building or piece of equipment.
- 3.21 Install seismic bracing within 45 degrees above and 45 degrees below horizontal relative to the horizontal centreline of the pipe.

END OF SECTION

304 STAINLESS STEEL PIPING

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to supply, fabrication, and installation of 304 Stainless Steel process piping as identified on the *Drawings*.

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Related Requirements

(a) Section 40 05 01: Common Requirements for Process Piping Systems

1.2 References

1.2.1 Reference Standards

(a) Conform with the most recent version of all standards referenced in this Section.

(i) ANSI/ASME B16.5:

(ii) ANSI/ASME B16.9:

(iii) ANSI/ASME B16.11:

(iv) ANSI/ASME B16.21:

(v) ANSI/ASME B36.19: Stainless Steel Pipe

(vi) ASTM A182: Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings and Valves and parts for High Temperature Service

(vii) ASTM A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications

(viii) ASTM A312: Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes

(ix) ASTM A380: Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems

(x) ASTM A403: Wrought Austenitic Stainless Steel Piping Fittings

304 STAINLESS STEEL PIPING

- (xi) ASTM A480: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
- (xii) ASTM A778: Welded, Unannealed Austenitic Stainless Steel Tubular Products
- (xiii) ASTM A967: Chemical Passivation Treatments for Stainless Steel Parts
- (xiv) AWWA C220: Stainless Steel Pipe ½ In (13 mm) and Larger
- (xv) AWWA C226: Stainless-Steel Fittings for Waterworks Service, Sizes ½ in. through 72 in (13 mm through 1,800 mm)
- (xvi) AWWA C227: Bolted, Split-Sleeve Restrained and Non-restrained Couplings for Plain-End Pipe
- (xvii) AWWA C606: Grooved and Shouldered Joints

1.3 Delivery, Storage and Handling

- 1.3.1 Protect materials from contamination from dirt or road salt by shrink wrap or other suitable packaging, and end caps, prior to and during shipment.
- 1.3.2 Store materials in such a way to prevent scratching and scoring of the surface and to avoid contact with dirt or carbon steel.

1.4 Design Conditions

1.4.1 Water Treatment Process Piping

- (a) Normal commodity temperature range: 0.5 to 25 °C.
- (b) Normal service operating pressure range: 0 to 50 PSI
- (c) Maximum (intermittent short term) operating pressure: 260 PSI
- (d) Test pressure: 100 PSI

304 STAINLESS STEEL PIPING

1.4.2 Process Air Piping

- (a) Normal commodity temperature range: 0 to 75 °C.
- (b) Normal service operating pressure range: 0 to 6 PSI
- (c) Test pressure: 9 PSI

2.0 PRODUCTS

- 2.1 Provide piping systems as detailed below with components suitable for the operating conditions.

Component	Size Range (mm)	Description	Applicable Standards
Pipe (general)	75 and under	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	100 and up	304L Stainless Steel. Sch 10S, welded	ASTM A312 ANSI/ASME B36.19
Pipe above roof line, buried or where penetrating structures	50 to 250	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	300 and up	304L Stainless Steel. STD wall, welded	ASTM A778 ANSI/ASME B36.19
Coating		Not applicable	
Lining	All	No. 1 mill interior finish or better	ASTM A480
Fittings	75 and under	304L Stainless Steel, Class 3000, socket weld Sch 40S bore, or threaded.	ASTM A182, ANSI/ASME B16.11
	100 and up	304L Stainless Steel, Sch 40S, buttweld. Elbows S.R. unless indicated otherwise. No mitred elbows allowed.	
Fittings above roof line, buried or where penetrating structures	100 and up	304L Stainless Steel, Sch 40S, buttweld. Elbows S.R. unless indicated otherwise. No mitred elbows allowed.	
Unions	75 and under	304L Stainless Steel, Class 3000, socket weld Sch 40S bore, or threaded.	ASTM A182, ANSI/ASME B16.11
Couplings, Grooved Joint	50 to 600	Grooved Joint Couplings as specified in Section 40 05 01	AWWA C606

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Flanges – slip on or weld neck	75 to 600	304 Stainless Steel, Class 150. Slip-on or weld neck. Machine flat face where connecting to flat faced flanges	ASTM A182 ANSI/ASME B16.5.
Flanges – lap joint. Not for buried service.	75 to 600	304 Stainless Steel stub end, Sch 40S butt weld except above roof Sch 40S, 304 SS backing ring	ASTM A774 ANSI/ASME B16.5
Blind Flanges	75 to 600	304 Stainless steel, solid type.	
Gaskets	All	Flanges, Non-metallic, non-asbestos, flat ring	ANSI/ASME B16.21
	All	Couplings; Grooved Joint, Victaulic Grade E EPDM flush seal or approved equal for liquid service. Victaulic Grade L Silicone flush seal or approved equal for air service.	AWWA C606

3.0 INSTALLATION

3.1 Stainless Steel Pipe Welding and Fabrication

- 3.1.1 Stainless steel fabrication shall be done in an approved CSA W47 fabrication shop set up to handle, fabricate and weld stainless steel using handling procedures designed to eliminate carbon contamination of the stainless steel including but not limited to: the use of stainless steel tools including wire brushes, chisels, files and hammers, welding gloves and grinding wheels. Only 300 series stainless steel brushes or wheels shall be used on austenitic and nickel alloys.
- 3.1.2 Areas used for fabrication of austenitic and nickel alloys shall be separated from carbon steel areas by methods suitable to prevent contamination by dirt, carbon steel shavings, grinding dust and sparks, and zinc dust from painting operations. Welding gloves and tools used during the fabrication of stainless steel shall not have been used on previous carbon steel work.
- 3.1.3 Where tape is used for backing purge gas the tape shall use an adhesive backing such that when no longer required it can be completely removed with residual adhesive removed by a suitable solvent or abrasive.
- 3.1.4 Clean piping to a pre-weld zone extending 50 mm on either side of the weld with alcohol or acetone.

304 STAINLESS STEEL PIPING

- 3.1.5 All welding of the root pass of austenitic stainless steel pipe shall be done using the Gas Tungsten Arc Weld (GTAW) process with shielding gas protection of the backside of the weld sufficient to reduce oxygen content to a level that can avoid granulation and ensure a high quality corrosion resistant weld. Large bore piping may be internally back welded to achieve the same result.
- 3.1.6 The Shield Metal Arc Weld (SMAW) process may only be used for fill passes or fillet welds.
- 3.1.7 Solar Flux is not acceptable.
- 3.1.8 Clean welds after fabrication in accordance with ASTM A380.
- 3.1.9 Pickle and passivate welds after fabrication in accordance with AWWA C220, ASTM A380 and ASMT A967 by immersing in a liquid bath of pickling solution NSF certified for drinking water.
- 3.1.10 Any noticeable discolouration on the piping after welding shall be removed by pickling.
- 3.1.11 Once sufficient pickling time has elapsed to re-passivate the stainless steel surface, clean the piping of all acids by thoroughly rinsing the pipe with water.
- 3.1.12 Thread stainless steel pipe in accordance with threading machine manufacturer's instructions.
- 3.2 Pipe Grooving
 - 3.2.1 Groove stainless steel pipe in accordance with grooving machine manufacturer's instructions.
 - 3.2.2 Contamination from iron particles by pressure contact with rollers or tooling should, if at all possible, be avoided. Where stainless steel rollers or tools are unavailable, adhesive plastic films or tape can be used to prevent direct contact. They shall be removed after fabrication.
- 3.3 Fabricated Fittings
 - 3.3.1 Shop fabricated fittings made from rolled stock in accordance with ASTM A240 shall be in a solution annealed condition. Shop fabricated fittings made from pipe shall be in accordance with AWWA C220, ASTM A312, ASTM A778. Design standard shall be in accordance with AWWA C226 and thickness of all reinforcement collars and pads shall be determined by the appropriate formula in the latest edition of AWWA M11.
- 3.4 Pipe Coating: Do not paint stainless steel piping.

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304 STAINLESS STEEL PIPING

END OF SECTION

POLYVINYL CHLORIDE (PVC) PROCESS PIPING

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to supply, fabrication and installation of PVC SCH 40 and SCH 80 process piping for the following commodities as identified on the *Drawings*;

(a) DR – Drain Piping

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the Work described herein.

1.1.3 Related Requirements

(a) Common Requirements for Process Piping Systems Section 40 05 01

1.2 Delivery, Storage and Handling

1.2.1 Store and handle in accordance with manufacturer recommendations.

1.2.2 Protect materials from contamination from dirt or road salt by shrink wrap or other suitable packaging, and end caps, prior to and during shipment.

1.2.3 Store materials in such a way to prevent scratching and scoring of the surface. Keep stored materials out of hot areas.

1.2.4 Protect from direct exposure to sunlight.

1.2.5 Support pipe while in storage to prevent sagging or bending.

1.3 Design Conditions

1.3.1 Ambient temperature range for indoor piping: 5 to 35 °C

1.3.2 Applies to all commodities where Schedule 80 PVC pipe is identified unless otherwise noted:

(a) Normal commodity temperature range: 2 to 30 °C.

(b) Normal service operating pressure range: 0 to 760 kPa

(c) Maximum (intermittent short term) operating pressure: 815 kPa

(d) Test pressure: 1200 kPa

1.3.3 Not Used

1.4 Submittals

1.4.1 Submit details of the proposed primer and solvent glue intended for each type of commodity with statement from manufacturer stating fitness for the specified operating conditions.

1.4.2 Submit details of proposed gaskets and O-ring materials, stating suitability for the specified operating conditions

POLYVINYL CHLORIDE (PVC) PROCESS PIPING

1.5 Quality Control

- 1.5.1 Mark products in accordance with ASTM D1785 including in addition to the requirements of Section 40 05 01 the pressure rating in psi for water @ 73°F, the ASTM designation D1785, and the date and time of manufacture. For potable water usage, mark products with independent laboratory's seal of approval for potable water usage.

2.0 PRODUCTS

- 2.1 Provide Piping Systems as detailed below with components suitable for the operating conditions.

Component	Size Range (mm)	Description	Applicable Standards
Sch 80 pipe	12 - 300	Type 1 Grade 1 grey with Cell Classification of 12454	ASTM D1784, ASTM D1785, CSA B137.3
Sch 40 pipe	100 - 300	White	ASTM D1784, ASTM D1785, CSA B137.3
Fittings (general)		All fittings solvent cement socket type unless noted otherwise	
Sch 80 fittings and couplings	12-300	Molded socket type	ASTM D2467
Sch 80 fittings, double containment	<50 primary pipe	Special double containment, molded socket type	
Sch 40 fittings and couplings	100-300	Molded socket type	ASTM D2466
Coating		Not applicable	
Lining		Not applicable	
Unions	<65	True Union, socket weld ends, O-ring compatible with material	
Couplings, grooved joint, Sch 80 pipe	50 to 300	Rigid: Ductile Iron Victaulic Style 357 with SS trim, or approved equal	AWWA C606
Flanges	65 to 300	PVC socket, flat faced. Boltups 316 SS to Grade 8 ASTM A193/194.	
Tapping Fittings	ERW, SW, PW and FA service	All 316 SS construction with EPDM or nitrile seals.	
Tubing fittings		Leak Free, Chemflare or approved equal	
Primers and Solvent Cements		Per manufacturer's recommendations for service. NSF listed for potable water applications.	ASTM D2564
Gaskets and O-rings	50-300	Wastewater service; EPDM or neoprene FA: EPDM or Nitrile	ASTM B16.21 AWWA C228

POLYVINYL CHLORIDE (PVC) PROCESS PIPING

		COG: EPDM SCS : Nitrile or PTFE HYP:CPE or Viton PLY: EPDM or Nitrile	
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- 2.2 Connections between metal and PVC pipe shall be made with grooved joint couplings or flat faced flanges. Where a PVC reducing tee is not available for drains, vents and FA pipe connections, pipe tapping fittings are allowed.
- 2.3 Double Containment Systems
- 2.3.1 Provide continuous, PVC, double containment pipe systems for sections of chemical (SCS and COG) piping that run above ground outside of chemical containment areas, and as shown on drawings.
- 2.3.2 Exterior containment piping system to be rated for minimum 1.5 times the operating pressure of the interior pipe.
- 2.3.3 Exterior containment piping to be clear. Fittings clear or standard PVC.
- 2.3.4 Slope containment pipes as indicated on process drawings to provide positive drainage.
- 2.3.5 Provide pipe centralizers on intervals recommended by manufacturer.
- 2.3.6 Join systems with solvent cement and specialized fittings for double containment.
- 2.3.7 Provide HPDE or PVC valve boxes for containment around valves and fittings, including flanges and unions. Seal valve boxes to double containment pipe for continuous containment.
- 2.3.8 Provide manufacturer's standard termination fittings with closure coupling at each end of each run of double containment piping, to completely seal the containment piping system.
- 2.3.9 Where shown on drawings provide Repair Joint Assembly of easily disassembled joints to allow repair of containment piping system. Spears Double Containment Union Closure fitting *or Approved Equal*. Fitting outer pipe to be clear PVC. Inner pipe connection to be true union.
- 2.3.10 Where required by *Contractor's Engineer* to provide for expansion/contraction of piping and space is not available for an expansion loop, provide Spears Double Containment Union Closure fitting or *Approved Equal* for expansion contraction of the outer piping. Fitting outer pipe to be clear PVC. Inner pipe connection to be carrier expansion joint type.
- 2.3.11 At the lowest point on each outer containment system provide visual inspection and drainage provisions for the outer containment system.

POLYVINYL CHLORIDE (PVC) PROCESS PIPING

3.0 INSTALLATION

- 3.1 Install piping and fittings in accordance with manufacturer recommendations.
- 3.2 Provide adequate spacing at elbows and direction changes as well as expansion loops on straight runs to allow for thermal expansions and contraction based on commodity temperature ranges and manufacturer recommendations.
- 3.3 Install expansion loops on the horizontal where space allows to minimize high and low points in piping. Obtain approval for loop locations with *Consultant* prior to installation.
- 3.4 Use suitable tools specifically designed for use with thermoplastic piping and fittings.
- 3.5 Joining
 - 3.5.1 Solvent Cementing
 - (a) Inspect and clean all components prior to joining
 - (b) Primer shall be used to soften areas prior to joining with cement.
 - (c) Apply sufficient cement to fill gaps in joining area.
 - (d) Assemble joints while surfaces are wet and soft.
 - (e) Allow adequate time for surfaces to bond and fuse in order to achieve required strength for operating and test conditions. Take into account ambient temperature for cure times.
 - 3.5.2 Flange Joints
 - (a) Bolt torque in accordance with manufacturer recommendations.
 - (b) Connect only to flat faced flanges. Do not connect to raised face or lap joint flanges.
 - (c) Flange faces shall be flush for installation. Gap between flanges shall not exceed 3 mm.
 - 3.5.3 Where connecting plastic to metal pipes use flanges or flexible grooved joint couplings.
 - 3.5.4 Supply grooved PVC pipe by the PVC pipe manufacturer. Field grooving of PVC pipe is not acceptable.
- 3.6 Double containment pipe leak testing.
 - 3.6.1 Pressure test primary pipe prior to making secondary pipe joints.
- 3.7 Leak test secondary containment pipe. Outer secondary containment pipe to be pressure tested to same standard as primary pipe [shall be watertight when filled].

END OF SECTION

COMMON REQUIREMENTS FOR PROCESS VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This Section specifies supply and installation of all valves and related appurtenances installed on process piping systems. This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.2 Related Requirements

- (a) Section 40 05 01: Common Requirements for Process Piping Systems
- (b) Valve data sheets and details are provided in separate Sections for each valve type
 - (i) Section 40 05 64.36: High Performance Butterfly Valves for Air or Gas Service
 - (ii) Section 40 05 63.33: Metallic Ball Valves

1.2 References

1.2.1 Reference Standards

- (a) Conform with the most recent version of all standards referenced in this Section.
 - (i) ANSI B1.20.1: Pipe Threads, General Purpose, Inch
 - (ii) ANSI B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - (iii) ANSI B16.5: Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - (iv) MSS SP-25: Marking System for Valves, Fittings, Flanges and Unions
 - (v) AWWA C504 (for gear actuators only): Rubber-Seated Butterfly Valves, 3 In. (75 mm) through 72 In. (1800 mm).

1.3 Submittals - Review

1.3.1 Provide catalogue cuts and/or shop drawings for each type of valve and actuator indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and maximum pull on actuator, and valve end configuration.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 1.3.2 Provide valve pressure/temperature rating. For bidirectional valves provide rating for both sealing directions.
- 1.3.3 For butterfly and globe valves provide headloss vs. percent open curves.
- 1.3.4 Canadian Registry Number (CRN) designated by the Province of British Columbia.
- 1.3.5 A copy of the specific valve specification sections marked to indicate with check marks where the valve supplied meets the specification and with written amendments with explanation where the product differs from the specification.
- 1.3.6 On piping submittals, indicate direction of sealing.
- 1.4 Submittals – For Operations and Maintenance Manuals
 - 1.4.1 Submit operation and maintenance data for incorporation into operation and Maintenance manual, including detailed exploded views, a complete numbered list of replacement and repair parts, and supplier and parts manufacturer's contact information.
- 1.5 Quality Assurance
 - 1.5.1 If a CRN is not available, provide a letter notarized in Canada and stating:
 - (a) The standard or code under which the valve was manufactured (ANSI, MSS, AWWA, etc.)
 - (b) If not stated under the code in Item (a), state the pressure/temperature rating of the valve body, seat, and all seals.
 - (c) The quality control program under which the valve was manufactured.
 - 1.5.2 Provide valves marked in accordance with MSS SP-25 for type, size, rating, and where applicable, direction of flow.
- 1.6 Delivery, Storage and Handling
 - 1.6.1 Deliver valves and unload at site using methods which do not damage casings, coatings or any valve or actuator parts.
 - 1.6.2 Clear tag each valve stating size, type, coatings and mating parts.
 - 1.6.3 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

2.0 PRODUCTS

- 2.1 General

COMMON REQUIREMENTS FOR PROCESS VALVES

- 2.1.1 Provide valves of the same type, size range and service from a single manufacturer.
- 2.1.2 All valves to have true alignment or bores.
- 2.1.3 Unless otherwise indicated on the Process and Instrumentation drawings valves shall be the same size as the pipe run in which they are to be installed.
- 2.1.4 Valves to open counter-clockwise.
- 2.1.5 The process drawings indicate major process valves required for the process to operate as intended. Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but is not shown in the drawings, inform the *Consultant* and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the *Consultant's* approval.
- 2.2 Valve Ends
 - 2.2.1 Valves less than 75 mm diameter shall have female threaded connections conforming to ANS B1.20.1. Valve sizes greater or equal to 75 mm shall have flanged connections to ANSI B16.1 or ANSI B16.5. Valves with grooved joint ends are not to be used without the written approval of the *Consultant*.
 - 2.2.2 Not used.
 - 2.2.3 Lug style water body valves shall have tapped holes.
- 2.3 Manual Lever or Handwheel Actuators
 - 2.3.1 Provide lever actuators for quarter turn valves. Operator to be perpendicular to the pipe run when the valve is closed.
 - 2.3.2 Provide lever operator for ball valves less than 150 mm diameter, butterfly valves less than 250 mm diameter, and plug valves less than 100 mm diameter, unless noted otherwise on drawings.
 - 2.3.3 Not used.
 - 2.3.4 Provide handwheel actuator for butterfly valves 250 mm and greater.
 - 2.3.5 Maximum pull on the end of the lever arm or at the rim of a handwheel not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. If greater force is required, provide a gear operator.
 - 2.3.6 Provide padlockable lockout feature on all control valves and manual isolation and shut-off valves.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 2.3.7 Provide valve stem extensions where additional clearance is required for pipe insulation or where operation without the extension is difficult.
- 2.3.8 Minimum hand wheel diameter:
 - (a) 38 mm valve: 75 mm handwheel
 - (b) 50 mm valve: 85 mm handwheel
 - (c) 250 mm valve: 400 mm handwheel
- 2.3.9 Minimum lever operator length:
 - (a) 25 mm valve: 125 mm lever
 - (b) 38 mm valve: 150 mm lever
 - (c) 50 mm valve: 150 mm lever
 - (d) 75 mm valve: 175 mm lever
 - (e) 100 mm valve: 225 mm lever
 - (f) 150 mm valve: 250 mm lever
 - (g) 200 mm valve: 300 mm lever
- 2.4 Manual Gear Actuators
 - 2.4.1 Provide manual gear actuators for valves not specified to have a manual lever or handwheel actuator.
 - 2.4.2 Gear operator to be worm gear type equipped with a non-rising stem handwheel and an integrated visual indicator of the valve position. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant recommended by the gear operator manufacturer for the specific application. Gear operators for direct bury or submergence to be manufactured in accordance with AWWA C504.
 - 2.4.3 Equip operators with mechanical stop-limiting devices to prevent over travel of the disc, ball or plug in the open and closed positions, self-locking to hold the valve in any intermediate position between full open and full closed. Actuator components between the input and the stop limiting device shall be designed to withstand, without damage, a rim pull of 890 N for a handwheel or chainwheel and an input torque of 400 N m for wrench nuts.
 - 2.4.4 Actuator shall provide 1.25 times required operating torque under full rated line pressure for direct bury or submergence applications, or for commodities with 2%

COMMON REQUIREMENTS FOR PROCESS VALVES

- or greater solids content; 1.0 times required operating torque under full rated line pressure in other applications.
- 2.4.5 Maximum pull at rim of hand wheel with gear operator – 300 N.
 - 2.4.6 Manual operators for buried service valves to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures up to 700 kPa. Where angle valve stem extensions are employed, they shall be angle geared. Provide valve stem extension to surface with cast iron valve box, lid and rock plate.
 - 2.4.7 Actuator body to be exterior epoxy coated.
 - 2.4.8 Orientation of valve as per mechanical drawings or to allow for the greatest degree of hand wheel access.
 - 2.4.9 For manual valves on pipes 75 mm and greater mounted over 2 m above the operating floor, provide chain wheel gear operators, sized so that a force of 150 N is sufficient to open the valve when one side of valve is at test pressure and the other side is at atmospheric pressure. Chain pulley to mesh positively with the chain. Extend chain from valve operator to 1.2 m above the operating floor or as directed by the *Consultant*, with exact dimensions field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.
- 2.5 Electric Actuators
 - 2.5.1 Not used.
 - 2.6 Valve Identification
 - 2.6.1 Tag all valves using AISI 304 stainless steel tags with 12 mm high engraved letters and numbers. Fill numbers and letters with black paint. Attach tag to valve using a 304 stainless steel chain or braided wire. Inscription to include valve ID number from the Process and Instrumentation drawings, valve size in mm, manufacturer and model number.
 - 2.7 Coating
 - 2.7.1 Coat all carbon steel, ductile iron and cast iron valves and actuators for corrosion protection.
 - 2.7.2 All valves and actuators to be provided with standard shop finish rated and warrantied for the intended service application.

COMMON REQUIREMENTS FOR PROCESS VALVES

3.0 EXECUTION

3.1 Preparation

- 3.1.1 The valve and piping arrangement indicated on the drawings is based on typical dimensions for valves of the specified type. Make all necessary modifications in the *Work* to allow for discrepancies between the valve dimensions shown and those supplied for the *Work*, at no extra cost.
- 3.1.2 Ensure that valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for automatic actuators.
- 3.1.3 Ensure that valve location and orientation provides sufficient space for tightening of flange and valve nuts with a standard wrench.
- 3.1.4 Ensure that valve actuators can operate without conflicting with other piping, equipment, structures or insulation. Do not cut insulation to allow valve actuators to operate. Where conflicts are identified, inform the *Consultant* and propose modifications. Do not commence work on the affected piping run until modifications are approved.

3.2 Installation

- 3.2.1 Install all valves in accordance with manufacturer's instructions.
- 3.2.2 In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball and plug valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.
- 3.2.3 Mount butterfly valves and trunnion ball and plug valves with the shaft in a horizontal orientation. Plugs to rotate to top of pipe to open. Disks to swing up in direction of flow to open.
- 3.2.4 Provide spool pieces between butterfly valves, swing check valves and fittings as required to allow for free disc movement.
- 3.2.5 Do not over torque bolts to correct for misalignment.
- 3.2.6 Support valves in position using temporary supports until valves are fixed in place.
- 3.2.7 Not used.
- 3.2.8 Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.

COMMON REQUIREMENTS FOR PROCESS VALVES

3.3 Coating

3.3.1 Repair and damage to shop coating as recommended by valve manufacturer, including and not limited to:

- (a) Steel brushing for removal of any rust
- (b) Solvent cleaning of repair and surrounding area
- (c) Priming coat
- (d) Two coats of top coat

3.4 Testing

3.4.1 All valves to be shop tested according to current applicable AWWA Standards and the standards under which the valves were manufactured.

3.4.2 Operate valves under simulated and/or real process conditions to ensure valves operate as intended.

3.4.3 Pressure test valves in conjunction with the pipes in which the valves are installed.

END OF SECTION

KNIFE GATE VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to stainless steel knife gate valves from 100mm to 450mm diameter provided for the following commodities as identified on the *Drawings*.

(a) Raw Water (RAW)

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific design conditions for valves installed in piping identified in Section 40 05 24.23.

1.1.4 Related Requirements

(a) Section 40 05 01: Common Requirements for Process Piping Systems

(b) Section 40 05 51: Common Requirements for Process Valves

2.0 PRODUCTS

2.1 Acceptable manufacturers: Red Valve Series D Flexgate, Bray, Dezurik KSL-SD, or approved equal.

2.2 Where applicable or shown on the *Drawings*, provide bevel gear style operator.

2.3 Valves to be resilient seated and bi-direction rated to 250 psi working pressure.

2.4 Provide valves as detailed below.

Component	Description
Body	Ductile iron, factory applied two part epoxy.
Valve Ends	Lugged style to ASME/ANSI B16.5 for flanged connections
Packing	Braided PTFE impregnated synthetic fiber
Gate	Type 316 stainless steel to ASTM A240
Gland	Carbon Steel or Ductile Iron
Sleeve	Natural rubber, Buna-N, or EPDM.
Yoke	Carbon Steel or Ductile Iron
Stem and Extension	8-18 stainless steel or as indicated on the drawings
Fasteners	Appropriate grade of stainless steel such as 18-8 for all rivets, grease fittings, nuts, bolts, screws, washers, caps etc.
Bevel Gear Operator	Epoxy coated CI or DI housing, heavy duty hardened steel gears, EPDM seals, SS hardware and packed with grease.

KNIFE GATE VALVES

Floor Boxes	Cast iron, fusion bonded epoxy coatings in and out.
Gearboxes	Gear boxes where applicable to be to of a heavy duty design, use epoxy coated cast iron housing and flanges, hardened steel gears, sleeves, shafts and bearings, stainless steel fasteners, nitrile rubber seals, grease packed with Renolit CL-X2, enclosure to be IP68 rated for continuous submergence in municipal secondary effluent.

3.0 EXECUTION

3.1 Not used.

END OF SECTION

METALLIC BALL VALVES

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to metallic ball valves 10 mm to 65 mm diameter as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

- 2.1.1 Manual Ball Valves: Bray Flow-Tek or approved equal
- 2.1.2 Electrically Actuated Ball Valves: Bray Flow-Tek, Series F15 or approved equal

2.2 Valves to be rated to 250 PSI.

2.3 Provide Manual Ball Valves as detailed below:

Component	Description
Body	304 or 316 stainless steel, full port, two piece, ASTM A351 CF8M
Valve Ends	NPT Female threaded ANSI B1.20.1
Coating	Not applicable
Lining	Not applicable
Ball	304 or 316 floating ball, ASTM A351 CF8M
Seats	Reinforced PTFE
Stem	316 SS, blow-out proof.
Packing	Reinforced PTFE
Actuator	304 or 316 SS locking lever handle, vinyl coated

METALLIC BALL VALVES

3.0 EXECUTION

3.1 Not used.

END OF SECTION

BUTTERFLY VALVES

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to butterfly valves 65 mm to 750 mm diameter as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers and models:

- 2.1.1 Water Treatment Plant Butterfly Valve:
 - (a) 65 mm – 450 mm: Bray, Series 31H-375N or approved equal
 - (b) Electrically Actuated Butterfly Valve: Bray, Series 31-324N or approved equal
- 2.1.2 Submerged Applications:
 - (a) Val-Matic (Reservoir)
 - (b) Bray (Raw water pump station)

2.2 Valves to be rated to 250 PSI.

BUTTERFLY VALVES

2.3 Provide In-Water Treatment Plant Butterfly Valves (65 mm – 450 mm) as detailed below:

Component	Description
Body	Ductile iron
Valve Ends	Lugged style, ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Disc	316 stainless steel
Seat	EPDM
Seals	EPDM
Seat Ring	Stainless steel
Stem	416 stainless steel
Bolting	304 stainless steel
Operator	Gear operator and handwheel or as noted on the <i>Drawings</i> .

BUTTERFLY VALVES

2.4 Electrically Actuated Butterfly Valves (300 mm to 450 mm) as detailed below:

Component	Description
Body	Ductile iron
Valve Ends	Lugged style, ANSI Class 125/150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Disc	316 stainless steel disc
Seat	EPDM, bonded
Seals	EPDM
Seat Ring	Stainless steel
Stem	416 stainless steel
Stem Packing	Vee-type
Bolting	304 stainless steel
Operator	Rotork IQT3 Series Electric Actuator (open/close service): Model: IQT Watertight enclosure: IEC529, IP68 (3m for 72 hours) NEMA 4, 4X, 6 double sealed enclosure Two conduit entries for terminal connections Integral controls: Open/Stop/Close, and Local/Remote Bluetooth non-intrusive commissioning LEDs showing Valve Open/Intermediate/Closed Temperature rating: - 30 °C to + 60 °C On-board data logger Absolute position sensing Declutchable manual override Duty cycle: 60 starts per hour, 15 minute run time Power rating: 208V/3ph/60Hz Control rating: 120 VAC

BUTTERFLY VALVES

2.4.1 Not Used Wet Well – 600 mm:

Component	Description
Body	Ductile iron
Valve Ends	AWWA Class 150B flanged ends
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Disc	Ductile iron
Seat	Buna N
Seals	Buna N
Seat Ring	Stainless steel
Stem	Stainless steel
Stem Packing	Vee-type
Bolting	304 stainless steel
Operator	Extended Bonnet c/w handwheel. Handwheel to be 1.5 m above finished floor or as noted on the <i>Drawings</i> . Contractor to grout around valve riser to ensure leak proof seal with wet well slab.

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BUTTERFLY VALVES

3.0 EXECUTION

3.1 Not used.

END OF SECTION

CHECK VALVES

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to check valves 100 mm 600 mm diameter as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

- 2.1.1 Pump Style Check Valve:
 - (a) Water
 - (i) 75-300 mm: Val-Matic, Wafer Series 8800 (raw water pumps) or approved equal
- 2.1.2 Wet Well Inlet Check Valve: Tideflex, Series 35-1 Check Valve NSF-61 (Wet Well inlet)

CHECK VALVES

2.2 Provide 75 mm to 300 mm Water Pump Style Check Valves as detailed below:

Component	Description
Body	Ductile iron
Valve Ends	ANSI Class 150 flanged ends
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Seat	Buna-n
Disc	Silicon bronze (up to 30 mm), aluminium bronze (350 mm)
Spring, pins, thrust bearing	316 Stainless steel
Stabilization sphere	Buna-n
Pressure Rating	Rated to 250 PSI

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CHECK VALVES

CHECK VALVES

2.3 Provide 600 mm Duckbill Style Check Valves as detailed below:

Component	Description
Sleeve Material	EPDM
Certification	NSF 61
Clamps	304 stainless steel
Max. Back Pressure	12 PSI
Line Pressure	15 PSI

3.0 EXECUTION

3.1 Not used.

END OF SECTION

GLOBE VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to globe valves ranging in size from 75 mm to 400 mm as identified on the *Drawings*.

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

2.0 SPECIFIC DESIGN CONDITIONS FOR VALVES IDENTIFIED ON THE *DRAWINGS*. PRODUCTS

2.1 Acceptable manufacturers:

2.1.1 Pressure reducing and dual solenoid valves

(a) CLA-VAL

2.2 Valves to be rated to 250 PSI.

2.3 Provide Pressure Reducing/Sustaining Valves as detailed below (to be installed at the Chidley PRV):

Component	Description
Sizes	75 mm and 450 mm
Model	CLA-VAL 90-01KO
Body and cover	Ductile iron
Valve Ends	ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Diaphragm	EPDM
Accessories	Pilot strainer, open/close speed control, anti-cavitation trim
Pilot, tubing, seat assembly, anti-cavitation trim and fasteners	Stainless steel
Position indicator	Model X101
Set point	To be determined

GLOBE VALVES

2.4 Provide Dual Solenoid Valves as detailed below:

Component	Description
Sizes	100 mm and 450 mmm
Model	CLA-VAL 390-02
Body and cover	Ductile iron
Valve Ends	ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Diaphragm	EPDM
Accessories	Pilot strainer, open/close speed control, anti-cavitation trim
Pilot, tubing, seat assembly, anti-cavitation trim and fastners	Stainless steel
Options	Valves to come with CRD-34 electronic actuated pilot system to accept 4-20 mA input and output signal. Provide IP-68 enclosure. Refer to electrical drawings and specifications for additional details regarding power supply and control wiring.
Control	One valve to be designated lead and the other standby Lead valve to open and close based on Cousins Road Reservoir level Lead valve to modulate based on pressure or flow set point when filling the reservoir

3.0 EXECUTION

- 3.1 Install per manufacturer's recommendations.
- 3.2 Contractor must ensure that a CLA-VAL technician inspects the installed valves and assists with Commissioning. Contractor to allow for the CLA-VAL technician to complete a minimum of two trips at two days per trip.

END OF SECTION

PRESSURE RELIEF VALVE

1.0 GENERAL

1.1 Summary

- 1.1.1 This section applies to pressure relief valves 150 mm to 300 mm in diameter as identified on the *Drawings*.
- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.
- 1.1.3 Operating Conditions
 - (a) Specific design conditions for valves identified on the *Drawings*.

2.0 PRODUCTS

2.1 Acceptable manufacturers:

2.1.1 Pressure Relief Valves:

- (a) 150 mm and 300 mm: Singer or approved equal

2.2 Valves to be rated to 250 PSI.

2.3 Provide Pressure Relief Valves as detailed below:

Component	Description
Body and cover	Ductile iron
Valve Ends	ANSI Class 150 flange rating
Coating	NSF approved fusion bonded epoxy
Lining	NSF approved fusion bonded epoxy
Diaphragm	Rolling style, EPDM
Accessories	Pilot strainer, open/close speed control, anti-cavitation trim
Pilot, tubing, seat assembly, anti-cavitation trim and fasteners	Stainless steel
Position indicator	Model X107
Set point	To be determined

3.0 EXECUTION

3.1 Not used.

END OF SECTION

PRESSURE SUSTAINING VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to hydraulically actuated diaphragm globe pressure sustaining valves with or without solenoid actuated pilot controls for the following commodities as identified on the *Drawings*.

(a) RAW- Raw Water

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific design conditions for valve installed in piping identified in Section 40 05 23.24.

1.1.4 Related Requirements

(a) Section 40 05 01: Common Requirements for Process Piping Systems

(b) Section 40 05 51: Common Requirements for Process Valves

(c) Section 40 05 23.24 304 Stainless Steel Piping

1.2 Quality Control

1.2.1 Factory test control valve and piloting factory set in accordance with controls section.

1.3 Warranty

1.3.1 Provide two-year manufacturer warranty against defects and workmanship.

2.0 PRODUCTS

2.1 Acceptable Manufacturer / Qualifications

2.1.1 Valves shall be Singer model 106-RPS, Cla-Val model 50-90 or approved equal.

2.2 Design Criteria

2.2.1 Provide single chamber hydraulic control valve with pressure sustaining pilot system.

2.2.2 See drawings for proposed valve diameter.

2.2.3 Operating Conditions – To complete later.

2.2.4 Valves shall be suitable for Raw Water filtered to 50 microns. Manufacturer to confirm suitability of standard pilot controls for application.

PRESSURE SUSTAINING VALVES

- 2.2.5 Full port style body with ANSI Class 150 flanges with removable bonnet and stem cap. The valve stem shall have wrench flats for ease of maintenance.
- 2.2.6 The main valve shall provide a drip-tight seal using a mechanically retained resilient disc.
- 2.2.7 Provide 40 mesh strainers at pilot inlet connection to the valve body complete with removable plug for access to pilot screen for maintenance.
- 2.2.8 Pilots
 - (a) Pilot system to include stainless steel insertion tubes on all piloted body connections.
 - (b) Isolation ball valves on all piloted body connections.
 - (c) All pilot tubing and valves shall be suitable for 1036kPa operating pressure.
 - (d) For pressure sustaining valve pilot system:
 - (i) Provide speed control for opening and closing.
 - (ii) Provide adjustable needle valve for closing speed control.
- 2.2.9 Cavitation Trim
 - (a) The valve manufacturer shall provide a computerized sizing and cavitation analysis using independent third party software.
 - (b) Cavitation analysis shall provide the status of cavitation based on customer supplied parameters as to valve size, flow rate requirements and pressure conditions.
 - (i) The cavitation analysis shall also provide information as to Cv factor, percent of valve lift, cavitation index and noise level.
 - (c) The valve manufacturer shall supply cavitation control trim engineered to the actual operating parameters of the control valve application and warranted to perform correctly and prevent main valve cavitation damage under the stated conditions.

2.3 Materials

Component	Description
Body, bonnet and stem cap	Ductile Iron to ASTM A536
Seat ring and stem	AISI Type 316 stainless steel
Diaphragms, resilient disc and seals	Buna-N

PRESSURE SUSTAINING VALVES

Hardware and trim (nuts, bolts, washers, springs, stems, yokes, etc.)	AISI Type 304 or 316 stainless steel.
Pilot fittings, ball valves, solenoid valves, check valves and strainers	Brass
Pilot tubing	ASTM B280 seamless copper
Strainer screens and ball valve handles	Stainless steel
Limit switch actuation stem rod	AISI 316 stainless steel, brass adaptor bushing
Protective coatings – all internal and external ferrous components including all mating surfaces	NSF-61 approved fusion bonded epoxy to a minimum of 10mils DFT-Dry Film Thickness.

2.4 Controls

2.4.1 Pressure Sustaining Valve Intent

- (a) Provide pressure sustaining pilot system suitable for maintaining upstream pressure at specified setpoint.
- (b) The pressure sustaining the pilot reacts to small changes in the inlet supply pressure which acts to modulate the main valve bonnet pressure, hydraulically adjusting the inner valve assembly position to maintain a constant upstream pressure.
- (c) Where indicated provide PLC/SCADA pilot solenoid control.

3.0 EXECUTION

3.1 Not Used.

END OF SECTION

SOLENOID VALVES

1.0 GENERAL

1.1. Summary

- 1.1.1 This section applies to solenoid valves provided for the following commodities as identified on the *Drawings*.

RAW– Raw Water

- 1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

- (a) Specific design conditions for valves installed in piping identified in Section 40 05 23.24.

1.1.4 Related Requirements

- (a) Section 40 05 01: Common Requirements for Process Piping Systems
(b) Section 40 05 51: Common Requirements for Process Valves
(c) Section 40 05 23.24: 304 Stainless Steel Process Piping

2.0 PRODUCTS

- 2.1 Acceptable Manufacturer: Valves to manufactured by Asco or approved equal.

2.2 Design Criteria

- 2.2.1 Direct acting 2-way valve ASCO 8210 for general service, solenoid by Red-Hat II, or approved equivalent.
- 2.2.2 All materials shall be suitable and in accordance with NSF-61.
- 2.2.3 All seals and diaphragm shall be replaceable.
- 2.2.4 Pressure rating to 150psi (1035kPa).

2.3 Materials

Component	Description
Body and Bonnet	Lead-Free Brass or Stainless Steel.
Valve Ends	Female Threaded FNPT
Disc, Seat, Seals and O-Rings	Resilient seat, PTFE or NBR.
Spring, Core, Core Tube, Plugnut and Hardware	Suitable Stainless Steel.

SOLENOID VALVES

Solenoid	24VDC voltage, epoxy encapsulated pull-type with Type 1 enclosure.
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3.0 EXECUTION – NOT USED

END OF SECTION

CHEMICAL PIPING, VALVES, AND FITTINGS

1.0 GENERAL

- 1.1 These specifications apply to chemical related system piping, valves, fittings and appurtenances shown on all the Process and Instrumentation *Drawings* (P-Series) related to systems conveying:
 - 1.1.1 PACl Coagulant (ISOPAC)
 - 1.1.2 Sodium Hydroxide (50% stock solution concentration)
 - 1.1.3 Sodium hypochlorite (15% stock solution concentration)
 - 1.1.4 Polymer (mid-point filter aid and solids dewatering)
- 1.2 Reference Sections
 - 1.2.1 Section 40 05 01 – Common Requirements for Process Piping Systems
 - 1.2.2 Section 40 05 07 – Supports, Anchors, and Seismic Bracing for Process Piping
- 1.3 This section applies to all piping:
 - 1.3.1 Above ground;
 - 1.3.2 Piping located inside facilities.
- 1.4 Provide complete, fully tested and operational chemical system components and materials to meet requirements described herein and in complete accord with applicable codes and ordinances.
- 1.5 Provide true union connections for all fittings connecting to rigid piping and leak free connections for fittings connecting to tubing (e.g., ChemFlare™ or approved equivalent).
- 1.6 Submittals for Review
 - 1.6.1 Before fabrication, provide manufacturer data for each type of pipe material and for each fitting.
 - 1.6.2 Before fabrication, provide *Shop Drawings* for fabricated fittings.
 - 1.6.3 Before delivery to site provide manufacturer data for each valve, coupling, expansion joint, guide and appurtenance used to complete the *Work* covered in this section.
 - 1.6.4 *Shop Drawings*: *Shop Drawings* for all piping systems greater than 19mm diameter, shall be furnished prior to fabrication. Indicate in orthogonal and/or isometric drawings as required to furnish the assembly details, solvent weld joint placement, vents, drains, instrument connections, supports, anchors, and the provisions for thrust and seismic restraint as well as any other pertinent details.

CHEMICAL PIPING, VALVES, AND FITTINGS

- 1.6.5 Do not commence *Work* on items requiring submittals until *Consultant's* review is complete.

2.0 PRODUCTS

2.1 Ball Valves

- 2.1.1 Ball valves locations and sizes shown on the *Drawings*.
- 2.1.2 Ensure that all valve materials including body, seal, seats, fasteners, etc. conform to the requirements summarized in 2.5 of this Section.
- 2.1.3 Ball valves for general chemical use shall be:
- (a) For PVC - socket ends for 65mm diameter and smaller and flanged ends for 75mm and larger.
 - (b) For Chemflare – To suit tubing.
- 2.1.4 Valve shall be full ported and rated for 1,035 kPag (150 psig).
- 2.1.5 Valves used for sodium hypochlorite systems shall be the vented type.
- 2.1.6 Valves shall be manufactured by Chemline, Hayward, PLAST-O-Matic, or approved equal.

2.2 Check and Foot Valves

- 2.2.1 Check valves locations and sizes shown on the *Drawings*.
- 2.2.2 Ensure that all check and foot valve materials conform to the chemical compatibility identified in 2.5 of this Section.
- 2.2.3 Check valves for general chemical use shall be:
- (a) For PVC - socket ends for 65mm diameter and smaller, and flanged ends for 75mm and larger.
 - (b) For Chemflare – To suit tubing.
- 2.2.4 Check valve shall be full ported and rated for 1,035 kPag (150psig).
- 2.2.5 Check valves shall be manufactured by Chemline, PLAST-O-Matic, or approved equal.

2.3 Injection Quills

- 2.3.1 Injection Quills shall be the retractable type, allowing the Quill assembly to be completely removed and serviced during system full operation with full gauge pressure in the main process piping.

CHEMICAL PIPING, VALVES, AND FITTINGS

- 2.3.2 Injection Quill assembly shall have a built-in check valve. Quill housing shall have a ball style isolation valve manufactured from stainless steel.
- 2.3.3 Injection Quill body and all wetted parts shall be manufactured from materials per 2.5 of this section.
- 2.3.4 Unless otherwise specified, the quills shall utilize 25 mm diameter connections (12 mm tube) with the exception of the sodium hypochlorite injection quill which shall be 38 mm (25 mm tube). Injection quills shall be capable of dosing flow rates between 0 mL/min and 1,500 mL/min with the exception of the sodium hypochlorite quill which shall be capable of dosing flow rates between 0 mL/min and 4,500 mL/min.
- 2.3.5 Injection Quills shall be rated for a maximum operating pressure of 1,035kPag (150psig). Quill shall be connected to housing using a compression style connection. Safety chains manufactured from stainless steel shall also connect the Quill to the housing.
- 2.3.6 Injection Quill length shall be sized and manufacturer approved according to process pipe diameter (see Process *Drawings*) and target flow range per 2.3.4, and installed as per manufacturers recommendations.
- 2.3.7 Injection Quills shall have NPT male threaded or flanged connections. Use Teflon tape on threaded connection prior to installation.
- 2.3.8 Injection Quills shall be manufactured by SAF-T-Flo or approved equal.
- 2.4 Component Tagging and Identification
 - 2.4.1 Tag all valves and minor equipment with 304 stainless steel tags with 12 mm high engraved letters and numbers. Numbers and letters shall be filled with black paint. Inscription shall contain P&ID identification tag, size, model and manufacturer.
- 2.5 General Material Compatibility Requirements.
 - 2.5.1 Sodium Hypochlorite (15%): Use CPVC or PVC plastics, Viton seals and gaskets and Hastelloy alloy C-276 metals if required.
 - 2.5.2 PACl (Isopac) Coagulant: Use CPVC or PVC plastics, Viton A or teflon seals and gaskets and Hastelloy alloy B metals if required.
 - 2.5.3 Sodium Hydroxide (50%): Use PVC plastics, EPDM or teflon seals and gaskets.
 - 2.5.4 Polymers: Use PVC plastics, viton seals and gaskets.
- 2.6 Fittings, Joints and Piping:

CHEMICAL PIPING, VALVES, AND FITTINGS

- 2.6.1 Provide fittings of the same material, size and wall thickness as the pipe.
- 2.6.2 Chemical piping routing has not been shown on the layout *Drawings*. Submit *Shop Drawings* detailing alignment for approval prior to installation.
- 2.6.3 Pipe shall be Chemflare PFA Tubing as manufactured by Chemline Plastics or Schedule 80 PVC as indicated on *Drawings*. Size as indicated on the *Drawings*.
- 2.6.4 PVC joints shall be socket joints except where flanges are indicated on the *Drawings*. Flanges shall be socket type.
- 2.6.5 Ensure that piping materials conform to the requirements summarized in 2.5 of this Section.
- 2.6.6 Schedule 80 CPVC materials shall be Type 4, Grade 1, conforming to ASTM D1784, ASTM F441/442, sockets and pressure rating to ASTM D2672. Solvent weld cement shall conform to ASTM F4933.
- (a) Use XIRTEC primer and XIRTEC 24 cement or approved equal.
- 2.6.7 For joints on plastic and thermoplastic pipe:
- (a) Permanent, no future disassembly required: Use socket welded joints.
- (b) Temporary, future disassembly required: Use flanged joints.
- 2.6.8 Provide flexible tubing where indicated on the Process *Drawings*. Use stainless steel braided over flexible tubing material that is compatible with the specific application. Refer to Section 2.5 for material requirements.

2.7 Pipe Colour Coding

- 2.7.1 Colour code all chemical piping. Colour coding shall conform with CGSB-24.3-92 standards. Colour coding shall consist of adhesive banding Adhesive bands to 50mm in width and two tone. Colour schedule as follows:

Description	Adhesive Banding Colour	Letter/Arrow Color
Sodium Hypochlorite	Yellow Background with Orange Centre Band	Black
Sodium Hydroxide	Yellow Background with Orange Centre Band	Black
PACl	Yellow Background with Orange Centre Band	Black
Polymers	Yellow Background with Orange Centre Band	Black

CHEMICAL PIPING, VALVES, AND FITTINGS

- 2.7.2 Place flow arrows every 2.0m on centre. Adjacent to each flow arrow shall be 12mm high letters indicating the type of chemical being conveyed.
- 2.8 O-rings, seats and seals:
 - 2.8.1 Internal component o-rings, seats, seals, etc. shall conform to chemical compatibility requirements outlined in Section 2.5.
- 2.9 Pipe Support Systems
 - 2.9.1 Supply and install supports per Section 40 05 07.
- 2.10 Back Pressure Valves
 - 2.10.1 Back pressure valves locations and sizes shown on the *Drawings*.
 - 2.10.2 Ensure that all materials conform to the chemical compatibility identified in 2.5 of this Section.
 - 2.10.3 Back pressure valves for general chemical use shall be:
 - (a) For PVC - socket ends for 65mm diameter and smaller, and flanged ends for 75mm and larger.
 - (b) For Chemflare – To suit tubing.
 - 2.10.4 Back pressure valve shall be full ported and rated for 1,035 kPag (150psig).
 - 2.10.5 Back pressure valves shall be manufactured by Chemline, PLAST-O-Matic, or approved equal.

3.0 EXECUTION

- 3.1 Preparation
 - 3.1.1 Prior to installation, inspect and field measure to ensure that previous *Work* is not prejudicial to the proper installation of piping.
 - 3.1.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.
 - 3.1.3 Advise the *Consultant* of all modifications. Do not commence *Work* on the related piping until the *Consultant's* approval has been received.
- 3.2 Pipe Handling
 - 3.2.1 Each pipe and fitting shall be inspected prior to installation. Damaged pipe shall not be installed.

CHEMICAL PIPING, VALVES, AND FITTINGS

- 3.2.2 To ensure chemical contamination does not occur remove all foreign matter from inside of pipe prior to installation.
- 3.3 Conflicts
 - 3.3.1 Confirm the routing of each section of pipework with the *Consultant* prior to commencement of installation. Advise the *Consultant* of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict, as approved by the *Consultant*.
- 3.4 Socket Welded Joints:
 - 3.4.1 Install all piping and fittings as per manufacturer's recommendations.
 - 3.4.2 Apply solvent weld primer then cement as per manufacturer's recommendations.
 - 3.4.3 Properly align all joints. All misaligned joints upon system inspection will require correction at the *Contractor's* expense.
 - 3.4.4 Allow manufacturer initial set time prior to handling joint. Carefully handle joint after initial setup. Allow for manufacturers recommended joint cure times before final installation or stressing pipe assembly.
- 3.5 Inspection
 - 3.5.1 The *Consultant* may use any method of inspection necessary to establish quality of the installation procedure.
 - 3.5.2 If equipment fails to meet the performance requirements, immediately make the necessary repairs, replacements, modifications and adjustments to ensure equipment functions as intended at no additional cost to *Owner*.
- 3.6 Interior Pipe Installation
 - 3.6.1 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag and stress.
 - 3.6.2 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.
 - 3.6.3 Accurately cut all piping for fabrication to field measurements.
 - 3.6.4 Pipes shall be installed in straight alignment. Variance from the true alignment shall not exceed 10mm in any direction. Pipe runs shall be fabricated and assembled to ensure that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment shall not be permitted. The *Contractor* shall undo and subsequently remake all pipework connections where

CHEMICAL PIPING, VALVES, AND FITTINGS

so instructed by the *Consultant* to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.

3.6.5 Do not cut or weaken the building structure to facilitate installation.

3.6.6 Provide readily disassembled joint at 150 mm of either side of wall or floor penetration unless shown otherwise.

3.7 Pipe Through Walls and Floors

3.7.1 Provide PVC sleeving through wall or floor slabs. Fill space between conveyance piping and sleeve with expandable foam. Ensure filling product is compatible with piping material.

3.7.2 Co-operate with other divisions to locate and place sleeves or cast-in-place pipe sections prior to the construction of concrete and masonry building elements.

3.8 Valves

3.8.1 Tag all valves as per the P&ID (I-Series *Drawings*) numbering. Include valve size, manufacturer and model.

3.8.2 Orient valves as per mechanical *Drawings* or to allow for the greatest degree of operator access.

3.8.3 Field test all valves as per manufactures recommendations. Test for correct valve function and actuation as well as pressure testing as part of the pipeline system.

3.9 Pressure Testing

3.8.4 Give *Consultant* 24 hours notice of testing.

3.8.5 Do not insulate or otherwise conceal *Work* until piping systems are tested and accepted.

3.8.6 Supply all water required for pressure testing.

3.8.7 Supply all pumps, compressors, gauges, etc. required for testing.

3.8.8 Cap or plug all lines which are normally open ended. Remove on completion of testing.

3.8.9 Isolate all low pressure equipment and valves during testing so as not to place any excess pressure on the operating equipment.

3.8.10 Where defective material or equipment is identified, repair or replace using new material.

3.8.11 Flush, drain and dry chemical lines with compressed air after pressure tests.

3.10 Pressure Testing of Chemical Lines

CHEMICAL PIPING, VALVES, AND FITTINGS

- 3.8.12 All proposed pressure piping that is to convey liquid chemical shall be hydrostatically pressure tested.
- 3.8.13 *Contractor* must provide any additional piping support required for the additional testing loads if using liquid to pressure test air lines. Test duration for air piping is four hours.
- 3.8.14 Perform hydrostatic pressure and leakage testing of above ground piping as follows:
- (a) All pressure testing shall be done in the presence of the *Consultant*.
 - (b) The duration of the test shall be 2 hrs.
 - (c) Prior to hydrostatic testing, all water retaining structures, pipework and conducts shall be thoroughly cleaned.
 - (d) If required, safety relief valves shall be supplied with test gags for hydrostatic testing purposes. Upon completion of testing, the gags shall be removed and the system shall be repressed to the relieving pressure of the relief valves to ensure proper valve operation.
 - (e) Test pressure shall be a 690 kPa (100 PSI).
 - (f) Maintain system pressure to within ± 2.0 kPa of test pressure throughout the duration of the test without the addition of make-up water.
 - (g) Visually inspect all joints and flanges. There should be no visual evidence of leakage throughout the duration of test. Zero leakage is required.

END OF SECTION

COMMISSIONING OF PROCESS SYSTEMS

1.0 GENERAL

1.1 Description

- 1.1.1 The Work includes the provision of all necessary testing, calibration, and installation verification, for each component, equipment, instrumentation, etc. Once verification that all components, equipment instrumentation, etc. are functioning as intended, the Contractor shall commence with commissioning and start-up activities as specified herein.
- 1.1.2 Testing of the components, equipment, instrumentation and control equipment shall be coordinated.
- 1.1.3 Provide a coordinated commissioning and start-up program to the Owner and Consultant for approval at least two and a half weeks in advance of any activities. A minimum of two weeks' notice shall be provided by the Contractor to the Owner and Consultant prior to any Commissioning and Start-Up activities. Activities shall only commence once the Commissioning and Start-Up Plan has been approved by the Owner and Consultant.
- 1.1.4 Commissioning and start-up shall be performed in cooperation with the Consultant and include verification of all of the systems (operation) described herein after their installation is completed. Cooperation will be required to facilitate the timely performance of these activities and under the direction of the Consultant. The Contractor will coordinate and schedule all activities associated with commissioning and start-up, and shall cooperate and arrange the commission schedule to facilitate the timely performance and completion of this work. Start-up activities shall be conducted for at least <INSERT NUMBER> consecutive days.

2.0 PRODUCTS

- 2.1 Not Applicable

3.0 EXECUTION

3.1 Testing

- 3.1.1 Prior to the completion of the Work, perform comprehensive testing of all installed equipment, components, instrumentation, etc. Include the following activities:
 - (a) Pressure testing of components and piping.
 - (b) Flow and pressure validation of all liquid pumps including chemical dosing pumps.
 - (c) Performance testing of all equipment including but not limited to process and chemical pumps, pressure reducing/sustaining valve assemblies, flow

COMMISSIONING OF PROCESS SYSTEMS

control valve assemblies, chemical storage equipment, instrumentation, ,
etc.

(d) Test and calibrate all instrumentation to ensure proper functionality. Refer to Division 26 for further requirements.

(e) Demonstrate that all components, equipment and instrumentation are working as intended..

3.1.2 If required, provide the services of a manufacturer's representative for equipment to assist with any of the equipment tests to be performed. Any components, or systems found to be defective or deficient during the tests shall be repaired or replaced.

3.1.3 Coordinate test schedules with the Consultant.

3.1.4 The participation in testing activities and the use of the equipment during testing periods by the Owner is to be allowed provided it does not adversely affect specified testing requirements. Such participation shall not relieve the Contractor of any of the obligations stipulated herein.

3.1.5 Prior to the commencement of any testing, the Contractor shall ensure that all spare parts, expendables, and test equipment pertinent to the system being tested are on site.

3.1.6 Test equipment shall include all necessary pumps, gauges, meters, process instrument calibrators for 4-20 mA, 24 VDC devices and signal generators or simulators. Test equipment shall be provided by the Contractor and shall remain the property of the Contractor at the end of all testing.

3.2 Calibration

3.2.1 In situ, calibrate and adjust all components, equipment and instrumentation to verify correct operation, range adjustment, compensation, scaling, etc. Where required, provide instrument calibration services for all individual components such as signal transmitters, analyzers, transducers, power supplies, and like equipment where appropriate.

3.2.2 Provide certified calibration reports for each component, equipment and instrument. In the reports, include, but do not limit to, such information as:

- (a) Device tag number
- (b) Equipment descriptions
- (c) Service applications
- (d) Flow and pressure validation (if applicable).
- (e) Process variable measurement range

COMMISSIONING OF PROCESS SYSTEMS

- (f) Description of calibration equipment used
 - (g) Date, name, and signature of technician
- 3.2.3 Include calibration reports in the operating and maintenance manuals.
- 3.3 Installation Verification
 - 3.3.1 When the system installation has been completed (or part thereof), perform detailed verification checks for all sub systems supplied and installed as part of the Work. In the checks and reviews, include the following:
 - (a) Certify that the equipment, components and instrumentation has been installed as per the Contract drawings and Manufacturer recommended installation procedures, reporting any discrepancies to the Consultant.
 - (b) Certify that the equipment, components and instrumentation power and grounding requirements have been satisfied, reporting any discrepancies to the Consultant.
 - (c) Certify that the installation (or part thereof as completed) is ready for commissioning and start-up.
 - (d) Witnessed Functional Acceptance Test shall be done on the complete control system.
 - 3.3.2 Undertake any corrective action found to be necessary during the course of the verification checkout and review.
 - (a) Report any discoveries of defects or deficiencies in writing to the Consultant for any equipment supplied by the Owner.
 - (b) Allow for the participation of the Owner's personnel in the verification checks. Such participation shall not relieve the Contractor of any of the obligations.
 - (c) Prepare the various reports and certificates described herein. Forward three (3) copies of each report or certificate to the Consultant. Clearly identify any discrepancies which require action on the part of the Consultant.
- 3.4 Commissioning and Start-Up
 - 3.4.1 Prior to commissioning and start-up activities, a series of operational tests will be performed by the Contractor, including, but not be limited to:
 - (a) Verification that all major equipment is installed and functioning as intended, including but not limited to pumps, valves, actuators, filters, instrumentation, etc.

COMMISSIONING OF PROCESS SYSTEMS

- (b) Perform testing of each subsystem. Upon confirmation that subsystems are functioning correctly perform testing of entire system.
 - (c) Complete any corrective action necessary that has been identified as part of the checkout procedure, on an ongoing basis.
- 3.4.2 Conduct final verification of commissioning of all systems through actual operation of the various parts of the process as determined by the Owner and the Consultant.
- 3.4.3 Coordinate work with supplier and Manufacturer representative and verify that their equipment and control systems are operating as part of the overall control system.
- 3.4.4 System commissioning will be considered complete when, in the opinion of the Consultant, the entire system has properly operated for seven (7) continuous days, 24 hours per day without interruption. This 7-day period is in addition to any test periods or operational demonstrations specified elsewhere. The objective will have been achieved once it has been demonstrated that all systems are operating and have complied with the specified performance requirements herein.

END OF SECTION

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

PROCESS CONTROL HARDWARE

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 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.

INSTRUMENT CONTROL PANEL

2.6 PILOT LIGHTS

- .1 Water and dust-proof with internal Gasket, jeweled lens, color as shown on drawings, bulb voltage 120VAC.
- .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.

INSTRUMENT WIRING

- .2 Write on labels are not acceptable.

3.3 CONDUCTOR LABELING

- .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

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.

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- .3 Materials of construction.
- .4 Wetted materials.
- .5 Accuracy.
- .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.

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

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.
- .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.

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- .3 Manufacturer.
 - .4 Type of Class.
 - .5 Application.
 - .6 Plant Location.
 - .7 Voltage Rating.
 - .8 Date of Test.
 - .9 Ambient Conditions.
 - .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

**DIVISION 43 – PROCESS GAS AND LIQUID
HANDLING, PURIFICATION AND STORAGE
EQUIPMENT**

SUBMERSIBLE SUMP PUMP

1.0 GENERAL

1.1 Section 43 21 39 refers to those portions of the *Work* that are unique to the supply and installation of submersible sump pumps. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Intent

- .1 Provide complete, fully tested and operational pump systems to meet requirements described herein and in complete accordance with applicable codes and ordinances.
- .2 *Contract Documents* of this Division and Process *Drawings* are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Uncrate equipment, move in place and install complete; start up and test.

1.3 Submittals

- .1 *Shop Drawings*: Contractor shall provide *Shop Drawings* which are to include: dimensions, parts list, materials of construction and motor data.
- .2 Operating/Maintenance Manuals: Provide manuals per Section 01 33 00.
- .3 Record Drawings: Provide drawings as per Section 01 33 00

2.0 PRODUCTS

2.1 Pump Selection

- .1 Submersible Sump Pumps
 - .1 Pump shall be capable of delivering 1 L/s at 10.0 m TDH
 - .2 Pump shall be manufactured by ECOFLO, model SPP50W or approved equal.
 - .3 Motor shall be ½ HP, 120V or as needed
 - .5 To come with sufficient cord length to suit sump and receptacle location

SUBMERSIBLE SUMP PUMP

3.0 EXECUTION

3.1 Installation

- .1 All equipment shall be installed in accordance with the manufacturer's installation instructions.

END OF SECTION 43 21 39

DIVISION 44 – POLLUTION CONTROL EQUIPMENT

DUST CONTROL

1.0 GENERAL

- 1.1 Section 44 11 13 refers to those portions of the work that are unique to the supply and application of materials for dust control. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Environmental Procedures Section 01 35 43
 - 1.2.2 Soil Stripping and Stockpiling Section 31 14 13
 - 1.2.3 Roadway Excavation, Embankment and Compaction Section 31 24 13
 - 1.2.4 Granular Base Section 32 11 23
- 1.3 References
 - 1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 01 43 00: Quality Assurance.
- 1.4 Samples
 - 1.4.1 Samples may be required at the discretion of the *Consultant*.
- 1.5 Delivery, Storage and Handling
 - 1.5.1 Deliver calcium chloride to site in substantial and moisture-proof bags indicating name of manufacturer, name of product, net weight or mass, and percentage of calcium chloride guaranteed by manufacturer.

2.0 PRODUCTS

- 2.1 Materials
 - 2.1.1 The *Contractor* shall supply the dust control material in accordance with the most recent Alberta Transportation Recognized Products list, with final approval from the *Consultant*.
 - 2.1.2 Calcium chloride: to CAN/CGSB-15.1, Type 1-Regular (77%) or as liquid at 35% solution concentration.
 - 2.1.3 Magnesium chloride as 29 to 35% solution concentration.
 - 2.1.4 Water: to *Consultant's* approval.
 - 2.1.5 Aqueous magnesium chloride or calcium chloride may be used provided application is not in an environmentally harmful manner.
 - 2.1.6 Lignosulphonates may be used subject to conditions specified in 3.2. Environmental Restrictions herein.
 - 2.1.7 Used oil or "cut back" bitumen products are not permitted.

3.0 EXECUTION

- 3.1 Application

DUST CONTROL

- 3.1.1 Control dust at all times for duration of *Contract*.
- 3.1.2 Apply aqueous solutions with distributors equipped with spray system that will ensure uniform application and with means of shut-off.
- 3.1.3 Apply aqueous solutions at following rates:
 - 3.1.3.1 Calcium chloride (25%) at 2.4 L/m² on roads not previously treated and 3.0 L/m² for road stabilization.
 - 3.1.3.2 Calcium chloride (35%) or magnesium chloride (30%) at 1.6 L/m² on roads not previously treated and 2.0 L/m² for road stabilization.
- 3.1.4 Apply flake calcium chloride at rate of 1.00 kg/m².
- 3.1.5 The completed treatment shall provide a smooth and relatively dust free surface.
- 3.2 Environmental Restrictions
 - 3.2.1 No application on slopes where precipitation may cause chemical to drain into watercourses.
 - 3.2.2 No application within 10m minimum on either side of watercourses.
 - 3.2.3 No application of lignosulphonates in residential areas when air temperature exceeds 26°C.
 - 3.2.4 No application of lignosulphonates when rain is imminent as minimum drying time of six hours is required.

END OF SECTION

**DIVISION 46 – WATER AND WASTEWATER
EQUIPMENT**

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

1.0 GENERAL

1.1 Description

- 1.1.1 This section specifies general standards applicable to all process mechanical equipment to be supplied as part of the Project.
- 1.1.2 All materials not specifically listed or specified, but required to complete the installation are the responsibility of the *Contractor*.
- 1.1.3 For instrumentation, control and electrical elements and devices, including control panels and their components, use this Section in conjunction with Division 26 for conformance to style, quality, product, and mounting requirements.

1.2 Definitions

- 1.2.1 "*Supplier's Representative*" means a factory trained representative qualified to provide detailed installation instructions for equipment, inspect equipment installation, supervise equipment testing, and provide training on equipment maintenance and operation.

1.3 Reference Divisions

- 1.3.1 Division 26 Electrical
- 1.3.2 Division 33 Utilities
- 1.3.3 Division 40 Process
- 1.3.4 Division 43 Process Gas and Liquid Handling, Purification and Storage Equipment
- 1.3.5 Division 46 Water and Wastewater Equipment

1.4 Reference Standards

- 1.4.1 ASTM A380

1.5 Submittals for Review

- 1.5.1 Provide shop drawings conforming to the general requirements.
- 1.5.2 Provide, in addition to the submittal requirements of specific equipment specification sections, the following:

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

- .1 Product literature with specific items to be supplied clearly indicated.
- .2 Process flow diagrams and process and instrumentation diagrams using ISA symbols for equipment which interfaces with the plant Programmable Logic Controller.
- .3 Assembly drawings showing dimensions, details of connections, anchorage and terminations of equipment for connection by others.
- .4 Equipment capacity. For pumps, blowers, compressors and fans, provide curves relating capacity to operating total dynamic head, and indicate operating point(s).
- .5 List of materials of construction, detailing component parts and reference ASTM, ANSI, CSA etc. specifications.
- .6 Electrical single line diagram.
- .7 PLC and control panel details.
- .8 Motor data including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and illustrative construction drawings.
- .9 Enclosure ratings for motors, starters and control panels.
- .10 Gearbox and drive data including AGMA/AFBMA ratings for components, tolerances, and details and materials of construction.
- .11 Details of coating systems.
- .12 Details of methods of preventing galvanic corrosion between mating surfaces constructed of dissimilar metals.
- .13 Layout drawings showing location of ancillary devices, conduit, junction boxes, safety and control devices and conduit entries for feeding or controlling the equipment.
- .14 Instrument Loop Diagrams, Motor Control Schematics, Interconnecting Wiring Diagrams and Instrumentation and Control Schematics.
- .15 Instrument details.
- .16 Valve and valve actuator details.

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

- .17 Design loadings to be transmitted to foundations or supports, including size and location of anchor bolts or other attachments to foundations or supports.
 - .18 Manufacturer technical assistance contact information.
- 1.6 Submittals for Information Only
 - 1.6.1 Provide submittals for information only conforming to the general requirements.
 - 1.6.2 Provide:
 - .1 Installation instructions indicating assembly, mounting and anchorage requirements, alignment and assembly tolerances, and points of connection for ancillary services.
 - .2 Start-up instructions including lubricant requirements, electrical requirements, etc.
 - .3 Certification by a professional engineer registered in the Province of AB that anchor bolt calculations have been performed for all pieces of equipment indicating adequacy of bolt type, sizing and anchor embedment for all forces including seismic.
 - 1.6.3 Provide operations and maintenance data.
 - .1 In information supplied, cross off all data not applicable to the specific equipment model supplied and highlight all data applicable to the specific equipment model supplied.
 - .2 Provide running clearances and tolerances
 - .3 Provide exploded views and drawings to illustrate relations of component parts of equipment and systems.
 - .4 For operating and maintenance instructions for each piece of equipment provide typewritten text as required to supplement product data. Provide logical sequence of instructions for each operation and maintenance procedure, incorporating manufacturer's instructions.
 - .5 Provide complete and detailed lubricating and servicing schedule and recommended lubricants to be utilized.
 - .6 Equipment and Instrument calibration reports

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

- .7 Local service representative(s), and local source of supplies and replacement parts.
- 1.6.4 Provide certificate of final inspection and approvals from the local electrical inspection authority.
- 1.7 Quality Assurance
 - 1.7.1 All instrumentation, control and electrical devices to be CSA approved and to bear the CSA approvals sticker.
 - 1.7.2 Provide all supports, anchorage and mounting of all equipment in accordance with the manufacturer's recommendations, the National Building Code, AB Building Codes, and S series drawings, and industry standard requirements unless otherwise specified.
 - 1.7.3 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.
 - 1.7.4 Stainless Steel Corrosion Control
 - .1 Factory weld with 316L filler wire using inert gas welding process. Solar flux is not acceptable. Provide a cross section equal or greater than the parent metal.
 - .2 Make all welds using the automatic orbital weld, gas tungsten arc welding (GTAW) or TIG process with an internal inert gas purge to exclude oxygen in the weld root area. Welds shall be full penetration, free of cracks overlaps and cold laps. Maximum misalignment 1.6 mm or half the pipe wall thickness, whichever is less. Maximum weld reinforcement and concave root 1.6 mm. Maximum undercut 0.8 mm or 10% of base metal thickness, whichever is less. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.
 - .3 Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:
 - (i) Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or stainless steel deburring and finish grinding wheels. Ensure brush material is compatible for stainless

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

- steel applications. Brushes to be manufactured from type 316 stainless steel.
- (ii) Passivate and finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380.
- .4 Use graphite-free anti-seize compound on all stainless steel bolt-ups.
- .5 Provide electrical isolation kits on all flanged connections where stainless steel pipe is connected to a dissimilar metal in outdoor conditions, including valves and fittings.
- 1.7.5 Vibration Loosening Prevention
 - .1 Provide lock nuts or double nuts with lengthened bolts as suitable for the service to prevent loosening of bolt and nut assemblies if they are subject to vibration during equipment operation.
- 1.8 Delivery, Storage and Handling
 - 1.8.1 Follow all of manufacturer's recommendations for delivery, site storage and handling of equipment.
 - 1.8.2 Protect all finished surfaces of exposed flanges and interior of equipment and piping by wooden blank flanges, bolted to the equipment flanges.
 - 1.8.3 Protect all coatings from damage during shipping.
 - 1.8.4 Any finished iron or steel surfaces not coated shall be properly protected to prevent rust and corrosion.
 - 1.8.5 Shrink-wrap stainless steel components if delivering during winter months to protect against chloride corrosion from road salt.
- 1.9 Warranty
 - 1.9.1 Each system *Supplier* shall guarantee that the equipment supplied shall be capable of performing the functions described in the *Specifications*.
 - 1.9.2 Provide in addition to warranties described in the General Conditions and Supplemental General Conditions specified guarantees and warranties in the relevant specification Section.

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

2.0 PRODUCTS

2.1 Acceptable Manufacturer / Qualifications

- 2.1.1 Each equipment specification lists a Design Standard upon which the design has been based, including dimensions, quality of workmanship, operating protocol, basic materials and ancillary services.
- 2.1.2 Where Acceptable Products or Acceptable Manufacturers have also been listed in an equipment specification, those products are considered as being capable of meeting the basic functional requirements of the equipment, but may not be the same as the Design Standard in detail.
- 2.1.3 Where "or approved equal" has been listed, acceptance is at the sole discretion of the *Consultant* and refers only to equipment that has been specifically approved by addendum prior to tender closing.
- 2.1.4 Provide all ancillary services, material upgrades etc. as necessary to satisfy quality requirements defined by the Design Standards.
- 2.1.5 Make all minor changes in arrangement, piping and/or electrical connections etc. as necessary to suit the requirements of the Acceptable Products or Acceptable Manufacturers.
- 2.1.6 No additional payment will be made for revisions or alterations made to accommodate the specific equipment approved and supplied.

2.2 Component Compatibility

- 2.2.1 Ensure all components of equipment systems including motor, drive, driven equipment and controls are compatible.
- 2.2.2 Provide equipment systems comprised of two or more components as a unit by the responsible manufacturer. Unless otherwise specified, the *Supplier* of the driven unit is the responsible manufacturer.
- 2.2.3 Prevent isolation or choose materials to prevent electrolytic action between dissimilar metals and materials.
- 2.2.4 Choose and assemble all components of the equipment system to enhance compatibility, ease of construction, and efficient maintenance.

2.3 Bearings – Not Used

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

- 2.4 Motors – Not Used
- 2.5 CSA Approval
 - 2.5.1 All instrumentation, control and electrical devices to be CSA approved and to bear the CSA approvals sticker.
- 2.6 V-Belt Assemblies – Not Used
- 2.7 Guards – Not Used
- 2.8 Piping Connections
 - 2.8.1 Provide piping connections compatible with piping systems to be connected. Refer and conform to quality standards in Section 40 05 23.24.
- 2.9 Couplings
 - 2.9.1 Acceptable manufacturers: Dodge, Woods.
 - 2.9.2 Design Criteria
 - .1 Provide flexible couplings for equipment with drives greater than 0.5 hp.
 - .2 Couplings to accommodate angular and parallel misalignment and end float and to cushion shock loads and dampen torsional vibrations. No metal to metal contact.
 - .3 Size each coupling as recommended by the coupling manufacturer and install in conformance with the coupling manufacturer's instructions. Provide equivalent of shrunk-on fit.
 - .4 Provide tire-type flexible member, attached to flanges by means of clamping rings and cap screws, with flanges attached to stub shaft by taperlock bushings.
- 2.10 Gauge Taps
 - 2.10.1 Provide gauge taps on the suction and discharge side of pumps, blowers and compressors, complete with nipple, ball valve and cap.
 - 2.10.2 Taps on air and clean water services to be 12 mm diameter.
 - 2.10.3 Taps on wastewater services to be 25 mm diameter.
- 2.11 Housekeeping Pads – Not Used

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

.1

- 2.12 Equipment Bases – Not Used
- 2.13 Anchor Bolts – Not Used
- 2.14 Jacking Screws – Not Used
- 2.15 Pump Shaft Mechanical Seals – Not Used
- 2.16 Equipment Identification
 - 2.16.1 Provide metal nameplate on each piece of equipment, mechanically fastened, complete with recessed letters.
 - 2.16.2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle phase and power of motors.
 - 2.16.3 Indicate design conditions (ie: flow, outlet pressure) in metric units, RPM, and equipment identification number as shown on process and instrumentation drawings.
 - 2.16.4 Nameplate to be 304 stainless steel with 6 mm high indented letters.
- 2.17 Spare Parts
 - 2.17.1 Provide two year supply of manufacturer's recommended lubricants for all equipment.
 - 2.17.2 For all belt driven equipment, provide two V-belt sets.
 - 2.17.3 For shop applied coatings, provide 1 unopened litre each of primer and finish coat.
 - 2.17.4 For equipment that requires specialty tools for operations and maintenance, provide 1 set of specialty tools.
 - 2.17.5 Tag and store spare parts as directed by the *Owner's* staff.

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

3.0 EXECUTION

3.1 General

- 3.1.1 Provide all necessary lifting and loading equipment, special tools, materials, supplies, lubricants, measuring devices, shims, gaskets, incidentals and other consumables as required to complete the installation and testing.
- 3.1.2 Inspect and field measure prior to equipment installation to ensure that previous work is not prejudicial to the proper installation for equipment.
- 3.1.3 Make all submissions required by the *Specifications* and local authorities and pay all fees required for the equipment installation.
- 3.1.4 Dimensions shown in the *Contract Documents* for equipment bases, piping connections, control panel locations, etc. are approximate and must be modified during equipment installation to suit the actual equipment provided. Review modifications with *Consultant* before proceeding.
- 3.1.5 Make all minor modifications to suit piping and other installed equipment and structural element locations and elevations. Review modifications with *Consultant* before proceeding.

3.2 Installation

- 3.2.1 Install all equipment specified or shown in the *Drawings*.
- 3.2.2 Provide for each piece of equipment a *supplier's* representative who shall instruct the *Contractor* in the proper installation of the *supplier's* equipment.
 - .1 The *supplier's* representative shall attend a preliminary site meeting to instruct the *Contractor* on the installation procedure. Allow for 1 day.
 - .2 The *supplier's* representative shall also provide all necessary installation instructions to the *Contractor* in writing.
- 3.2.3 Install equipment as indicated in written instructions provided by the equipment manufacturer.
- 3.2.4 Level equipment using 304 stainless steel shims unless otherwise specified.
- 3.2.5 Not Used.
- 3.2.6 Not Used.

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

3.2.7 Not Used.

.1

3.2.8 Near the end of the equipment installation period, the *Contractor* shall notify the *Supplier* who shall send his representative to check over the installation when completed.

3.2.9 The *Supplier's* representative shall do a detailed check of the installation including, but not limited to, such items as: alignment, belt tension, bolt tension, running clearances, lubrication and workmanship.

3.2.10 The *Contractor* shall promptly remedy any defects to the satisfaction of the *Supplier's* Representative and the *Consultant*.

3.2.11 After the *Supplier's* Representative is satisfied that defects in installation have been remedied, alignment will be demonstrated to the *Consultant*, following which the equipment shall be given a brief test run in the presence of the representative, the *Contractor* and the *Consultant*. Provide a minimum of two weeks' notice to the *Consultant* that alignment and a brief test run will be demonstrated.

3.2.12 When the *Supplier's* representative is satisfied that installation is satisfactory in accordance with manufacturer's requirements and that the brief test run was successful, the representative shall complete Form 101 certifying that the installation is satisfactory in accordance with manufacturer requirements, and listing any minor defects requiring rectification.

3.2.13 Any defects in the installation shall be rectified by the *Contractor*.

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

3.3 Functional Testing

- 3.3.1 Equipment Functional Testing as described under this section is in addition to the brief test run described in Section 3.1.
- 3.3.2 Prior to equipment Functional Testing, pressure testing of all piping connected to the equipment must be completed as specified in Section 40 05 23.24
- 3.3.3 Equipment Functional Testing is to be performed with water to demonstrate to the satisfaction of the *Consultant* that:
 - .1 All system components are fully operational
 - .2 Control and instrumentation components have been calibrated and properly adjusted
 - .3 All connecting piping is leak-proof and properly anchored
 - .4 The entire system is ready for continuous safe operation
- 3.3.4 The *Contractor* shall notify the *Supplier* and the *Consultant* 14 days ahead of the date when Functional Testing of the equipment furnished is to take place and the *Supplier* shall send his representative to the site to supervise and assist the *Contractor* in the testing of the equipment. The site visit may be concurrent with the check for the satisfactory installation of the equipment, if mutually agreed upon by the *Supplier* and the *Contractor*.
- 3.3.5 Before the *Consultant* witnesses the testing, the *Supplier's* representative shall recheck the installation and advise the *Contractor* as to any further installation, adjustments, checking, flushing or cleaning of the equipment required, and shall confirm that the equipment is ready to be operated.
- 3.3.6 The *Contractor* and the *Supplier's* representative shall operate the equipment for at least one hour to demonstrate to themselves the satisfactory operation of the equipment and controls, and shall take any remedial steps necessary to ensure the satisfactory operation of the equipment.
- 3.3.7 Following such remedial action, the *Contractor* shall notify the *Consultant* that the equipment operation is ready to be demonstrated, and the *Consultant* shall arrange to promptly attend such demonstration together with the *Owner's* representative.

PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

- 3.3.8 The *Contractor* and the *Supplier's* representative shall then demonstrate to the *Consultant's* satisfaction the equipment operation, and shall prove out the satisfactory operation of all controls over several cycles and in all operating modes. The *Contractor* shall arrange to provide any supplies and water necessary to demonstrate the satisfactory operation of the equipment. Equipment shall be run continuously for a minimum of 24 hours as part of this demonstration, in automatic mode, without any alarms.
- 3.3.9 Should the demonstration reveal any defects, then they shall be promptly rectified by the *Contractor* and the demonstration of the equipment repeated to the satisfaction of the *Consultant*. Should such repeat demonstration require a second, or subsequent, visit to the site by the *Consultant*, the Owner's representative, the *Contractor*, or the *Supplier's* representative, then the additional costs, if any, incurred by each party shall be paid for by the *Contractor*.
- 3.3.10 During these tests instrument settings etc. shall be adjusted. Pressure, voltage, and amperage readings must be recorded. Each operating alarm condition must be simulated to ensure all controls and alarms are in good working order. The cost of any changes, adjustments or replacement of equipment that, in the opinion of the *Consultant*, are due to defective materials or errors or omissions on the part of the *Contractor* shall be made good by the *Contractor*.
- 3.3.11 Once testing has been completed to the satisfaction of the *Supplier's* representative and the *Contractor*, a Certificate of Satisfactory Testing Form 102 shall be completed and presented to the *Consultant*.
- 3.3.12 The *Consultant* shall sign the Certificate of Satisfactory Testing Form 102 completed by the *Supplier's* representative when testing has been completed to the satisfaction of the *Consultant*.
- 3.4 Operator Training
- 3.4.1 After successful completion of Equipment Testing, provide the services of the *Supplier's* Representative to train representatives of the Owner in process control and proper operation and maintenance of the equipment.
- 3.5 Start-Up and Commissioning
- 3.5.1 Refer to Section 01 91 00.

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PROCESS EQUIPMENT SPECIFICATIONS - GENERAL

END OF SECTION

TESTING AND DISINFECTION OF PIPING AND FACILITIES

1.0 GENERAL

1.1 Description

- 1.1.1 Section 46 80 00 refers to the portions of the *Work* that are unique to the pressure testing, leak testing and disinfection of piping and facilities as required prior to commissioning.

2.0 PRODUCTS

N/A

3.0 EXECUTION

3.1 General

- 3.1.1 *Contractor* to supply all water and chlorine as required for flushing, pressure or leak testing and disinfection.
- 3.1.2 *Contractor* responsible for completing chlorine residual and bacteriological tests as outlined in applicable AWWA standards.
- 3.1.3 *Contractor* to de-chlorinate and dispose of water used for disinfection process in location acceptable to the *Owner*.

3.2 Piping

- 3.2.1 Clean, pressure test and disinfect all raw water piping as identified in Section 33 11 01, 46 05 00 and per AWWA-C651.

3.3 Tanks and Channels – Not Used

3.4 Filters – Not Used

3.5 Leak Testing of Concrete Tanks – Not Used

END OF SECTION