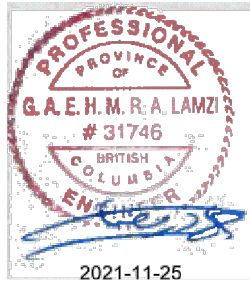


CONSULTANTS - SEAL & SIGNATURE

Discipline

Seal/Signature/Date

Civil (Prime)



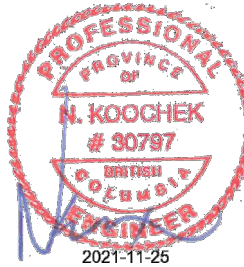
Engineers & Geoscientists BC Permit #1000200

CONSULTANTS - SEAL & SIGNATURE

Discipline

Seal/Signature/Date

Mechanical



CONSULTANTS - SEAL & SIGNATURE

Discipline

Seal/Signature/Date

Electrical



-End Of Section-

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MECHANICAL DRAWINGS

M0-00	Cover Sheet and Drawing List
M0-01	Overall Plan, Mechanical Legend and Notes
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M1-00	DCW Valve Rooms – Demo Plan – Living Units 1,2,3,4
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M3-01	Valve Rooms-New Plan Living Unit 5, Segregation Unit and Jensen Centre-DCW & FP
M3-02	Valve Rooms-New Plan Administration Building, Industries and Maintenance DCW and FP

ELECTRICAL DRAWINGS

E-000	Site Plan, Legend and Drawing List
E-001	Fire Alarm Control Panel/Annunciator/Phasing Plan
E-101	Valve Rooms
E-102	Valve Rooms
E-103	Electrical Panel Schedules

END OF DRAWINGS

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY OF WORK

- .1 Work covered by Contract Documents:
 - .1 This Contract covers the following work at the Mission Medium Institution, 8751 Stave Lake Street, Mission, B.C.
- .2 Work to be performed under this Contract includes, but not limited to, the following items covered further in the Contract documents:
 - .1 Provide a detailed work plan including a project schedule and phasing. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service. Plan shall be approved by Operations prior to mobilization.
 - .2 A Traffic and Safety Control Plan shall be submitted by the Contractor prior to the pre-construction meeting.
 - .3 The Contractor to engage Geotechnical Consultant to review and approve all Geotechnical Engineering works included in the design. Also, review and approve existing ground subgrade and fill material prior to use.
 - .4 Do not start work until all essential equipment is delivered to the site and the work can proceed without delays.
 - .5 Provide as-built drawings and closeout submittals.
- .3 Contractor's Use of Premises:
 - .1 Contractor has limited use of site for work of this contract until Substantial Completion:
 - .1 Contractor use of premises for storage and access, as approved by the Departmental representative.
 - .2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
 - .2 Vehicular access through Mission Medium Institute will be restricted during the inmate "count" at breakfast, lunch and dinner hours. Confirm times with Departmental Representative. Delays may occur when entering and exiting the Institution with vehicles due to security situations and heavy traffic.

1.2 WORK RESTRICTIONS

- .1 Notify Departmental Representative of intended interruption of power, communication and water services and provide schedule of interruption times.
- .2 No works are permitted within Right-of-Way or Road Allowances without Approval from Departmental Representative.
- .3 Tie-in to existing services must be confirmed through the Departmental Representative.
- .4 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of services throughout course of work. Keep duration of interruptions to a minimum. Coordinate interruptions with local

- authority having jurisdiction and local residences and businesses affected by the disruption.
- .5 Provide for access by pedestrian and vehicular traffic on and around site where work is in progress.
 - .6 Construct barriers in accordance with Section Temporary Barriers and Enclosures.
 - .7 Security Requirements: refer to Section 01 14 10 - Security Requirements.
 - .8 Hours of work:
 - .1 Perform work during normal working hours of the Institution 0730 to 1600, Monday through Friday except holidays.
 - .2 When it is necessary, arrange in advance with Departmental Representative to work outside of normal working hours.
 - .9 The contractor shall ensure all approvals required for the proposed work have been obtained prior to commencement of any construction.

1.3 CONSTRUCTION WORK SCHEDULE

- .1 Commence work immediately upon official notification of acceptance of offer and complete the work within 36 weeks from the date of such notification.
- .2 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Certificate and Final Certificate as defined times of completion are of essence of this contract.
- .3 Submittal:
 - .1 Submit to Departmental Representative within 10 working days of Award of Contract, a Bar (GANNT) Chart as Master Plan for planning, monitoring and reporting of construction progress.
 - .2 Identify each trade or operation.
 - .3 Show dates for delivery of items requiring long lead time.
 - .4 Departmental Representative will review schedule and return one copy.
 - .5 Re-submit two (2) copies of finalized schedule to Departmental Representative within five (5) working days after return of reviewed preliminary copy.
- .4 Project Scheduling Reporting:
 - .1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
 - .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
- .5 Project Meetings:
 - .1 Discuss Project Schedule at bi-weekly site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
 - .2 Weather related delays with their remedial measures will be discussed and negotiated.

- .3 Before submitting first progress claim submit breakdown of Contract price in detail as directed by Departmental Representative and aggregating contract price. After approval by Departmental Representative cost breakdown will be used as basis for progress payments. Only PWGSC paper work is acceptable.

1.4 SUBMITTAL PROCEDURES

- .1 Administrative:
 - .1 Submit to Departmental Representative submittal listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .2 Work affected by submittal shall not proceed until review is complete.
 - .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
 - .4 Where items or information is not produced in SI Metric units converted values are acceptable.
 - .5 Review submittal prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittal not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
 - .6 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
 - .7 Verify field measurements and affected adjacent Work are coordinated.
 - .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittal.
 - .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
 - 10 Keep one reviewed copy of each submission on site.
- .2 Shop Drawings:
 - .1 Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.
- .3 Product Data:
 - .1 Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that the product concerned is clearly identified. Submit in sets, not as individual submissions.
- .4 Samples:
 - .1 Submit samples in sizes and quantities specified.

- .2 Where colour is criterion, submit full range of colours.
- .3 Submit all samples as soon as possible after the contract is awarded, to facilitate production of complete colour scheme by the Departmental Representative.
- .5 Mock-ups:
 - .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
 - .2 Construct in location as specified in specific Section.
 - .3 Prepare mock-ups for Departmental Representative' review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
 - .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .5 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- .6 Progress Photographs:
 - .1 Provide construction photographs in accordance with procedures and submission requirements specified in this clause.
 - .2 Progress Photographs:
 - .1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression.
 - .2 Number of viewpoints: four (4), locations of viewpoints directed by Departmental Representative.
 - .3 Frequency: monthly, submitted on disk with monthly progress statement, sent via e-mail or as directed by Departmental Representative.
 - .4 Identify photos by location, date and sequential numbering system.
 - .3 Final Photographs:
 - .1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression. Where photos are e-mailed compression can be increased.
 - .2 Number of viewpoints:
 - .1 Each side of building for a total of 4.
 - .2 Interior of rooms and finishes for a total of 8.
 - .3 Locations of viewpoints determined by Departmental Representative.
 - .3 Submit final photographs in digital format on CD, before final acceptance of building.
 - .4 Label disks and identify with name and project number of project. Indicate exposure dates and viewpoints of each photo and photo number.

- .7 Submission Requirements:
 - .1 Schedule submissions at least ten days before dates reviewed submissions will be needed.
 - .2 Submit number of copies of product data, shop drawings which Contractor requires for distribution plus four (4) copies which will be retained by Departmental Representative.
 - .3 Accompany submissions with transmittal letter in duplicate.
 - .4 Submit bond copies (hard copy) as directed by Departmental Representative.
- .8 Coordination of Submissions:
 - .1 Review shop drawings, product data and samples prior to submission.
 - .2 Coordinate with field construction criteria.
 - .3 Verify catalogue numbers and similar data.
 - .4 Coordinate each submittal with requirements of the work of all trades and contract documents.
 - .5 Responsibility for errors and omissions in submittal is not relieved by Departmental Representative's review of submittal.
 - .6 Responsibility for deviations in submittal from requirements of Contract documents is not relieved by Departmental Representative's review of submittal, unless Departmental Representative gives written acceptance of specified deviations.
 - .7 Notify Departmental Representative, in writing at time of submission, of deviations in submittal from requirements of Contract documents.
 - .8 Make any changes in submissions which Departmental Representative may require consistent with Contract Documents and re-submit as directed by Departmental Representative.
 - .9 After Departmental Representative's review, distribute copies.
 - .10 Shop Drawings Review:
 - .1 Review of shop drawings by Public Works and Government Services Canada (PWGSC) is for the sole purpose of ascertaining conformance with the general concept.
 - .2 The Departmental Representative's review does not mean that PWGSC approves the detail design inherent in the shop drawings, responsibility remains with the contractor submitting same, and such review will not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and contract documents.
 - .3 Without restricting the generality of the foregoing, 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 and installation, and for co-ordination of the work of all subtrades.

1.5 HEALTH AND SAFETY

- .1 Specified in Section 01 35 33.

1.6 ENVIRONMENTAL PROCEDURES

- .1 Fires and burning of rubbish on site not permitted.
- .2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.
- .3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.
- .4 Provide temporary drainage and pumping as necessary to keep excavations and site free from water during excavation and grading activities.
- .5 Deleterious materials shall be prevented from entering the existing drainage system.
- .6 Control disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements. Construct settlement ponds and silt fences as required by the Provincial Environmental authority.
- .7 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .8 Under no circumstances dispose of rubbish or waste materials on adjoining property.

1.7 REGULATORY REQUIREMENTS

- .1 References and Codes:
 - .1 Perform Work in accordance with the most recent version of the National Building Code of Canada, the British Columbia Building and Plumbing Codes 2018 and the Master Municipal Construction Documents, including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.8 QUALITY CONTROL

- .1 Inspection:
 - .1 Give 48 hours notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
 - .2 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
 - .3 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is

found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

- .2 Procedures:
 - .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
 - .2 All testing materials, subgrade and compaction shall be performed by an independent testing agency retained by the Consultant. Cost of testing shall be paid by the Contractor
 - .3 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
 - .4 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.
- .3 Rejected Work:
 - .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
 - .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .4 Reports:
 - .1 Submit (4) four copies of inspection and test reports to Departmental Representative.
- .5 Tests and Mix Designs:
 - .1 Furnish test results and mix designs as may be requested.
- .6 Mock-ups:
 - .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
 - .2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.
 - .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
 - .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .5 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.
 - .6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- .7 Mill Tests:
 - .1 Submit mill test certificates as requested and as required of specification Sections.

- .8 Equipment and Systems:
 - .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
 - .2 Refer to specific Section for definitive requirements.

1.9 TEMPORARY UTILITIES

- .1 Installation and Removal:
 - .1 Provide temporary utilities controls in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .2 Dewatering:
 - .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.
- .3 Water Supply:
 - .1 Arrange, pay for and maintain temporary water supply in accordance with local authority, governing regulations and ordinances.
 - .2 Permanent water supply system installed under this contract may be used for construction requirements provided that guarantees are not affected thereby. Replace damaged components.
- .4 Heating and Ventilation:
 - .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
 - .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
 - .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
 - .4 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .5 Temporary Power and Light:

- .1 Arrange, pay for and maintain temporary electric power supply in accordance with local power authority governing regulations and ordinances.
- .2 Electrical power and lighting installed under this contract may be used for construction purposes at no extra cost, provided that guarantees are not affected thereby and electrical components used for temporary power are replaced when damaged.
- .3 Replace lighting bulbs/tubes and clean reflectors and lenses used for more than three months.
- .6 Temporary Communication Facilities:
 - .1 Provide and pay for temporary telephone and fax hook up, line(s) necessary for own use.
- .7 Fire Protection:
 - .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

1.10 CONSTRUCTION FACILITIES

- .1 Installation and Removal:
 - .1 Provide construction facilities in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .2 Scaffolding:
 - .1 Design, construct and maintain scaffolding in rigid, secure and safe manner, in accordance with WorkSafeBC regulations and Section 01 35 33.
 - .2 Erect scaffolding independent of walls. Remove promptly when no longer required.
- .3 Hoisting:
 - .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
 - .2 Hoists to be operated by qualified operator.
- .4 Site Storage/Loading:
 - .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
 - .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.
- .5 Construction Parking:
 - .1 Make good damage to existing roads used for access to project site.
 - .2 Build and maintain temporary access where required and provide snow removal during period of Work.
 - .3 Park vehicles outside perimeter fence in designated parking areas.
- .6 Contractor's Site Office and enclosure:
 - .1 Provide office of size to accommodate site meetings and Contractor's operations.

- .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
- .3 Provide temporary fenced area to enclose site and operations.
- .7 Equipment, Tools and Material Storage:
 - .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
 - .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.
- .8 Sanitary Facilities:
 - .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
 - .2 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures. Permanent facilities may be used on approval of Departmental Representative.

1.11 TEMPORARY BARRIERS AND ENCLOSURES

- .1 Hoarding:
 - .1 Erect temporary site enclosure using new 1.8 m high temporary construction fencing. Provide lockable truck gate. Maintain fence in good repair.
- .2 Enclosure of Structure:
 - .1 Provide temporary weathertight enclosures and protection for exterior openings until permanently enclosed. Design enclosures to withstand wind pressure. Provide lockable entry as required for moving personnel equipment and materials.
 - .2 Provide temporary enclosures to secure building from entry of unauthorized personnel during construction period.
- .3 Guardrails and Excavations:
 - .1 Provide secure, rigid guard rails and barricades around deep excavations, open edges of floors and roofs etc.
 - .2 Provide as required by governing authorities.
- .4 Access to Site:
 - .1 Maintain immediate local access roads in clean condition used during work of this contract.
- .5 Protection for Off-Site and CSC Property:
 - .1 Protect surrounding CSC property from damage during performance of Work.
 - .2 Be responsible for damage incurred.
- .6 Protection of Building Finishes:
 - .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
 - .2 Provide necessary screens, covers, and hoardings.

- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

1.12 COMMON PRODUCT REQUIREMENTS

- .1 Reference Standards:
 - .1 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
 - .2 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
 - .3 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.
- .2 Quality:
 - .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
 - .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
 - .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
 - .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
 - .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.
 - .6 The use of asbestos containing materials is prohibited in this project. Contractor shall provide a letter to the Departmental Representative prior to Substantial Completion confirming that asbestos containing materials are not used in this project.
- .3 Storage, Handling and Protection:
 - .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
 - .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
 - .3 Store products subject to damage from weather in weatherproof enclosures.

- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.
- .4 Transportation:
 - .1 Pay costs of transportation of products required in performance of Work.
 - .2 Transportation cost of products supplied by Departmental Representative will be paid for by Departmental Representative. Unload, handle and store such products.
- .5 Manufacturer's Instructions:
 - .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
 - .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.
 - .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.
- .6 Quality of Work:
 - .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
 - .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
 - .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.
- .7 Co-ordination:
 - .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
 - .2 Be responsible for coordination and placement of openings, sleeves and accessories.

- 8 Concealment:
 - .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
 - .2 Before installation, inform Departmental Representative if there is interference. Install as directed by Departmental Representative.
- .9 Remedial Work:
 - .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
 - .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner neither to damage nor to put at risk any portion of Work.
- .10 Location of Fixtures:
 - .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
 - .2 Inform Departmental Representative of conflicting installation. Install as directed.
 - .3 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.
- .11 Fastenings:
 - .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
 - .2 Prevent electrolytic action between dissimilar metals and materials.
 - .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
 - .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
 - .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
 - .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- .12 Fastenings - Equipment:
 - .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
 - .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
 - .3 Bolts may not project more than one diameter beyond nuts.
 - .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

- .13 Protection of Work in Progress:
 - .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Departmental Representative.
- .14 Existing Utilities:
 - .1 The Engineer is not responsible for the accuracy of all locations and elevations of existing underground services as determined from 'As Constructed' drawings, provided by PSPC.
 - .2 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.
 - .3 Before commencing work, establish location and extent of service lines in areas of work and notify Departmental Representative of findings. The contractor is to verify the location of all existing services, crossings and tie-in points prior to construction and to notify the Departmental Representative of any discrepancies, conflicts or omissions.
 - .4 The contractor is to check with Fortis BC prior to commencing work for verification of locations and inverts of all gas mains.
 - .5 The contractor shall use extreme care when working near the existing services, and any services disrupted are to be replaced to the satisfaction of the Departmental Representative.
 - .6 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
 - .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
 - .8 Record locations of maintained, capped and re-routed services lines.
- .15 Contractors Options for Selection of Products:
 - .1 Products specified by "**Prescriptive**" specifications: select any product meeting or exceeding specifications.
 - .2 Products specified under "**Acceptable Products**" (used for complex Mechanical or Electrical Systems): select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.
 - .3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.
 - .4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Instructions to Bidders".
 - .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

- .16 Substitution after award of Contract:
 - .1 No substitutions are permitted without prior written approval of the Departmental Representative.
 - .2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.
 - .3 Proposals will be considered by the Departmental Representative if:
 - .1 products selected by tenderer from those specified are not available;
 - .2 delivery date of products selected from those specified would unduly delay completion of Contract, or
 - .3 alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.
 - .4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.
 - .5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

1.13 EXAMINATION AND PREPARATION

- .1 Existing Services:
 - .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
 - .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.
- .2 Location of Equipment and Fixtures:
 - .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
 - .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
 - .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
 - .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.14 EXECUTION REQUIREMENTS

- .1 Preparation:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .2 After uncovering, inspect conditions affecting performance of Work.

- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.
- .2 Execution:
 - .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
 - .2 Fit several parts together, to integrate with other Work.
 - .3 Uncover Work to install ill-timed Work.
 - .4 Remove and replace defective and non-conforming Work.
 - .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
 - .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
 - .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
 - .8 Cut rigid materials using purpose made saw or core drill. Pneumatic or impact tools not allowed on brittle materials without prior approval.
 - .9 Restore work with new products in accordance with requirements of Contract Documents.
 - .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
 - .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.
 - .12 The contractor shall repair or replace any existing pavements, services, utilities, or any other improvements that may be damaged as a result of the construction.
 - .13 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.
 - .14 All new concrete pavements shall be graded so that no ponding forms. The minimum cross slope of any new concrete road surface shall be 2%.
 - .15 Contractor to restore roadside non traveled surfaces by hydroseeding with native grasses approved by departmental representative in advance. Contractor to maintain and reapply hydroseed until established.
 - .16 All existing lands impacted by construction are to be restored to the satisfaction of the Departmental Representative. The Departmental Representative may require written acceptance by the affected property owners for restoration works performed by the contractor.
 - .17 All proposed grading shall meet existing adjacent ground surface elevations unless otherwise noted. Any defects shall be corrected immediately at the Contractor expense.

- .18 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.15 CLEANING

- .1 Project Cleanliness:
 - .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
 - .2 The contractor shall ensure that the work area and adjacent surface are kept clean and free of equipment and materials at all times when construction is not underway.
 - .3 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
 - .4 Clear snow and ice from access to building.
 - .5 Provide on-site containers for collection of waste materials and debris.
 - .6 Provide and use clearly marked separate bins for recycling. Refer to Construction/Demolition Waste Management And Disposal.
 - .7 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
 - .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
 - .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
 - .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
 - .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .2 Final Cleaning:
 - .1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
 - .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
 - .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
 - .4 Remove waste products and clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
 - .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls, and floors.
 - .6 Clean lighting reflectors, lenses, and other lighting surfaces.
 - .7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

- .8 Wax, seal, vacuum clean, shampoo or prepare floor finishes, as recommended by manufacturer.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .11 Remove dirt and other disfiguration from exterior surfaces.
- .12 Sweep and wash clean paved areas.
- .13 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .14 Clean roofs, downspouts, and drainage systems.
- .15 Remove snow and ice from access to building.

1.16 CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL

- .1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials and waste.
 - .1 Separate non-salvageable materials from salvaged items.
 - .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
 - .3 Transport and deliver non-salvageable items to licensed disposal facility.
- .2 Provide containers to deposit reusable and/or recyclable materials. Locate containers in locations, to facilitate deposit of materials without hindering daily operations. Provide containers to deposit reusable and/or recyclable materials.
- .3 Collect, handle, store on-site and transport off-site, salvaged materials in separate condition. Transport to approved and authorized recycling facility and/or users of material for recycling.
- .4 Locate waste and salvage bins on site as directed by Departmental Representative.

1.17 CLOSEOUT PROCEDURES

- .1 Inspection and Declaration:
 - .1 Contractor's Inspection: Conduct an inspection of Work with all subcontractors, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .2 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .3 Request Departmental Representative's Inspection.
- .2 Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .3 Substantial Completion: prior to requesting Substantial Completion, submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.

- .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Fire alarm verification report per CAN/ULC-S537, confirmation of proper installation of fire alarm panel to CAN/ULC-S527 signed off by the fire alarm technician and confirmation of fire alarm emergency power capacity. 24-hour battery test as described in CAN/ULC-S537, signed off by fire alarm technician.
 - .5 Confirmation of emergency power lighting, operating on emergency power for the required amount of time as dictated by NBCC, signed off by technician.
 - .6 Certificates required by Authority Having Jurisdictions for fire protection systems.
 - .7 Certificates required by Authority Having Jurisdictions for seismic restraints.
 - .8 Operation of systems have been demonstrated to Departments personnel.
 - .9 Work is complete and ready for Final Inspection.
 - .10 Asbestos containing materials are not used in this project.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

1.18 CLOSEOUT SUBMITTAL

- .1 Record Drawings:
 - .1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on as-built drawings as changes occur. At completion supply:
 - .1 Four (4) sets of CD's in AutoCad file format (version: 2010) and PDF format with all as-built information on the diskettes.
 - .2 Four (4) sets of printed as-built drawings.
 - .3 Submit one copy of check plots to Departmental Representative prior to final printing of as-built drawings.
 - .4 Departmental Representative will supply copies of the original AutoCad files.
 - .5 Retain original logo and title block on the as-built drawings. Contractor may place on the upper right-hand title block area a small company logo, the text "AS-BUILT" and the date.
 - .2 Costs for transferring as-built information from marked up working set of drawings to electronic format using ACAD and plotting service is included in the Contract.
- .2 Operation and Maintenance Manuals:
 - .1 On completion of project submit to Departmental Representative four (4) CD R/disk copies and four (4) paper copies (in loose leaf type binder) of Operation and Maintenance Manual, made up as follows:
 - .1 Provide maintenance manual on CDs using pdf, or other approved format for descriptive writing, page size images and page size drawings. Organize manuals into industry standard maintenance manual tabs with

- links in index to each descriptive section describing the component or maintenance procedure etc.
 - .2 Organize files into CSI Masterformat numbering system or other approved descriptive titles.
 - .3 Label disk "Operation and Maintenance Data", project name, date, names of Contractor, subcontractors, consultants and subconsultants.
 - .4 Include scanned guarantees, diagrams and drawings.
 - .5 Organize contents into applicable sections of work to parallel project specification break-down. Mark each section by labeled tabs (navigational buttons).
 - .6 Drawings, diagrams and manufacturer's literature must be legible.
 - .7 Refer to Mechanical and Electrical Divisions for specific details for Mechanical and Electrical data.
- .3 Maintenance Materials, Special Tools and Spare Parts:
- .1 Specific requirements for maintenance materials, tools and spare parts are specified in individual sections.
 - .2 Deliver maintenance materials, special tools and spare parts to Departmental Representative and store in designated area as directed by Departmental Representative.
 - .3 Prepare lists of maintenance materials, special tools and spare parts for inclusion in Manual specified in Clause 18.2.
 - .4 Maintenance materials:
 - .1 Deliver wrapped, identify on carton or package, colour, room number, system or area as applicable where item is used.
 - .5 Special tools:
 - .1 Assemble as specified;
 - .2 Include identifications and instructions on intended use of tools.
 - .6 Spare parts:
 - .1 Assemble parts as specified;
 - .2 Include part number, identification of equipment or system for which parts are applicable;
 - .3 Installation instructions;
 - .4 Name and address of nearest supplier.
 - .5 Deliver one underground valve common to domestic size water line 100mm and 150mm valve common to fire hydrant supply line. Include suitable length water keys – quantity two
- .4 Warranties and Bonds:
- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing in maintenance manual.

- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
- .4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Interim Completion is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Retain warranties and bonds until time specified for submittal.

1.19 DEMONSTRATION AND TRAINING

- .1 Demonstration and Training:
 - .1 Demonstrate operation and maintenance of equipment and systems to maintenance personnel following interim Completion and prior to date of final certificate of completion
- .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.20 GENERAL COMMISSIONING

- .1 Commission installed systems prior to Demonstration and Training.

END OF SECTION

PART 1

GENERAL

1.1. PURPOSE

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

1.2. DEFINITIONS

- .1 "Contraband" means:
 - .1 an intoxicant, including alcoholic beverages, drugs and narcotics;
 - .2 a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization;
 - .3 an explosive or a bomb or a component thereof;
 - .4 currency over any applicable prescribed limit, \$25.00; and
 - .5 any item not described in paragraphs (a) to (d) that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2 Unauthorized smoking and related Items@ means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, matches and lighters.
- .3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4 "CSC" means Correctional Service Canada.
- .5 "Director" means Director or Warden of the Institution as applicable or their representative.
- .6 "Construction employees" means persons working for the general contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .7 "Departmental Representative" means the Public Works and Government Services Canada representative defined in General Conditions.
- .8 "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.
- .9 "Construction zone" means the area, as indicated in the contract documents, that the contractor will be allowed to work". This area may or may not be isolated from the security area of the institution. Limits to be confirmed at construction start-up meeting.

- 1.3. PRELIMINARY PROCEEDINGS
 - .1 At construction start-up meeting:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
 - .2 The Contractors' responsibilities:
 - .1 Ensure that all construction employees are aware of the CSC security requirements.
 - .2 Ensure that a copy of the CSC security requirements is always prominently on display at the job site.
 - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all construction employees.

- 1.4. CONSTRUCTION EMPLOYEES
 - .1 Submit CPIC form and scanned copy of government issued ID for each employee to the Departmental Representative.
 - .2 Allow 10 working days for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at this institution except as approved otherwise.
 - .3 The Director may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Director may require that Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the construction employees clothing at all time while employees are at the institution.
 - .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
 - .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
 - .1 appear to be under the influence of alcohol, drugs or narcotics;
 - .2 behave in an unusual or disorderly manner; and
 - .3 are in possession of contraband.

- 1.5. VEHICLES
 - .1 All unattended vehicles on CSC property must have windows closed; fuel caps locked, doors and trunks locked and keys removed. The keys must be securely in the possession of the owner or an employee of the company that owns the vehicle.
 - .2 The director may limit at any time the number and type of vehicles allowed within the Institution.

- .3 Drivers of delivery vehicles for material required by the project will require security clearances and must remain with their vehicle the entire time that the vehicle is in the Institution. The director may require that these vehicles be escorted by Institutional staff or PWGSC Construction Escorts while in the Institution.
 - .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, the trailer doors must be locked at all times. All windows must be securely locked bars when left unoccupied. Cover all windows with expanded metal mesh. When not in use lock all storage trailers located inside and outside the perimeter. All storage trailers inside and outside the perimeter must be locked when not in use.
- 1.6. PARKING
- .1 The parking area(s) to be used by construction employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.
- 1.7. SHIPMENTS
- .1 To avoid confusion with the institution's own shipments, address all shipments of project material, equipment and tools in the Contractor's name and have a representative on site to receive any deliveries or shipments. CSC or PWGSC staff will NOT accept receipt of deliveries or shipments of any material equipment or tools for the contractor.
- 1.8. TELEPHONES
- .1 The installation of telephones, facsimile machines and computers with Internet connections is not permitted within the Institution perimeter unless prior approved by the Director.
 - .2 The Director will ensure that approved telephones, facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.
 - .3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, Blackberries, PDAs, telephone used as 2-way radios are not permitted within the Institution unless approved by the Director If wireless cellular telephones are permitted, the user will not permit their use by any inmate.
 - .4 The Director may approve but limit the use of 2-way radios.
- 1.9. WORK HOURS
- .1 Work hours within the Institution are: conform to Division.
 - .2 Work is not permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waived by the Director.

- 1.10. OVERTIME WORK
- .1 Conform to Division 1.
 - .2 Provide 48-hours advance notice to Director for all work to be performed after normal working hours of the Institution. Notify Director immediately if emergency work is required, such as to complete a concrete pour or make the construction site safe and secure.
- 1.11. TOOLS AND EQUIPMENT
- .1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required by the Institution.
 - .2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
 - .3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
 - .4 Store all tools and equipment in approved secure locations.
 - .5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor. Secure and lock scaffolding when not erected and when erected Secure in a manner agreed upon with the Institution designate.
 - .6 Report all missing or lost tools or equipment immediately to the Departmental Representative/Director.
 - .7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
 - .1 At the beginning and conclusion of every work day or shift upon entering and exiting the Institution.
 - .2 At any time when contractor is on Institution property.
 - .8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day. Maintain up to date inventory of all used blades/cartridges.
 - .9 If propane or natural gas is used for heating the construction, the institution will require that the contractor supervise the construction site during non-working hours.
- 1.12. KEYS
- .1 Security Hardware Keys:
 - .1 Arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO).
 - .2 The SMO will provide a receipt to the Contractor for security hardware keys.
 - .3 Provide a copy of the receipt to the Departmental Representative.

- .2 Other Keys:
 - .1 Use standard construction cylinders for locks for his use during the construction period.
 - .2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.
 - .3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:
 - .1 Prepare an operational keying schedule.
 - .2 Accept the operational keys and cylinders directly from the lock manufacturer.
 - .3 Arrange for removal and return of the construction cores and install the operational core in all locks.
 - .4 Upon putting operational security keys into use, the PWGSC construction escort will obtain these keys as they are required from the SMO and open doors as required by the Contractor. The Contractor shall issue instructions to his employees advising them that all security keys shall always remain with the PWGSC construction escort.
- 1.13. SECURITY HARDWARE
- .1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.
- 1.14. PRESCRIPTION DRUGS
- .1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one-day supply only into the Institution.
- 1.15. SMOKING RESTRICTIONS
- .1 Smoking is not permitted inside correctional facilities or outdoors within the perimeter of a correctional facility and persons must not possess unauthorized smoking items within the perimeter of a correctional facility.
 - .2 Persons in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist will be directed to leave the Institution.
 - .3 Smoking is permitted outside the perimeter of a correctional facility in an area designated by the Director.
- 1.16. CONTRABAND
- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.
 - .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.
 - .3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.

- .4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.
- 1.17. SEARCHES
- .1 All vehicles and persons entering institutional property may be subject to search.
 - .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband, he may order that person to be searched.
 - .3 All employees entering the Institution may be subject to screening of personal effects for traces of contraband drug residue.
- 1.18. ACCESS AND REMOVAL FROM INSTITUTION PROPERTY
- .1 Construction personnel and commercial vehicles will not be admitted to the institution after normal working hours, unless approved by the Director.
- 1.19. MOVEMENT VEHICLES
- .1 Construction vehicles are not to leave the Institution until an inmate count is completed. Escorted commercial vehicles will be allowed to enter or leave the institution through the vehicle access gate during the following hours:
 - .1 AM: 0745 hrs. to 1100 hrs.
 - .2 PM: 1300 hrs. to 1530 hrs.
 - .2 The contractor will advise the Director twenty-four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
 - .3 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or PWGSC construction escorts working under the authority of the Director.
 - .4 Commercial vehicles will only be allowed access to institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.
 - .5 Vehicles will be refused access to institutional property if, in the opinion of the Director, they contain any article which may jeopardize the security of the institution. Arrange with Director for parking of contractor=s vehicles at minimum security Institutions.
 - .6 Private vehicles of construction employees will not be allowed within the security wall or fence of medium or maximum-security institutions without the authorization of the Director.
 - .7 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.

- 1.20. MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY
- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.
 - .2 However, notwithstanding paragraph above, the Director may:
 - .1 Prohibit or restrict access to any part of the institution.
 - .2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when accompanied by a member of the CSC security staff or PWGSC Construction Escort Officer.
 - .3 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the Institution cafeteria and dining room.
- 1.21. SURVEILLANCE AND INSPECTION
- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
 - .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.
- 1.22. STOPPAGE OF WORK
- .1 The director may request at any time that the contractor, his employees, sub-contractors and their employees not enter or leave the work site immediately due to a security situation occurring within the Institution. The contractor's site supervisor will note the name of the staff member giving the instruction, the time of the request and obey the order as quickly as possible.
 - .2 The contractor shall advise the Departmental Representative of this interruption of the work within 24-hours.
- 1.23. CONTACT WITH INMATES
- .1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any employee doing any of the above will be removed from the site and his security clearance revoked.
 - .2 Digital cameras (or any other type) are not allowed on CSC property.
 - .3 Notwithstanding the above paragraph, if the director approves of the use of cameras, it is strictly forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this contract.

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

END OF SECTION

PART 1 GENERAL

- 1.1 RELATED SECTIONS
 - .8 Section 32 11 23 - Aggregate Base Courses.
 - .9 Section 32 11 16.01 - Granular Sub-Base.
- 1.2 REFERENCES
 - .1 Manual of Uniform Traffic Control Devices for Streets and Highways for Canada, Transportation Association of Canada.
 - .2 Traffic Control Manual for Work on Roadways, BC Ministry of Transportation.
- 1.3 PROTECTION OF PUBLIC TRAFFIC
 - .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
 - .2 Comply with most recent editions of the Traffic Control Manual for Work on Roadways published by the BC Ministry of Transportation and the Manual of Uniform Traffic Control Devices for Streets and Highways for Canada published by the Transportation Association of Canada.
 - .3 During progress of the Work, make adequate provision to accommodate normal traffic along roads and highways immediately adjacent to or crossing the works so as to cause minimum inconvenience to the general public.
 - .4 When working on travelled way:
 - .1 Place equipment in position to present minimum of interference and hazard to travelling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
 - .5 Do not close any lanes of road without prior approval of Departmental Representative. Before re- routing traffic erect suitable signs and devices in accordance with instructions reference manuals.
 - .6 Keep travelled way graded, free of pot holes and of sufficient width for required number of lanes of traffic.
 - .1 Provide minimum 7 m wide temporary roadway for traffic in two-way sections Through Work and on detours.
 - .2 Provide minimum 5 m wide temporary roadway for traffic in one-way sections through Work and on detours.
 - .7 As directed by Departmental Representative, provide gravelled detours or temporary roads to facilitate passage of traffic around restricted construction area:
 - .1 Place and compact granular sub-base in accordance with Section 32 11 16.01 - Granular Sub- base.
 - .2 Place and compact granular base in accordance with Section 32 11 23 Aggregate base Courses.

- .8 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas as indicated, unless other means of road access exist that meet approval of Departmental Representative.
- 1.4 INFORMATIONAL AND WARNING DEVICES
- .1 Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response.
 - .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified reference manuals.
 - .3 Place signs and other devices in locations recommended in the reference manuals.
 - .4 Meet with Departmental Representative prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of Departmental Representative.
 - .5 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Removing or covering signs which do not apply to conditions existing from day to day.
- 1.5 CONTROL OF PUBLIC TRAFFIC
- .1 Provide competent flag persons, trained in accordance with, and properly equipped as specified in the reference manuals in following situations:
 - .1 When public traffic is required to pass working vehicles or equipment that block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .5 For emergency protection when other traffic control devices are not readily available.
 - .6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
 - .7 At each end of restricted sections where pilot cars are required.

- .8 Delays to public traffic due to contractor's operators: maximum 15 minutes.
 - .2 Where roadway, carrying two-way traffic, is restricted to one lane, for 24 hours each day, provide portable traffic signal system. Adjust, as necessary, and regularly maintain system during period of restriction. Signal system to meet requirements of the reference manuals.
- 1.6 OPERATIONAL REQUIREMENTS
- .1 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified and approved by Departmental Representative to protect and control public traffic.
 - .2 Maintain existing conditions for traffic crossing right-of-way.

END OF SECTION

PART 1

GENERAL

PSPCC Update on Asbestos Use

Effective April 1, 2016, all Public Works and Government Services Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit the use of asbestos-containing materials. Further information can be found at <http://www.tpsgc-pwgsc.gc.ca/comm/vedette-features/2016-04-19-00-eng.html>.

1.1. REFERENCES

- .1 Government of Canada:
 - .1 Canada Labour Code – Part II
 - .2 Canada Occupational Health and Safety Regulations.
- .2 National Building Code of Canada (NBC):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electric Code (as amended).
- .4 Canadian Standards Association (CSA) as amended:
 - .1 CSA Z797-2009 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes.
 - .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
 - .4 CSA Z1006-10 Management of Work in Confined Spaces.
 - .5 CSA Z462-Workplace Electrical Safety Standard.
- .5 National Fire Code of Canada 2010 (as amended):
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .6 American National Standards Institute (ANSI):
 - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .7 Province of British Columbia:
 - .1 Workers Compensation Act Part 3-Occupational Health and Safety.
 - .2 Occupational Health and Safety Regulation.

1.2. RELATED SECTIONS

- .1 Refer to the following current NMS sections as required:
 - .1 Section 01 01 50 General Instructions

1.3. WORKERS' COMPENSATION BOARD

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4. COMPLIANCE WITH REGULATIONS

- .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5. SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 01 50.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 10 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6. RESPONSIBILITY

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .2 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.
- .3 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.

- 1.7. HEALTH AND SAFETY COORDINATOR
 - .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
 - .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.
- 1.8. GENERAL CONDITIONS
 - .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
 - .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
 - .2 Secure site at night time or provide security guard as deemed necessary to protect site against entry.
- 1.9. PROJECT/SITE CONDITIONS
 - .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.
 - .3 Energized electrical services.
 - .4 Working from heights.
 - .5 Persons incarcerated in the federal institutional system.
- 1.10. UTILITY CLEARANCES
 - .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.
 - .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.
- 1.11. REGULATORY REQUIREMENTS
 - .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
 - .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.
- 1.12. WORK PERMITS
 - .1 Obtain specialty permit related to project before start of work.
- 1.13. FILING OF NOTICE
 - .1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.
 - .2 Provide copies of all notices to the Departmental Representative.

1.14. SITE SPECIFIC HEALTH AND SAFETY PLAN

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a Site-Specific Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations.
 - .3 Definition of responsibilities for project safety/organization chart for project.
 - .4 General safety rules for project.
 - .5 Job-specific safe work, procedures.
 - .6 Inspection policy and procedures.
 - .7 Incident reporting and investigation policy and procedures.
 - .8 Occupational Health and Safety Committee/Representative procedures.
 - .9 Occupational Health and Safety meetings.
 - .10 Occupational Health and Safety communications and record keeping procedures.
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work.
 - .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
 - .5 Identify personal protective equipment (PPE) to be used by workers.
 - .6 Identify personnel and alternates responsible for site safety and health.
 - .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

- 1.15. EMERGENCY PROCEDURES
- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative.
 - .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
 - .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.
 - .3 Work with hazardous substances.
 - .4 Underground work.
 - .5 Work on, over, under and adjacent to water.
 - .6 Workplaces where there are persons who require physical assistance to be moved.
 - .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
 - .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.
- 1.16. HAZARDOUS PRODUCTS
- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 01 50.
 - .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.
 - .3 Provide adequate means of ventilation in accordance with Section 01 01 50.
 - .4 The contractor shall ensure that the product is applied as per manufacturers recommendations.
 - .5 The contractor shall ensure that only pre-approved products are brought onto the work site in an adequate quantity to complete the work.

- 1.17. ASBESTOS HAZARD
 - .1 Carry out any activities involving asbestos in accordance with applicable Provincial Regulations.
 - .2 Removal and handling of asbestos will be performed as indicated in Division 2 specifications.

- 1.18. PCB REMOVALS
 - .1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.
 - .2 Remove, handle, transport and dispose of as indicated in Division 2 specifications.

- 1.19. REMOVAL OF LEAD CONTAINING PAINT
 - .1 All paints containing TCLP lead concentrations above 5 ppm are classified as hazardous.
 - .2 Carry out demolition activities involving lead-containing paints in accordance with applicable provincial regulations.
 - .3 Work with lead containing paints shall be completed as per provincial and federal regulations.

- 1.20. ELECTRICAL SAFETY REQUIREMENTS
 - .1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
 - .1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.
 - .2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

- 1.21. ELECTRICAL LOCKOUT
 - .1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.
 - .3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.
- 1.22. OVERLOADING
- .1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.
- 1.23. FALSEWORK
- .1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003).
- 1.24. SCAFFOLDING
- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 Code of Practice for Access Scaffold and BC Occupational Health and Safety Regulations.
- 1.25. CONFINED SPACES
- .1 Carry out work in confined spaces in compliance with Provincial regulations.
- 1.26. POWER-ACTUATED DEVICES
- .1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.
- 1.27. FIRE SAFETY AND HOT WORK
- .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
 - .2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.
- 1.28. FIRE SAFETY REQUIREMENTS
- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.
 - .3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the Departmental Representative is required prior to any gas or diesel tank being brought onto the work site.

- 1.29. FIRE PROTECTION AND ALARM SYSTEM .1 Fire protection and alarm systems shall not be:
- .1 Obstructed.
 - .2 Shut off.
 - .3 Left inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.
- 1.30. UNFORESEEN HAZARDS .1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.
- 1.31. POSTED DOCUMENTS .1 Post legible versions of the following documents on site:
- .1 Health and Safety Plan.
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Notice of Project.
 - .6 Floor plans or site plans. Must be posted in a non-inmate access area and locked up when not being used.
 - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
 - .9 Material Safety Data Sheets (MSDS).
 - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
- .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.
- 1.32. MEETINGS .1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

- 1.33. CORRECTION OF NON-COMPLIANCE
- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
 - .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
 - .3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

PART 2 – PRODUCTS

- 2.1 NOT USED

PART 3 – PRODUCTS

- 3.1 NOT USED

END OF SECTION

PART 1

GENERAL

- | | |
|--|--|
| 1.1. RELATED SECTIONS | .1 Section 01 01 50 – General Instructions. |
| 1.2. DEFINITIONS | <p>.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.</p> <p>.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.</p> |
| 1.3. SUBMITTALS | <p>.1 The contractor shall prepare an Erosion and Sediment Control Plan.</p> <p>.2 Submittals: in accordance with Section 01 01 50 – General Instructions.</p> |
| 1.4. FIRES | <p>.1 Fires and burning of rubbish on site not permitted.</p> |
| 1.5. DISPOSAL OF WASTES | <p>.1 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.</p> <p>.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.</p> <p>.3 Safely dispose of wet concrete and pipe grout off-site in accordance with Municipal, Provincial and Federal authorities' requirements.</p> |
| 1.6. EROSION AND SEDIMENT CONTROL/DRAINAGE | <p>.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust that complies with the most stringent requirements of the authorities having jurisdiction.</p> <p>.2 The Erosion and Sediment control plan shall be prepared and submitted for the Departmental Representative a minimum of 1 week prior to the start of construction and implemented during construction. The plan shall follow the recommendations of the Land Development Guidelines for the Protection of Aquatic Habitat (Fisheries and Ocean Canada and BC Ministry of Environment, Lands and Parks, 1992) and A Users Guide to Working In and Around Water (BC Ministry of Environment 2005). The plan shall include both structural and non-structural Best Management Practices.</p> |

- .3 The Erosion and Sediment Control plan shall consist of two key components:
 - .1 Effectiveness monitoring of the mitigation measures to ensure they are functioning as intended.
 - .2 Water quality monitoring, which shall further confirm whether Erosion and Sediment control measures are functioning adequately as well as intended and ensuring that impacts to aquatic life/habitat are minimized. Water quality monitoring shall follow the parameters outlined in British Columbia's Ambient Water Quality Guideline (Criteria) for Turbidity, Suspended, and Benthic Sediments.
- .4 The Contractor shall retain an independent qualified Environmental Consultant to prepare an Erosion and Sediment Control (ESC) plan and completed the monitoring. The ESC supervisor shall provide weekly reports to the Departmental Representative until permanent vegetation has been established and the ESC Supervisor has signed off on removal of the works.
- .5 The contractor shall inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .6 The Erosion and Sediment Control Plan shall be signed and sealed by a Professional Engineer registered in the Province of British Columbia.
- .7 All work shall be undertaken and completed in such a manner as to prevent the release of sediment, silt, or sediment laden water, concrete or concrete leachate or any other deleterious substance into any ditch or water course.
- .8 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- .9 The contractor shall keep all portions of the work drained during construction until completion. Where necessary, catch water ditch shall be constructed along the tops of excavations or fill slopes to prevent water flowing into or over the excavated or filled area. The contractor will be responsible for the repair for the damage, directly resulting for their operations and for the removal or dirt or debris from existing system, which may be caused by or which may result from water backing up or overflowing through, from, or along any part of the work or adjacent properties. The contractor shall bear all costs associated with these repairs until works are complete and accepted by the Departmental Representative.

- .10 The contractor shall modify and/or provide additional silt control measures as necessary to accommodate construction activities and satisfy the requirements of the governing agencies.
 - .11 The contractor shall maintain all silt control facilities on an as-needed basis.
 - .12 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
 - .13 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- 1.7. SITE CLEARING AND PLANT PROTECTION
- .1 Protect trees and plants on site and adjacent properties where indicated.
 - .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2m.
 - .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
 - .4 Minimize stripping of topsoil and vegetation.
 - .5 Restrict tree removal to those indicated or designated by Departmental Representative.
- 1.8. WORK ADJACENT TO WATERWAYS
- .1 Rip rap and headwall installation are to be done at low tides and in dry conditions.
 - .2 Do not operate construction equipment in waterways.
 - .3 Do not use waterway beds for borrow material without approval of Departmental Representative.
 - .4 Do not dump excavated fill, waste material or debris in waterways.
 - .5 Design and construct temporary crossings to minimize erosion to waterways.
 - .6 Do not skid logs or construction materials across waterways.
 - .7 Avoid indicated spawning beds when constructing temporary crossings of waterways.
- 1.9. ENVIRONMENTALLY SENSITIVE HABITAT
- .1 The Contractor shall avoid all disruption to these areas.

- 1.10. POLLUTION CONTROL
- .1 Maintain temporary erosion and pollution control features installed under this contract.
 - .2 Control emissions from equipment and plant to local authorities' emission requirements.
 - .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area, by providing temporary enclosures.
 - .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- 1.11. SITE RESTORATION OF VEGETATED AREAS
- .1 All disrupted areas to be restored to match existing conditions.
 - .2 In vegetated areas, restoration shall include 100mm of topsoil and native vegetation to match existing.
 - .3 Supply and plant native vegetation approved by Departmental Representative in all vegetated areas disrupted by the construction.
 - .4 Acceptable grass seeds mixtures shall be limited to the following native varieties: Creeping Red Fescue, Bromus sitchensis, Elymus Glaucus, and Agrostis exarata. Legumes shall be inoculated.
 - .5 The contractor shall provide the seed mixture to the Departmental Representative for acceptance prior to seeding.
- 1.12. NOTIFICATION
- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
 - .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
 - .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
 - .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

END OF SECTION

PART 1

GENERAL

- 1.1. RELATED SECTIONS .1 Section 01 01 50 – General Instructions.
- 1.2. SUBMITTALS .1 Submittals: in accordance with Section 01 01 50 – General Instructions.
 - .2 Copy will be returned after final inspection with Departmental Representative comments.
 - .3 Revise content of documents as required prior to final submittal.
 - .4 Furnish evidence, for type, source and quality of products provided.
 - .5 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
 - .6 Pay costs of transportation.
 - .7 Submit to Departmental Representative, 4 final copies of all test reports completed for this project including compaction tests, granular material gradations, pipeline pressure tests, watermain certifications, a minimum 2 weeks prior to Substantial Performance of the Work.
- 1.3. FORMAT .1 Organize data as instructional manual.
 - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279mm with spine and face pockets.
 - .3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
 - .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .5 Arrange content by process flow, under Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .7 Text: manufacturer's printed data, or typewritten data.
 - .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- 1.4. CONTENTS – EACH VOLUME .1 Table of Contents: provide title of project:
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.

- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 01 50 – Quality Control.

1.5. AS-BUILTS

- .1 Maintain, in addition to requirements in General Conditions, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.6. RECORDING ACTUAL SITE
CONDITIONS

- .1 Record information on set of blue line, opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections to provide certification that all works have been completed as specified and that works are ready for tie-in.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .3 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .4 Acronyms:
 - AFD - Alternate Forms of Delivery, service provider.
 - BMM - Building Management Manual.
 - Cx - Commissioning.
 - EMCS - Energy Monitoring and Control Systems.
 - O&M - Operation and Maintenance.
 - PI - Product Information.
 - PV - Performance Verification.
 - TAB - Testing, Adjusting and Balancing.
- .5 Provide third party commissioning agent(s) for mechanical and electrical systems. Provide costs of commissioning in tender price.
- .6 Refer to sections of Mechanical, Electrical and Communications disciplines for specific requirements

1.2 GENERAL

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

1.3 COMMISSIONING OVERVIEW

- .1 Cx Agent:
 - .1 Hired and paid for by the Contractor.
 - .2 Responsibilities:
 - .1 Plan, coordinate, and carry out the Cx process.
 - .2 Develop Cx plan and Cx check forms (component, system and integrated system verification).
 - .3 Undertakes the component, system and integrated system performance verification testing and commissioning.
 - .4 Plans and carry out equipment demonstration and acceptance tests.
 - .5 Complete all Cx verification documentations.
 - .6 Chair Cx meetings.
- .2 Cx to be a line item of Contractor's cost breakdown.
- .3 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .5 Commissioning work to be completed prior Contractor's request for Substantial Performance:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system(s), including related systems as deemed required by Departmental Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to Departmental Representative.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 . During Construction:
 - .1 Coordinate provision, location and installation of provisions for Cx.

- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Departmental Representative.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

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

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 01 50 – General Instructions.
- .2 Submit immediately after award of Contract:
 - .1 Name of Contractor's Cx Agent.
- .3 Submit no later than 4 weeks after award of Contract:
 - .1 Draft Cx documentation.
 - .2 Preliminary Cx schedule.
- .4 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 2 weeks prior to start of Cx.
- .5 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 2 weeks prior to start of Cx.
- .6 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Provide the following verification check sheets.
 - .1 Installation Check Lists and Product Information (PI) forms.
 - .2 Performance Verification (PV) forms.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

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

1.10 COMMISSIONING MEETINGS

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

1.11 QUALITY ASSURANCE

- .1 Testing organization: current member in good standing of AABC certified to perform specified services.
- .2 Comply with applicable procedures and standards of the certification sponsoring association.
- .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.12 REFERENCES

- .1 Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation, Total Systems Balance, Air Distribution-Hydratics Systems.

1.13 SUBMITTALS

- .1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.
 - .1 Submit documentation to confirm organization compliance with quality assurance provision.
- .2 Submit 3 preliminary specimen copies of each of report forms proposed for use.
- .3 Ten (10) days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

- .4 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.14 PROCEDURES

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Notify Departmental Representative 3 days prior to beginning of operations.
- .3 Accurately record data for each step.
- .4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

1.15 CONTRACTOR'S RESPONSIBILITIES

- .1 Prepare each system for testing and balancing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.
- .5 Commission cost to be borne by Contractor.

1.16 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations.
- .2 Make instruments available to Departmental Representative to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.
- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify lighting is turned on when lighting is included in cooling load.
- .6 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

1.17 FINAL REPORTS

- .1 Organization having managerial responsibility shall make reports.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.
- .3 Identify each instrument used, and latest date of calibration of each.

1.18 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx deliverables have been submitted and accepted by Departmental Representative.

END OF SECTION

PART 1

GENERAL

1.1. SECTION INCLUDES

.1 Methods for removal of existing asphalt pavement.

PART 2 – EXECUTION

2.1 PROTECTION

.1 Protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of Departmental Representative at no additional cost.

2.2 REMOVAL

- .1 Remove existing asphalt pavement to lines and grades as established by in field.
- .2 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .3 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.
- .4 Provide for suppression of dust generated by removal process.

2.3 SWEEPING

.1 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.

END OF SECTION

PART 1

GENERAL

- 1.1. RELATED SECTIONS
 - .1 Section 01 01 50 – General Instructions.
 - .2 Section 03 30 00 – Cast-In-Place Concrete.
 - .3 Section 33 05 13 – Manhole Structures.

- 1.2. REFERENCES
 - .1 American Concrete Institute (ACI):
 - .1 SP-66, ACI Detailing Manual 2004.
 - .2 ACI 315, Details and Detailing of Concrete Reinforcement.
 - .3 ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - .2 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A 143/A 143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .2 ASTM A 185/A 185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM A 497/A 497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - .4 ASTM A 775/A 775M, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .3 Canadian Standards Association (CSA International):
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-A23.3, Design of Concrete Structures.
 - .3 CAN/CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.
 - .4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles, A National Standard of Canada.
 - .6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .4 Reinforcing Steel Institute of Canada (RSIC).
 - .1 RSIC, Reinforcing Steel Manual of Standard Practice.

- 1.3. SUBMITTALS
 - .1 Submittals in accordance with Section 01 01 50 – General Instructions.
 - .2 Submit shop drawings consisting of bar bending details, lists and placing drawings.

- .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and mechanical splices, with identifying code marks to permit correct placement with reference to structural drawings. Indicate sizes, spacing, and location of chairs, spacers and hangers. Drawings to be prepared in accordance with ACI315R, Manual of Contract Administrating and Place Drawing for Reinforced Concrete Structures.
- .4 Detail lap lengths and bar development length to CAN3-A23.3. Provide required tension lap splices.
- .5 Substitution of different size bars permitted only upon written approval of Departmental Representative.

PART 2

PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade as specified on contract drawings deformed bars to CAN/CSA-G30.12, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.16.
- .4 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .5 Deformed steel wire for concrete reinforcement: to CSA G30.14.
- .6 Welded deformed steel wire fabric: to CSA G30.15. Provide in flat sheets only.
- .7 Epoxy Coating of non-prestressed reinforcement: to ASTM A775/A775M.
- .8 Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610 g/m².
- .9 Chairs, bolsters, bar supports, spacers: to CSA-A23.1.
- .10 Mechanical splices: subject to approval of Departmental Representative.

- 2.2 FABRICATION
- .1 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
 - .2 Fabricate reinforcing in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and ACI 315R Manual of Contract Administration and Placing Drawings for Reinforced Concrete Structures.
 - .3 Upon Departmental Representative's approval for locations of reinforcement splices other than shown of placing drawings.
 - .4 Obtain Departmental Representative's approval, weld reinforcement in accordance with CSA W186.
- 2.3 SOURCE QUALITY CONTROL
- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
 - .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

PART 3

EXECUTION

- 3.1 FIELD BENDING
- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
 - .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
 - .3 Replace bars, which develop cracks or splits.
- 3.2 PLACING REINFORCEMENT
- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
 - .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- 3.3 FIELD TOUCH-UP
- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION

PART 1

GENERAL

1.1. RELATED SECTIONS

1. Section 03 20 00 – Concrete Reinforcing.
2. Section 31 23 33.01 – Excavating, Trenching and Backfilling.
3. Section 33 05 13 – Manhole Structures.
4. Section 33 11 16 – Watermains.

1.2. REFERENCES

1. American Society for Testing and Materials International (ASTM):
 - .1 ASTM C 260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C 330, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - .4 ASTM C 494/C 494M, Standard Specification for Chemical Admixtures for Concrete.
 - .5 ASTM C 1017/C 1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .6 ASTM D 412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .7 ASTM D 624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .8 ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 - .9 ASTM D 1752, 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-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Damp-proofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
3. Canadian Standards Association (CSA International):
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

- .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
 - .3 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - 1. CSA-A3001, Cementitious Materials for Use in Concrete.
- 1.3. DESIGN REQUIREMENTS
- 1. Alternative 1 – Performance: in accordance with CSA-A23.1/A23.2, and as described in MIXES of PART 2 – PRODUCTS.
- 1.4. QUALITY ASSURANCE
- 1. Quality Assurance: in accordance with Section 01 01 50 – General Instructions.
 - 2. Contractor to pay for an independent testing agency to complete concrete tests.
 - 3. Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety Requirements.
- 1.5. DELIVERY, STORAGE AND HANDLING
- 1. Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
 - .1 Modifications to maximum time limit must be agreed to Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 The Departmental Representative has full authority to refuse concrete that has exceeded maximum acceptable hauling time of 120minutes without approval of concrete producer.
 - .3 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
 - .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Departmental Representative.
 - .5 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .6 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial and National regulations.

PART 2

PRODUCTS

2.1 MATERIALS

1. Cement: to CAN/CSA-A3001, Type GU.
2. Water: to CSA-A23.1.
3. Aggregates: to CAN/CSA-A23.1/A23.2.
4. Admixtures:
 - .1 Air entraining admixture: to ASTM C 260.
5. Grout:
 - .1 Cell-Crete™ or approved equivalent.

2.2 MIXES

1. Alternative 1 – Performance Method for specifying concrete: to meet Departmental Representative performance criteria in accordance with CAN/CSA-A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 – VERIFICATION.
 - .2 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure: C-1.
 - .2 Minimum compressive strength at 28 days age: 35 MPa.
 - .3 Surface texture: steel trowel finish.

PART 3

EXECUTION

3.1 PREPARATION

1. Obtain Departmental Representative's approval before placing concrete.
 - .1 Provide 48-hours' notice prior to placing of concrete.
2. Place concrete reinforcing in accordance with Section 03 20 00 – Concrete Reinforcing.
3. During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
4. Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
5. Protect previous Work from staining.
6. Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

- 3.2 CONSTRUCTION
 - 1. Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.
- 3.3 SURFACE TOLERANCE
 - 1. Concrete tolerance in accordance with CSA-A23.1/A23.2 straightedge method.
- 3.4 FIELD QUALITY CONTROL
 - 1. Site tests: conduct following test in accordance with Section 01 01 50 – Quality Control and submit report as described in PART 1 – SUBMITTALS.
 - .1 Slump tests.
 - 2. Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review in accordance with CSA-A23.1/A23.2.
 - .1 Ensure testing laboratory is certified in accordance with CSA A283.
 - 3. Non-Destructive Methods for Testing Concrete: in accordance with CSA-A23.1/A23.2.
 - 4. Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.
- 3.5 VERIFICATION
 - 1. Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in PART 2 – Products, by Departmental Representative and provide verification of compliance as described in PART 1 – QUALITY ASSURANCE.

END OF SECTION

PART 1

GENERAL

1.1. GENERAL

- .1 This specification is NOT to be used for any structural facilities such as buildings, bridges, retaining wall, or similar structure requiring site specific structural engineering design.
- .2 Except where specifically stated otherwise, all materials and methods in this Section conform to requirements of the latest version of CAN/CSA-A23.1.

1.2. REFERENCES

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A 185/A 185M-[05a], Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM A 775/A 775M-[04a], Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .3 ASTM C 260-[01], Standard Specification for Air-Entraining Admixtures for Concrete.
 - .4 ASTM D 412-[98a(2002)e1], Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - .5 ASTM D 2240-[05], Standard Test Method for Rubber Property – Durometer Hardness.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.40-[97], Anticorrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-[99], Ready Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International):
 - .1 CSA-A23.1/A23.2-[2004], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-A23.3-[04], Design of Concrete Structures.
 - .3 CSA-A23.4-[05], Precast Concrete – Materials and Construction.
 - .4 CAN/CSA-A3000-[03], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-[03], Cementitious Materials for Use in Concrete.
 - .5 CAN/CSA-G30.18-[M92(R2002)], Billet-Steel Bars for Concrete Reinforcement.
 - .6 CAN/CSA-G40.20/G40.21-[2004], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .7 CAN/CSA-G164-[M92(R2003)], Hot Dip Galvanizing of Irregularly Shaped Articles.

- .8 CAN/CSA-S6-[2005], Canadian Highway Bridge Design Code.
- .9 CSA-W47.1-[03], Certification of Companies for Fusion Welding for Steel.
- .10 CAN/CSA W48-[01(R2006)], Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
- .11 CSA-W59-[03], Welded Steel Construction (Metal Arc Welding) (Metric version).
- .12 CSA-W186-[M1990(R2002)], Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 The Master Painters Institute (MPI) – Architectural Painting Specification Manual (ASM) – [February 2004]
 - .1 MPI # 18, Organic Zinc Rich Primer.
 - .2 MPI # 23, Oil Alkyd Primer.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- 1.3. DESIGN REQUIREMENTS
 - .1 Design precast elements to carry loads specified as indicated in accordance with applicable codes. All pre-cast elements to carry H20 traffic loading.
- 1.4. SUBMITTALS
 - .1 Submittals in accordance with Section 01 01 50-General Instructions.
- 1.5. QUALIFICATIONS
 - .1 Fabricate and erect precast concrete elements by manufacturing plant certified in appropriate category according to CSA-A23.4
 - .2 Precast concrete manufacturer to be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting bid and to specifically verify that plant is currently certified in appropriate category.
 - .3 Only precast elements fabricated in such certified plants to be acceptable to Departmental Representative and plant certification to be maintained for duration of fabrication, erection until warranty expires.
 - .4 Welding companies certified to CSA-W47.1.
- 1.6. DELIVERY, STORAGE AND HANDLING
 - .1 Deliver, handle and store precast/prestressed units according to manufacturer's instructions.

PART 2

PRODUCTS

- 2.1 MATERIALS
 - .1 Precast concrete units to be constructed in accordance with CAN/CSA-A23.1 unless stated otherwise.

PART 3

EXECUTION

3.1 GENERAL

- .1 Install precast concrete unit, including surface tolerances, finishing and field quality control, in accordance with Contract Drawings.
- .2 Protection, storage and handling of pre-cast concrete units to Manufacture's recommendation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 01 50 – General Instructions.
- .2 Section 21 13 13 – Wet Pipe Sprinklers Systems.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 01 50 – General Instructions.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.
- .3 Shop drawings to show:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of Anchorage
 - .4 Supports
 - .5 Accessories
 - .6 Certification of compliance to applicable codes.
- .4 Closeout Submittals:
 - .1 Provide in accordance with Section 01 01 50 – General Instructions.
 - .2 As-Built drawings:
 - .1 Provide in accordance with Section 01 01 50 – General Instructions
 - .2 Submit to Departmental Representative for approval and make corrections as directed.
 - .3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .3 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 01 50 – General Instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

- .1 All hangers and supports shall conform to the appropriate NFPA and local jurisdiction standards.

2.2 MISCELLANEOUS METALS RELATED TO FIRE PROTECTION SYSTEM

- .1 All miscellaneous metal related to the fire protection systems including all metal back up plates and supports for all ceiling or wall supported equipment is part of this section of the work.

PART 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Division 9 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CORE DRILLING

- .1 Arrange and pay for the cost of all core drilling for the fire protection work under Division 21.
- .2 Verify the location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting. Coring and cutting of structural building components shall only take place upon the receipt of specific written approval of the structural engineer. Repairs to existing services damaged as a result of core drilling is included in this section of the work.
- .3 Penetrations up to 150 mm [6"] nominal pipe size in precast concrete may be cored on site by fire protection contractor. Larger penetrations shall be located and arranged for in precast work with precast manufacturer prior to shipping to construction site.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct tests in accordance with Section 01 01 50 – General Instructions and Section 21 13 13_Wet Pipe Sprinkler System, and submit report to Departmental Representative.
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work.

3.4 TESTS AND INSPECTION

- .1 Furnish all labour, materials, instruments, etc. necessary for all required tests. All work shall be subject to inspection by the Engineer of Record, local plumbing inspector or design authority. At least forty-eight (48) hours notice shall be given in advance of making the required tests.
- .2 Tests on Fire Protection systems shall consist of pressure tests and shall conform to standards of Inspection Authority as listed in separate clauses of this section of specification.
- .3 Responsibility for completing "Contractor's Materials and Test Certificate" in accordance with inspection authority test procedure is included in this section.

3.5 SEISMIC RESTRAINT SYSTEMS

- .1 Include the design, supply, and installation of seismic restraint systems for all fire protection equipment, piping including all necessary engineering, labour, materials and incidentals for the work involved.

3.6 LETTER OF ASSURANCE

- .1 Provide signed and sealed Letters of Assurance, as required by the Authority having Jurisdiction, taking responsibility for:
 - .1 Structural capacity of sprinkler components, including anchorage and seismic restraint;
 - .2 Continuity of fire separations at fire sprinkler locations.
 - .3 Structural capacity of storage tanks including anchorage and seismic restraints.
 - .4 Provide records of site visits and corrective actions taken as a result thereof.
 - .5 Provide these Letters of Assurance sealed by a Registered Professional Engineer for "Assurance of Professional Design and Commitment for Field Review" prior to shop drawing review and for "Assurance of Field Review and Compliance", prior to request for substantial completion.

3.7 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 01 50 – General Instructions
- .2 Section 21 05 05 – Common Work Results for Fire Suppression

1.2 REFERENCES

- .1 Perform work in accordance with the following:
 - .1 ANSI/NFPA 13, Installation of Sprinkler Systems
 - .2 NFPA 25, Inspection, Testing, and Maintenance of Water-based Fire Protection Systems.
 - .3 BC Building Code
 - .4 BC Fire Code

1.3 SCOPE OF WORK

- .1 Contractor is responsible for complete installation of fire protection system valves, excess pressure pump, Alarm Check valves along with piping and to meet all requirements of the referenced codes in accordance with the specifications and drawings.
- .2 Allow for fire watch during sprinkler system renovation.
- .3 Contractor is responsible for completing full and complete as-builts to the requirements of NFPA 13 for “Working Plans.” As-builts shall be prepared using AutoCAD.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 01 50 – General Instructions and in accordance with ANSI/NFPA 13, working plans and design requirements.
- .2 Submit shop drawings for the following:
 - .1 Piping and joining method.

1.5 ENGINEERING DESIGN CRITERIA

- .1 Design system in accordance with ANSI/NFPA 13.
 - .1 To suit occupancy.
 - .2 Pipe size and layout.

1.6 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.7 SEISMIC RESTRAINT

- .1 Provide seismic restraint in accordance with current BCBC.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA 13. Minimum Sch.40 for threaded joints and minimum Sch.10 for roll groove joints.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: screwed, welded, flanged, roll grooved.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Up to 50mm (NPS 2): bronze, screwed or grooved ends. Ball or butterfly valves.
 - .3 65mm (NPS 2½) and over: cast iron flanged or roll grooved ends, indicating butterfly valve.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services.

2.2 SIGNS

- .1 Attach properly lettered and approved metal signs to each valve and alarm device to ANSI/NFPA 13.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.
- .2 All grooved end valves, fittings and couplings etc. shall be of one manufacturer. Contractor to provide proof of completion of installation training by grooved mechanical coupling manufacturer or manufacturer's representative on site prior to start of construction.
- .3 Pipe Installation:
 - .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
 - .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
 - .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
 - .4 Inspect piping before placing into position.
 - .5 All welding shall be performed off site using welding fittings. Field welding is not permitted.
 - .6 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.

- .7 Arrange piping routing to provide sufficient access to mechanical and electrical equipment.
- .8 A wrap around hanger or other approved means shall be provided at the end of each branch sprinkler line to prevent excessive movement.
- .4 Flow Switches:
 - .1 Install flow switches with a tight pipe drain connection to open discharge outside the building at grade level or other acceptable discharge point as approved by the Engineer.
 - .2 Install a 25 mm [1"] flow switch test drain valve with a 25 mm [1"] brass ball plug. Immediately downstream of flow switch for each flow switch. This is in addition to the normal inspector's test connections required by NFPA.
 - .3 Locate flow switches where shown.
- .5 Supervisory Switches - Valves:
 - .1 Install supervisory switches on all valves supplying the sprinkler and standpipe system inside the building. Switches shall be compatible with the valve supervised.
- .6 Provide inspector's test valves and pipes at all remote points in the system.
- .7 Flanged fittings shall be used at valve stations and at fire department connections.
- .8 Install monitored valves and flow switches for all zones. Electrical Division shall wire monitored valves and flow switches to the central fire alarm system. Identify which portion of the system each valve controls.
- .9 Protection of Electrical Equipment from Water:
 - .1 Responsibility for water damage to electrical equipment from the sprinkler system installation whether due to testing or leakage shall be the responsibility of this section.
 - .2 Provide and install in this section of the work minimum 20-gauge metal protective hoods, individually located over all electrical equipment susceptible to water damage upon release of sprinkler heads in electrical areas. Such electrical equipment shall include all transformers and all equipment with ventilation grilles that will allow water entry into the electrical equipment. Protective hoods shall be sloped to allow shedding for water, shall project horizontally beyond the equipment perimeter and shall not be mounted on the equipment unless prior approval is obtained from the electrical authorities. Holes through protective hoods shall be sealed watertight.

3.3 FLUSHING

- .1 Provide flushing connections on all sprinkler systems.
- .2 Flush all underground mains and Siamese supply lines before connecting to sprinkler systems.
- .3 Flush all pipelines so effluent is clear and free of debris.
- .4 Rate of flushing flows shall be as per NFPA 13 requirements.
- .5 Provide proper drainage for this flushing operation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 01 50 – General Instructions.
- .2 Section 01 91 00 – Commissioning.

1.2 REFERENCES

- .1 National Building Code Canada 2015
- .2 National Plumbing Code Canada 2015
- .3 Authority Having Jurisdiction
- .4 ULC and FM Standards for applicable products

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 01 50 General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all plumbing equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves, where applicable.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 01 50 General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all plumbing equipment for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems where applicable.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.

- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports where applicable.
- .5 Approvals:
 - .1 Submit two hard copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative. PDF draft copy may be submitted for review if agreed upon by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide one set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-built (as-constructed) drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED"
(Signature of Contractor) (Date).

- .3 Submit to Departmental Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing using as-built drawings.
- .5 Submit completed reproducible as-built drawings (hardcopy, CAD and PDF) with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 01 50 General Instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect products from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

PART 2 PRODUCTS

2.1 SECURITY FASTENERS

- .1 Fasteners used in areas accessible by inmates shall be TORX with pin, stainless steel screws, which require a special tool to remove the fasteners. Use fasteners compatible with material through which they pass.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that existing conditions are acceptable for connection to new materials to be installed within this contract.
 - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION FOR PLUMBING EQUIPMENT

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

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all plumbing equipment.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct operational tests and submit report as described in Section 01 01 50 General Instructions.

3.5 COMMISSIONING

- .1 Test and verify operation of each fixture, valve, and electrically controlled device in accordance with Section 01 91 00 Commissioning.

3.6 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing. Random equipment will be tested.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Perform in accordance with Section 01 01 50 General Instructions.

3.7 CLEANING

- .1 Clean in accordance with Section 01 01 50 General Instructions.
 - .1 Progress Cleaning: 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 01 50 General Instructions.

3.8 WASTE MANAGEMENT

- .1 Separate waste materials for recycling in accordance with Section 01 01 50 General Instructions.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

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

3.10 SEISMIC RESTRAINT SYSTEMS

- .1 Include the design, supply, and installation of seismic restraint systems for all fire protection equipment, piping including all necessary engineering, labour, materials and incidentals for the work involved.

- 3.11** LETTER OF ASSURANCE
- .1 Provide signed and sealed Letters of Assurance, as required by the Authority having Jurisdiction, taking responsibility for:
 - .1 Structural capacity of plumbing components, including anchorage and seismic restraint;
 - .2 Continuity of fire separations at plumbing locations.
 - .3 Structural capacity of storage tanks including anchorage and seismic restraints.
 - .4 Provide records of site visits and corrective actions taken as a result thereof.
 - .5 Provide these Letters of Assurance sealed by a Registered Professional Engineer for "Assurance of Professional Design and Commitment for Field Review" prior to shop drawing review and for "Assurance of Field Review and Compliance", prior to request for substantial completion.

END OF SECTION

PART 1 GENERAL

- 1.1 SECTION INCLUDES**
 - .1 Bases, pads, hangers and supports for piping.
- 1.2 RELATED SECTIONS**
 - .1 Section 01 01 50 – General Instructions.
- 1.3 REFERENCES**
 - .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2016, Power Piping.
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-96(2013)e1, Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- 1.4 SYSTEM DESCRIPTION**
 - .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 and ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
 - .2 Performance Requirements:
 - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events as specified Section 23 05 49 - Seismic Restraint.
- 1.5 SUBMITTALS**
 - .1 Submittals: in accordance with the Submittal Procedure requirements in Section 01 01 50 General Instructions.
 - .2 Submit all information and data in both printed paper format and PDF electronic format.
 - .3 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.

- .4 Quality Control Check Sheets
- .5 Closeout Submittals: Provide all applicable close-out submittals per Section 01 01 50 General Instructions.
- 1.6 QUALITY CONTROL**
 - .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .2 Check sheets to include the following information:
 - .1 Pipe or ductwork system
 - .2 Equipment number, make and model, including weights
 - .3 Pipe support type and spacing
 - .4 Pipe support finish (corrosion protection, painted)
 - .5 Details of pipe attachment to structure
 - .6 Hanger details at pipe insulation (where applicable and specified)
 - .7 Comments on seismic installation

PART 2 PRODUCTS

- 2.1 GENERAL**
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.
 - .2 Provide insulation protection saddles on all insulated piping.
 - .3 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.
 - .4 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.
 - .5 Support from (top of) structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.
 - .6 Do not suspend from metal deck.
- 2.2 VARIABLE SUPPORT SPRING HANGERS**
 - .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
 - .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
 - .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
 - .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

- 2.3** WALL SUPPORTS
 - .1 Horizontal and Vertical pipe adjacent to wall.
 - .1 Exposed pipe wall support for lateral movement restraint.
 - .2 Galvanized or other non-corrosive finish.
 - .3 Channel type support
 - .4 Angle iron wall brackets (galvanized or other non corrosive finish) with specified hangers.
- 2.4** FLOOR SUPPORTS
 - .1 Horizontal pipe.
 - .1 Do not support piping from the floor unless specifically indicated.
 - .2 Vertical pipe.
 - .1 Mid-point of risers between floor slabs - adjustable fabricated steel supports.
- 2.5** EQUIPMENT SUPPORTS
 - .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.
- 2.6** EQUIPMENT ANCHOR BOLTS AND TEMPLATES
 - .1 Provide templates to ensure accurate location of anchor bolts.
- 2.7** OTHER EQUIPMENT SUPPORTS
 - .1 Fabricate equipment supports from structural grade steel

PART 3 EXECUTION

- 3.1** MANUFACTURER'S INSTRUCTIONS
 - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2** INSTALLATION
 - .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
 - .2 Vibration Control Devices:
 - .1 Install on piping systems at plumbing fixtures and as indicated.
 - .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Cast iron pipes: install below joint.
 - .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
 - .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

- .6 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25% of total load.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation of thermal insulation for plumbing piping.

1.2 RELATED SECTIONS

- .1 Section 01 01 50 – General Instructions.
- .2 Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C449/C449M-07(2013), Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C547-15, Standard Specification for Mineral Fiber Pipe Insulation.
 - .4 ASTM E814-13a(2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
- .2 National Building Code of Canada
 - .1 NBCC-2015
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R2015).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S115-11(R2016), Standard Method of Fire Tests of Firestop Systems
 - .3 CAN/ULC-S702-14, Standard for Mineral Fibre Thermal Insulation for Buildings

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 01 50 General Instructions.
- .2 Submit following shop drawing information:
 - .1 Pipe insulation: manufacturer's catalogue literature
 - .2 Installation requirements
 - .3 Schedule of all piping systems and proposed insulation types, thicknesses and finishes.

1.6 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 01 50 General Instructions.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 01 50 General Instructions.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 or ASTM C547.
 - .2 Maximum "k" factor: to CAN/ULC-S702.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

- 2.6** INDOOR VAPOUR RETARDER FINISH
- .1 Vinyl emulsion type acrylic, compatible with insulation.
- 2.7** OUTDOOR VAPOUR RETARDER FINISH
- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².
- 2.8** JACKETS
- .1 Not applicable.
- 2.9** FIRE STOPPING AND SMOKE SEAL MATERIALS
- .1 References:
- .1 CAN4-S115-M, Standard Method of Fire Tests of Firestop Systems.
- .2 ASTM E814 Standard Method of Fire Tests and Through-Penetration Firestops.
- .3 1997 Certifications Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
- .4 Underwriters Laboratories of Canada. Listing of Equipment and Materials Vol. 3 Fire Resistance Ratings -Revision 4/95.
- .2 Work Included:
- .1 Furnish all labour, material, equipment and services necessary to supply and install firestopping and smoke seals around piping penetrations through fire rated wall and floor assemblies, as indicated and as specified.
- .3 Quality Assurance:
- .1 The work of this section shall be carried out only by an approved specialist firm, employing skilled tradesmen experienced in firestopping and smoke seal application and approved, licensed and supervised by the manufacturer of fire stopping materials.
- .2 All work to be of the highest quality according to best trade practice and in strict accordance with manufacturer's printed specifications.
- .4 Submittals:
- .1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.
- .2 Submit manufacturers' product data for materials and prefabricated devices. Include assembly/location design system number references with copies of test information. Construction details should accurately reflect actual job conditions.
- .3 For building assemblies which do not correspond to any previously tested and rated assemblies, submit proposals based on related designs using accepted fireproofing design criteria.
- .5 Materials:
- .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC CAN4-S115 and not to exceed opening sizes for which they are intended.
- .2 Service penetration assemblies and design numbers: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19. 1997 Certification Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).

- .3 Service penetration firestop components: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC or equivalent approved tests by Warnock Hersey.
- .4 Fire resistance rating of installed fire stopping assembly shall be not less than the fire resistance rating of surrounding floor and wall assembly.

PART 3 EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of piping systems to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: (A-1).
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code (1501-H).
- .3 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC code	Insulation thickness (mm)					
			Up to 1	1¼ -2	2½-4	5-6	6½-8	>8
Domestic Water	All	A-1	25	25	25	25	38	38

- .4 Finishes:
 - .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Outdoors: Water-proof aluminum jacket.

3.4 INSULATION PACKING OF PIPE SLEEVES

- .1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation - Thermal Ceramics to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

3.5 CLEANING

- .1 Clean in accordance with Section 01 01 50 General Instructions.
 - .1 Progress Cleaning: Leave work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.
- .2 Waste Management in accordance with Section 01 01 50 General Instructions.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 01 50 – General Instructions.
- .2 Section 22 05 00 – Common Work Results for Plumbing.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .2 ASTM International Inc.
 - .1 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 - .2 ASTM B88M-16, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B242-05 (R2016), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 National Building Code of Canada
 - .1 NBCC-2015
- .6 National Plumbing Code
 - .1 NPC-2015
- .7 National Sanitation Foundation (NSF) / American National Standards Institute (ANSI).
 - .1 NSF/ANSI 61-16, Drinking Water System Components.

1.3 QUALITY ASSURANCE

- .1 All potable water system components shall conform to NSF/ANSI Standard 61.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 01 50 General Instructions.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 General Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packaging Waste Management: remove in accordance with Section 01 01 50 General Instructions.
- .2 Place materials defined as hazardous or toxic in designated containers.

PART 2 PRODUCTS

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type K: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

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

2.3 JOINTS

- .1 Rubber gaskets, latex-free, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 PROTECTIVE CONDUIT

- .1 Not applicable.

PART 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with NPC, and local authority having jurisdiction.
- .2 Assemble piping using fittings manufactured to ANSI standards.
- .3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

- .4 Buried tubing:
 - .1 Not applicable.
- 3.3 VALVES**
 - .1 Isolate equipment, fixtures and branches with isolation valves.
 - .2 Balance recirculation system using existing valves. Mark settings and record on as-built drawings on completion.
- 3.4 PRESSURE TESTS**
 - .1 Not applicable.
- 3.5 FLUSHING AND CLEANING**
 - .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.
- 3.6 PRE-START-UP INSPECTIONS**
 - .1 Systems to be complete, prior to flushing, testing and start-up.
 - .2 Verify that system is fully functional.
- 3.7 DISINFECTION**
 - .1 Flush out, disinfect and rinse system to approval of Departmental Representative.
- 3.8 START-UP**
 - .1 Timing: start up after:
 - .1 Disinfection procedures have been completed.
 - .2 Certificate of static completion has been issued.
 - .2 Provide continuous supervision during start-up.
 - .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after leakage tests and disinfection are completed.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Verify performance of temperature controls.
 - .3 Verify compliance with safety and health requirements.
 - .4 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 Not applicable.

3.10 CLEANING

- .1 Clean in accordance with Section 01 01 50 General Instructions.
 - .1 Progress Cleaning: Leave work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

3.11 WASTE MANAGEMENT

- .1 Separate waste materials for recycling in accordance with Section 01 01 50 General Instructions.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS & SUMMARY

- .1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.
- .2 Reference to "Electrical Divisions" shall mean all related Electrical Sections and components including Division 26 in the Master Format Specifications.
- .3 Reference to "Mechanical Divisions" shall mean all related Mechanical Sections and components including Divisions 21 and 22 in the Master Format Specifications.
- .4 The word "Provide" shall mean "Supply, Install and Connect" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .5 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, and ensure coordination, establishing orderly completion and the delivery of a fully commissioned installation.
- .6 The most stringent requirements of this and other electrical sections shall govern.
- .7 All work shall be in accordance with the PROJECT Drawings and Specifications and their intents, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .8 Provide seismic restraints for all required equipment and piping
- .9 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

1.2 REFERENCES

- .1 Install in accordance with CSA C22.1-2018 except where specified otherwise.
- .2 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.
- .3 Comply with BC building Code 2018.
- .4 Comply with other applicable standards.

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages to CAN3-C235-83.
- .2 Motors, , control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SCOPE OF WORK

- .1 Contractor shall supply, install, commission and provide warranty for a complete and fully documented electrical system as per contract drawings and specified herein. The Work includes all hardware, and services necessary to provide fully functional, coordinated electrical system. Refer to Division 01 for hours of work.
- .2 Coordinate with Mechanical Div. 25 for all the demolition and installation work. Ensure safety.
- .3 Living unit LU1 to LU5
 - .1 The power distribution for each living unit LU1 TO LU5 (typical of 5) is the same. Each living unit has mechanical rooms (valve room) with fractional power booster pump and temper switch replacement:
 - .1 Booster Pumps:
 - .1 Existing pump shall be replaced with a new unit. Disconnect existing and reconnect new booster pump as per contract drawings.
 - .2 Circuit breaker and conduit to assure good working condition and report any deficiencies. Confirm that the motor overcurrent and overload protection ratings are acceptable and other wise provide new circuit breaker to the existing 120/208V panel board per contract drawings.
 - .2 Tamper Switch and Pressure switches:
 - .1 Existing tamper and pressure switches shall be replaced with new switch. Disconnect and reconnect new switch and verify all the connections with fire alarm control panel.
- .4 Maintenance Building:
 - .1 Fractional power booster pump and tamper, pressure switch replacement:
 - .1 Booster Pumps:
 - .1 Existing pump shall be replaced with a new unit. Disconnect existing and reconnect new booster pump as per contract drawings.
 - .2 Tamper and Pressure Switch:
 - .1 Existing tamper-Pressure switches shall be replaced with new switch. Disconnect and reconnect new switch and verify all the connections with fire alarm control panel.
- .5 Industrial Building:
 - .1 Fractional power booster pump and temper and pressure switch replacement:
 - .1 Booster Pumps:
 - .1 Existing pump shall be replaced with a new unit. Disconnect existing and reconnect new booster pump as per contract drawings.
 - .2 Tamper and Pressure Switch:
 - .1 Existing switches shall be replaced with new switch. Disconnect and reconnect new switches and verify all the connections with fire alarm control panel.
- .6 Coordinate the exact location of the mechanical equipment with mechanical drawing package.

- .7 Make sure no disturbance/hazard to existing equipment. Provide a cover to protect the communication panel while working.
- .8 Coordinate the outage in fire alarm systems with the owner during construction. Provide a verification of the fire alarm system with the integrated system.
- .9 All drawings to be read in conjunction with existing reference drawings provided with the package and other disciplines drawings.
- .10 Provide Quality Management (QM) services for the following:
 - .1 Project construction schedule
 - .2 Onsite testing and inspections of new and existing equipment
 - .3 Re-CSA certification of existing modified equipment
 - .4 Quality Management plan
- .11 Component subsystems of the electrical system will include, but are not limited to the following:
 - .1 Connect exterior mechanical equipment via a system of interior surface mounted conduit. Equipment shall be connected to an existing distribution system.
 - .2 Connect interior mechanical equipment via surface mounted conduit. Equipment shall be connected to an existing electrical distribution system.
 - .3 Provide all required motor starters, associated control wiring and local disconnect switches.
- .12 Provide grounding/bonding equipment as per CEC or as indicated in the contract drawings and specifications.
- .13 Provide fire stopping as required.
- .14 As-built drawings and maintenance manuals.
- .15 Seismic restraint for all electrical equipment and installations. See Section 26 05 25.

1.6

SUBMITTALS

- .1 Submittals to be in accordance with Division 01.
- .2 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
- .3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .4 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .5 Content
 - .1 Shop drawings submitted in accordance with Division 01.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Identify the electrical rating for each equipment.
 - .5 Information shall include all scheduled data.
 - .6 Indicate the exact proposed model number for certain equipment.
 - .7 Advertising literature will be rejected.
 - .8 The project and equipment designations shall be identified on each document.
 - .9 Information shall be given in S.I. units

- .10 The shop drawings/product data shall include:
 - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weight and mounting point loads.
 - .2 Mounting arrangements.
 - .3 Detailed drawings of bases, supports and anchor bolts.
 - .4 Control explanation and internal wiring diagrams for packaged equipment.
 - .5 A written description of control sequences relating to the schematic diagrams.
- .6 Format
 - .1 Electronic copy (PDF format).
 - .2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.
- .7 Coordination
 - .1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.
- .8 Keep one copy of shop drawings and product data, on site, available for reference.
- .9 Quality Control: in accordance with Division 01
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
- .10 Permits and Fees:
 - .1 Submit to Electrical Inspection Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.
 - .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.7 QUALITY ASSURANCE

- .1 Quality Assurance in accordance with Division 01.
- .2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians in accordance with authorities having jurisdiction.
 - .1 Employees registered in apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: Determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings in accordance with Division 01.
- .4 Health and Safety Requirements in accordance with Division 01.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Division 01.

1.9 SYSTEM START-UP

- .1 Refer to Division 01.
- .2 Instruct the Departmental Representative and operating personnel in the operation, care and maintenance of equipment.
- .3 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.10 OPERATING INSTRUCTIONS

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

1.11 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.12 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

1.13 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost without the Departmental Representative's written approval.
- .2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative and all affected parties.
- .4 Contractor to read the drawings in conjunction with existing reference drawings and specifications to understand the intent of the work. Notify Departmental Representative if there is any discrepancies. No extra cost will be considered for any misunderstanding of work to be done.
- .5 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.14 SPRINKLER PROOF REQUIREMENTS

- .1 In sprinklered rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors.

1.15 EQUIPMENT RESTRAINT

- .1 Related Section: 26 05 25 Seismic Restraint.
- .2 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.16 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one year from the date of substantial performance.
- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.17 EXAMINATION

- .1 A site visit before the close of tender to be communicated with the owner. No extra cost will be considered for any misunderstanding of work to be done.
- .2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specifications and the drawings, or in the drawings. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.18 RESPONSIBILITIES

- .1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .2 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Departmental Representative **prior** to Tender closing. Failing this, the most expensive alternative is to be allowed for.
- .3 The Contractor shall advise the Departmental Representative during the Tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Departmental Representative at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.
- .4 Advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

- .5 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all new and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced and replaced if and when required. Advise the Departmental Representative of space problems before fabricating or installing any material or equipment. Demonstrate to the Departmental Representative on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Departmental Representative's written direction.
- .6 Where electrical work and materials are noted as being provided by the Owner or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.
- .7 Protect equipment and material from the weather, moisture, dust and physical damage.
- .8 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Owner.
- .9 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.
- .10 Refinish damaged or marred factory finish to factory finish.
- .11 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.19 EQUIPMENT LIST

- .1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the subtrades, 10 days after the award of the Contract.
- .2 The equipment list shall be a full list of materials or systems intended for installation.

1.20 PROGRESS CLAIM AND CHANGE ORDER BREAKDOWNS

- .1 Ten days after the award of contract, submit detailed progress claim breakdown for each division. Items to be included but shall not be necessarily limited to the following:
 - .1 Distribution
 - .2 Feeders
 - .3 Branch circuit wiring, conduit and boxes
 - .4 Wiring devices
 - .5 Mechanical equipment and wiring
 - .6 Low tension
 - .7 Testing and commissioning
 - .8 As-built drawings and maintenance manuals
 - .9 Mobilization; not to exceed 2% of the contract value

- .2 Progress claims will not be certified nor payment made beyond 95% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.
- .3 Change order breakdowns shall include but not be necessarily limited to the following:
 - .1 Labour hours per unit of material or equipment to be added, deleted or altered
 - .2 Units of material or equipment to be added or deleted.
 - .3 Per unit cost of material, equipment and labour broken down by category of labour and type of material or equipment
 - .4 Extensions of the above to arrive at total costs
 - .5 Miscellaneous and identifiable charges such as re-stocking, overhead, profit, etc

1.21 PROJECT CLOSE-OUT REQUIREMENTS

- .1 Refer to Division 01.
- .2 Refer to detailed specifications in each section for detailed requirements. Provide the following list of required substantial completion submissions.
 - .1 Fire alarm system verification report.
 - .2 Seismic engineer report and schedules.
 - .3 Final electrical inspector certificate.
 - .4 Drafted as-built drawings.
 - .5 Operating and maintenance manual.
 - .6 Contractors letter of guarantee.
 - .7 Complete Demonstration of systems to Departmental Representative.
- .3 Record drawings to be submitted to the Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.22 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
 - .1 Commission all systems and prove out all components, interlocks and safety devices.
 - .2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.
 - .3 A complete list of incomplete or deficient items shall be provided by the Contractor. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Operating and Maintenance Manuals completed.
 - .3 "As Built" Record Drawing ready for review.
 - .4 Systems Commissioning has been completed and has been verified by Departmental Representative.
 - .5 All demonstrations to the owner have been completed.

- .6 All documents required have been submitted.
- .3 Letters of Assurance will not be issued until the following requirements have been met:
 - .1 All items listed in 1.22 above have been completed or addressed.
 - .2 Certificate of penetrations through separations have been sealed and labelled with certified fire stopping material.
 - .3 Provincial Electrical Inspection - Certificate of inspection.
 - .4 Seismic Engineers letter of Assurance and final inspection report.
 - .5 Certificate of Substantial Performance.
 - .6 Fire alarm system verification report.

PART 2 PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01.
- .2 Do verification requirements in accordance with Division 01.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01 and as follows.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.
- .3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.
- .4 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Provide all power and electrical system related control wiring, conduit, wire, fittings, disconnect switches, for all mechanical equipment unless otherwise specified.
- .2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.
- .3 Connections shall be made with watertight flexible conduit with watertight connectors.
- .4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

2.4 WARNING SIGNS

- .1 Provide warning signs, as specified or to meet requirements of Inspection Department and Departmental Representative.
- .2 Use decal signs, minimum 175 x 250 mm size.

2.5 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:

.2 Nameplates:

.1 ELECTRICAL EQUIPMENT:

COMPONENT	LABEL TYPE	INFORMATION
Terminal Cabinet	B	System and Voltage
Disconnect switches	B	Indicate equipment controlled and voltage
Starters/contactors	B	Indicate equipment controlled and voltage
Junction boxes, pull boxes	D	Circuit and panel designation
On/Off switches	C	If it is not obvious, then indicate area being served
Fire Alarm Devices (i.e. pull stations, bell, smoke detector, end-of –line)	C	Zone number and device number in that zone (i.e. Zone 1-#3, Zone 10-#7)

2.7

LABEL TYPE:

	LETTER HEIGHT	TYPE	COLOUR
Label Type A	9.5 mm	Lamacoid	White lettering/black background
Label Type B	6.0 mm	Lamacoid	White lettering/black background
Label Type C	3.0 mm	Lamacoid	White lettering/black background
Label Type D	3.0 mm	Adhesive label	As specified

.1 Adhesive Labels:

.1 Good quality vinyl, self-laminating label as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected.

.2 Provide plastic covered typewritten panel directory with circuits and areas served and mounted on inside of door. Directory shall conform to Record Drawings.

2.8

WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code to CSA C22.1-18.

.4 Use colour coded wires in communication cables, matched throughout system.

2.9 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 All junction boxes, pull boxes and their covers shall be painted according to the colour coding schedule.
- .2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.
- .3 Colour coding to be as follows unless otherwise specified:

COMPONENT	RACEWAY AND JUNCTION BOXES	RECEPTACLES AND OTHER
Normal 120/208, 240 volt	Gray	White
Normal 347/600 volt	Sand	White
Emergency 120/208, 240 volt	Green with red bands	Red
Emergency 347/600 volt	Sand with red bands	n/a
Fire Alarm	Red	Strobe (red)
Low voltage		
-switching/controls	Black	
-emergency/exit lighting	Black with red bands	
-security	Black with blue bands	Strobe (blue)
-mechanical alarms	Black with yellow bands	Strobe (amber)

2.10 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.
- .3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.

2.11 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa (2000 psi).
 - .2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 CAST-IN-PLACE TYPE:
 - .1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel.
 - .2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm (8") pipe size.
 - .3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm (8") pipe size.
 - .2 DRILLED, MECHANICAL EXPANSION TYPE:
 - .1 Hilti HSL or UCAN LHL heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa (2840 psi).
 - .2 Hilti Kwik-Bolt or UCAN WED stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Hilti HDI or UCAN IPA drop-in anchor for concrete.

- .4 Hilti or UCAN Sleeve Anchor (medium and light duty) for concrete and masonry.
- .5 Hilti ZBP or UCAN Zamac pin bolt (light duty) for concrete and masonry.
- .3 DRILLED, ADHESIVE TYPE:
 - .1 Hilti HVA or UCAN Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Hilti HY150 consisting of anchor rod with a 2 part adhesive system.
 - .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
 - .4 Rod assemblies shall extend a minimum of 50 mm (2") into the concrete slab below the housekeeping bases.

.3 Note:

- .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.
- .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.
- .3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System.

2.12 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.
- .3 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt.
- .5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.13 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
 - .1 Support of equipment.
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
 - .3 Earthquake restraint devices - refer also to "Seismic Restraint" sections
 - .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be primed and undercoat painted ready for finish under the related Division.

2.14 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.
- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .3 Include in the manual the following major sections:
 - .1 Title page (in plastic cover).
 - .2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.
 - .3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and trouble shooting instructions.
 - .4 Local source of supply for each item of equipment.
 - .5 Wiring and control diagrams.
 - .6 Spare parts list.
 - .7 Copies of guarantees and certificates.
 - .8 Manufacturer's maintenance brochures and shop drawings.
 - .9 Test and inspection reports.
- .4 Submit a draft copy to the Departmental Representative for approval thirty days prior to start up of the systems and equipment.

2.15 PROJECT RECORD DRAWINGS

- .1 Refer to Division 01.
- .2 During the construction period, maintain on Site a clean set of drawings and specifications marked up clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents and indicating final installation of feeders and branch circuits.
- .3 "As-Built" drawing markings shall include but shall not be limited to the following:
 - .1 All changes in circuiting.
 - .2 Size and routing of all conduits for all branch circuits including power, lighting and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record "As-Built" drawings the size and routing of all installed raceways and cables.
 - .3 Number and size of conductors (#10 AWG and larger) in raceways and cables.
 - .4 Location of all junction boxes and pullboxes.
 - .5 Location of all conduits or duct stubs, installed equipment, devices and fixtures.
 - .6 All changes to electrical installation resulting from Addenda, Change Orders and Field Instructions.

- .7 Exact location of all services left for future work.
- .8 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 2018 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.
- .3 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturers nameplates and CSA labels are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.
- .4 All cables and conduits shall be concealed in finished areas.

3.4 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated verify before proceeding with installation. Confirm the height of devices in handicapped facilities before installation.
- .3 Refer to detail on architectural drawings.

- .4 In the absence of a drawing detail or drawing note, use the following:

Device	Height		Comment
Local switches	1200	48"	
Wall receptacles/data	400	12"	General
Wall receptacles/data	175	7"	Above top of counters or counter splash backs – coordinate with Architectural detail
Wall receptacles/data	1400	56"	In mechanical rooms
Panelboards			Panelboards: as required by Code or as indicated.
Wall mounted telephone	1500	60"	
Fire alarm stations	1200	48"	As required by ULC S524.
Fire alarm bells/audio/visual	2300	90"	ULC S524 requires not less than 1800mm. In any event not closer than 50mm to the Ceiling
End of line resistors	1800	72"	
Television outlets			As receptacles –coordinate with equipment location
Wall mounted speakers & clocks	2100	84"	Coordinate with equipment location
Door bell pushbuttons	1200	48"	Coordinate with location
Emergency Lighting (wall mounted)			150mm below ceiling or 2300mm max.

- .5 Confirm mounting height with Departmental Representative prior to rough-in.

3.5 DELIVERY AND STORAGE

- .1 Store all electrical equipment and devices other than conduits, fittings, boxes, and ducts in a heated and ventilated space, and protect from construction damage. Include in the tender price all costs related to such storage.
- .2 Conduits, fittings, boxes, and ducts may be stored outside if properly protected against the weather.
- .3 Ship and store floor mounted equipment in upright position.
- .4 Ship equipment in adequate containers to assure it arrives undamaged at the site.
- .5 Keep equipment doors locked. Protect equipment from damage and dust.
- .6 Block moving parts when necessary to prevent damage during movement and shipment of equipment.
- .7 Remove from the site, and replace with new, all materials showing evidence of damage or rust.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Coordinate and pay for all tests specified herein including further tests as required by authorities having jurisdiction.
- .2 All testing shall be performed after each system installation has been completed. Prior to commissioning, all motors, the results recorded prior to the systems being put into operation.
- .3 Perform the testing, adjusting, and balancing only when conditions are commensurate with actual operating conditions for the given system.
- .4 Advise the Departmental Representative 48 hours in advance of each test. Carry out tests in the presence of Departmental Representative.

- .5 Submit detailed printed, dated and signed test reports in duplicate to the Departmental Representative within 7 days after the completion of each test. Include all test reports in the Maintenance Manuals. Each test shall clearly indicated, in a line-by-line format, that the components (not as a group) have been tested, test results, and whether test results are within acceptable limits. Each test report shall be accompanied by a front cover sheet briefly outlining what the test report is for and clearly summarizing all items that have failed the tests. The cover sheet shall indicate names of individuals who conducted the tests and their signatures.

3.7 FIELD QUALITY CONTROL

- .1 Load and Balance:
 - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Conduct and pay for the following tests:
 - .1 Motors, and associated control equipment including sequenced operation of systems where applicable.
 - .2 Systems: fire alarm system.
 - .3 Main ground resistance (at all grounding locations).
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Reports:
 - .1 Provide written reports in a timely manner upon completion of the testing. Indicate test hour and date.

3.8 DEMONSTRATION

- .1 Demonstrate to and instruct the Departmental Representative on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction and include all costs in the tender. Systems to be demonstrated shall include, but not be limited to, the following:
 - .1 Routing and installation of major feeders, duct banks and manholes, grounding and cable trays.
- .2 Arrange an acceptable time with the Departmental Representative and submit a program of instruction and demonstration for the Departmental Representative's approval. Assume that the Departmental Representative is not familiar with any of the special equipment and/or systems installed.
- .3 Submit to the Departmental Representative, at the time of Substantial Performance inspection, a complete list of systems stating for each system:
 - .1 Date of instruction.
 - .2 Duration of instruction.
 - .3 Name of persons instructed.
 - .4 Other parties present (manufacturer's representative, etc.).
 - .5 Signature of the Departmental Representative stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

3.9 CLEANING

- .1 Do final cleaning in accordance with Division 01.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 01.

3.10 WORKMANSHIP

- .1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.11 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.12 PROTECTION ELECTRICAL EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.13 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.14 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 Refer to 07 84 00.
- .2 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.
- .3 The scope includes new services which pass through existing rated separations and also all existing services which pass through a new rated separation or existing separations whose rating has been upgraded.

- .4 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.
- .5 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.
- .6 Contractors are expected to submit system information detailing firestopping product, backing, penetration, penetrated assembly, fire and temperature rating, and ULC or cUL system number.
- .7 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.
- .8 Allow openings for 100% capacity of raceway.
- .9 Provide split systems where existing cables are involved.

3.15 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 Provide metal sleeves for all cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.16 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated and non-rated walls and floors. Sleeves shall be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.
- .5 Conduit sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.
- .6 Sleeve Size: 12 mm clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.17 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.
- .2 CSA identification and equipment labels to be clearly visible after installation.

3.18 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.
- .3 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.
- .4 Openings in Concrete:
 - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
 - .2 All openings shall be core drilled or diamond saw cut.
 - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .4 Refer to structural drawings for locations of steel reinforcing.
 - .5 Be responsible for repairing any damage to steel reinforcing.
- .5 Openings in building surfaces other than concrete:
 - .1 Lay out all openings required.
- .6 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.
- .7 Precast concrete items such as transformer pad bases and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.
- .8 Excavation and backfilling will be provided by other Divisions. This division to supervise the work and provide all layouts and parameters.

3.19 PAINTING

- .1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and mill scale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.
- .4 Coordinate with Division 09.
- .5 Finish painting of all equipment and materials, supplied under the Electrical Divisions, installed in Electrical Rooms of the building or exposed outside the building, is included under Division 09 of the Specification.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documentation and is to be read, interpreted and coordinated with other parts.

1.2 INTENT

- .1 It is the intention of the specification and the drawings to call for all demolition work while keeping all essential electrical services operational in the areas that are to be maintained operational during demolition and new construction, according to phasing schedule for this project; refer to architectural specification for phasing and timing; electrical phasing descriptions, and thus the electrical work relating to them, is generic, and it shall be regarded as performance specifications aiming at having the specific clinical areas fully operational with all electrical systems.
- .2 The drawings do not accurately reflect as built conditions. The Contractor shall be responsible to adjust demolition requirements to suit such changes, as found on site.
- .3 **Power System:** maintain power connections to the areas which are to remain operational, remove power connections to the areas of demolition, make temporary provisions, rewire as required, and refer to the phasing description. Provide new power connections and new devices to the new permanently or temporarily renovated areas. Allow for multiple Z32 testing to accommodate phasing and temporary occupancy deadlines.
- .4 **Fire Alarm System:** maintain FA system connections to the areas which are to remain operational, remove FA system connections to the areas of demolition, make temporary provisions, rewire as required. Provide new FA connections new permanently or temporarily renovated areas.

1.3 WORK INCLUDED

- .1 **Work included is** a general outline only of the work to be included in Electrical Division scope of the work. It is not intended that this outline is all inclusive, nor sufficiently detailed, to thoroughly include all the components and services to be included in the contract.
- .2 Demolition work shall be in accordance with the drawings and specification and their intent.

1.4 INTERRUPTION OF EXISTING SERVICES

- .1 Give 14-day notice in writing to the Owner's designated representative of proposed interruption of services for modification and/or tie-in, or for permission to work in existing occupied areas of the building, be it a shut-down in Electrical, or disruption of existing functions, intended times and duration of the outages, so that he can make the necessary arrangements with the Owner. Refer to the Drawing where in the existing shut downs have to be performed in order to make new connections.
- .2 Giving notice to the Owner's designated representative does not constitute permission to disrupt services. Obtain written confirmation from the Owner before any shutdown is started. Shutdowns and disruptions of existing systems and spaces to be kept to a minimum.
- .3 Where unknown services are encountered, immediately advise Engineer, and confirm the finding.

1.5 DEMOLITION WORK

- .1 Demolish the scope of work indicated, and remove all materials from the premises unless noted otherwise.

- .2 Carry out demolition in a manner to cause as little inconvenience to this and other areas occupants as possible. Coordinate this activity with the Owner and the general contractor.
- .3 Carry out demolition in an orderly and careful manner.
- .4 All coring, patching and removal of existing equipment and conduit which may affect occupied areas of the building shall be carried out as scheduled with the Owner.
- .5 Demolition shall include all work not only indicated on drawings and outlined in the specifications, but also work which is deemed necessary, though not described directly, to achieve specific objectives. This work shall not only be limited to demolition, but should include removal, relocation and disposal of the removed material where required.
- .6 Selected electrical devices shall be salvaged by the Contractor for the Owner, or shall be removed by the Owner prior to the beginning of the demolition. Sufficient notice shall be given to the Owner prior to the beginning of demolition to either remove the items or to be tagged by the Owner to be removed and salvaged by Contractor for the owner. All other remaining removed materials or components shall be gutted or demolished, or dismantled and removed from the site.
- .7 The standards of British Columbia Government Ministry of Environment Canada shall be followed in handling, storing, transporting and disposal of hazardous products.

1.6 REMOVAL OF EXISTING EQUIPMENT

- .1 Remove all relevant electrical materials and equipment in the renovated area (excluding those items specifically identified to be salvaged) including redundant or abandoned conduit, wire, boxes and devices.
- .2 Reposition any equipment noted to new positions as indicated on the drawings.
- .3 In the event of conduit and wiring to existing equipment (in areas adjacent to or outside the renovation areas) being demolished or disconnected due to the new work, it is the responsibility of the Electrical Contractor to re-route and reconnect the connection in order to maintain the continuity of the service; inform the Owner to make arrangement, and obtain a written permission from the Owner to proceed.
- .4 Where electrical wiring is connected to devices not to be removed (fed through area of renovation), they shall be rewired to ensure circuit to the remaining devices are not affected.
- .5 Existing electrical equipment, devices and wiring to be retained that is mounted in or on walls that are removed, relocated or refinished shall be relocated in a concealed manner to suit new conditions.
- .6 All equipment to be removed or relocated shall be handled with utmost care to prevent damage. If damaged, Contractor shall replace with new equipment that matches existing manufacturer, rating, etc.
- .7 Demolition shall include all work designated on drawings and outlined in the specifications noted as requiring removal, relocation or referenced by specific note.
- .8 Removal requires disconnection/removal of the device or equipment and all the associated conduit, pullboxes and wiring to the source and wiring to be made safe. This also requires patching and sealing or firestopping of all holes left after such removal.
- .9 Relocation of devices or equipment shall require disconnection/removal of device, rerouting and installation of new conduits/pullboxes and wiring, reinstallation/ reconnection of devices or equipment. This also requires patching and sealing or firestopping of all holes left after such removal.

- .10 Examination
 - .1 Examine the work as it relates to existing features and services to be removed capped and sealed-off.
 - .2 Examine the area and surfaces adjacent to the demolition area and record any damages to avoid later disputes.
- 1.7 PREPARATION**
 - .1 Shut-off, disconnect, cap-off and seal all electrical services, slated for demolition, in accordance with the requirements of the authorities having jurisdiction, before starting demolition. Do not disturb active or energized utilities designated to remain undisturbed. Arrange for temporary power as required.
- 1.8 SITE VISIT**
 - .1 Contractor shall examine the site and local conditions affecting the work included under this contract. Examine all drawings and verify the suitability of the method of demolition and location of all equipment.
 - .2 Contractor shall examine possibility of any concealed conduits and wiring prior to demolition.
- 1.9 DISPOSITION OF EQUIPMENT REMOVED FROM BUILDING**
 - .1 All removed materials and devices shall be disposed of, except for the devices indicated by Owner as to be salvaged, which be turned over to the Owner.
 - .2 Remove from the site the equipment which was not identified by the Owner as to be salvaged.
 - .3 Obtain a written receipt from Owner when turning the salvaged materials.
- 1.10 SEQUENCE OF DEMOLITION**
 - .1 Coordinate demolition with specification and the sequence and timing of operations for specific phases of the project.
- 1.11 PROTECTION**
 - .1 Protect adjacent work from damage, staining, disfigurement caused by the work of this section. Make good to repair any damages, at no cost to the Owner.
 - .2 Promptly as the work proceeds, and on completion, keep the premises clean and free from rubbish, debris, surplus materials and equipment.
 - .3 At the end of each day's work, leave work in safe condition so that no parts are in danger of toppling or falling.
- 1.12 CLEAN-UP**
 - .1 Every day, upon the completion of all demolition work, remove all equipment, material and debris and leave the area clean, unless not practical to do so, and allowed by Owner and Consultant.
- 1.13 COORDINATION**
 - .1 Coordinate all aspects of work with the Owner and all trades.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 RELATED SECTIONS

- .1 Section "Division 1" – General Instructions
- .2 Section 26 05 00 - Common Work

1.3 REFERENCES

- .1 CSA C22.1-12
- .2 CSA C22.2
- .3 National Electrical Manufacturers Association (NEMA)

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Division 01.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01.

1.6 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated.
- .2 Armoured cable (BX) is permitted for branch circuits only; use of BX for feeders and home runs is not permitted. Where flexible connections are required provide wiring in flexible conduits.
- .3 Aluminum conductors not permitted.
- .4 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 having a PVC jacket with FT-6 flame spread rating.
- .5 Non-metallic sheathed wiring not to be used on this project.

PART 2 PRODUCTS

2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 12 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 1000 volt RW90XLPE (X link) for the general building wiring in conduit, unless otherwise specified.
- .3 Main feeders to be conduit and insulated copper wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.
- .4 Conductors within cable trays shall have 'plenum' rated (FT6 type) outer jacket to comply with all applicable regulations and bylaws.

- .5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors shall not be painted.

2.2 TECK CABLE

- .1 Conductors:
 - .1 Grounding conductor: copper
 - .2 Circuit conductors: copper, size as indicated.
- .2 Insulation: Chemically cross-linked thermosetting polyethylene, type RW90, rated 600 V.
- .3 Inner jacket: polyvinyl chloride material.
- .4 Armour: interlocking aluminum.
- .5 Overall covering: polyvinyl chloride material FT-4/6 flame test rated as specified.
- .6 Connectors: Watertight, approved for Teck cable installation.

2.3 LOW VOLTAGE CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.
- .2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

2.4 BUILDING WIRE AND CABLE

- .1 Unless otherwise directed, building wire and cable shall be copper conductors, sized as indicated.
- .2 Except where otherwise directed or required by Code or other applicable regulations, building wire and cable insulation shall be Type RW90, cross-linked polyethylene insulated 600 volts rated for not less than 90°C.
- .3 All conductors within cable trays shall have FT6 type outer jacket to comply with all applicable regulations and bylaws.
- .4 Use of NMD90 (Loomex) not permitted.

2.5 ARMOURED CABLE

- .1 Type: AC 90
- .2 Armour: flexible interlocked aluminium

2.6 WIRE AND BOX CONNECTORS AND MISCELLANEOUS MATERIALS

- .1 Connectors for wire and cable splices and taps: Unless otherwise directed, use 3M Co. 'Scotchlok,' Thomas & Betts PT Series, Buchanan 'B,' IDI Electric 'Super Nut,' or approved equal, for conductors #8 AWG or smaller; Burndy 'Servit' Type KSU or approved equal for conductors #1/0 AWG and smaller; and Burndy 'OKlip' Type KVSU or approved equal for conductors 750 MCM or smaller.
- .2 Clamps, glanding connectors, or box connectors for armoured cable, and flexible conduit as required.
- .3 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.
- .4 Plastic electrical insulation tape: Scotch #88 or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Unless specifically indicated otherwise, all wiring shall be installed in conduit. Use flexible conduits for final connections to suspend light fixtures and vibrating equipment.
- .2 Use no wire smaller than #12 AWG, unless otherwise directed.
- .3 Control circuit conductors for motors and mechanical equipment controls shall be not less than #14 AWG except where specifically directed otherwise.
- .4 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.
- .5 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Canadian Electrical Code. Submit data sheet with values measured.
- .6 The number of splices in any circuit shall be kept to an absolute minimum consistent with available coil length and installation conditions.
- .7 Conductors for lighting, receptacle, appliance and equipment branch circuits shall have ampacity not less than the rating of the over-current device protecting the branch circuit and shall be sized for a maximum voltage drop of 2% from panelboard to the last outlet of a circuit. The length of the branch circuit to be used in the determination of the required wire size shall be the combined vertical and horizontal distances from the panelboard to the last device in the circuit. In no case shall the wire sizes as determined above, be less than that indicated in the following table.

120 Volts, 1 Phase

15 Ampere Circuits
0-25 m - min. #12 AWG
Over 25 m - min. #10 AWG

20 Ampere Circuits
0-20 m - min. #12 AWG
0 m-30 m - min. #10 AWG
Over 30 m - min. #8 AWG

347 Volts, 1 Phase

15 Ampere Circuits
0-75 m - min. #12 AWG
Over 75 m - min. #10 AWG

20 Ampere Circuits
0-55 m - min. #12 AWG
Over 55 m - min. #10 AWG

- .8 Make final connections to recessed incandescent or gas-discharge lamp fixtures, and other heat-producing equipment with thermoplastic insulated, lacquered glass-braid-jacketed "equipment wire," except that where higher temperature rating of insulation or larger conductor size than #10 AWG is required, use wire specifically approved for the purpose.
- .9 Exercise care in stripping insulation from wire. Do not nick conductors; if nicked replace with new.

3.2 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.

3.3 INSTALLATION OF ARMoured CABLE

- .1 Unless specifically directed to the contrary, use armoured cables only for:
 - .1 Final connections from a junction box above accessible suspended ceilings to recessed light fixtures to a maximum length of 1500mm.
 - .2 Final connections from a junction box above accessible suspended ceilings down stud and drywall partitions to receptacles. Ceiling junction box to be located as close as possible to the partition wall and not further away than 900 mm.
- .2 Armoured cables are not permitted to run around corners. Interconnection of electrical devices on adjacent walls shall be done via the ceiling space.
- .3 Armoured cables in accessible ceiling spaces shall not be dragged on ceiling tiles but shall be fastened to the underside of the structure using manufacturer's approved fastening devices. Armoured cables shall not run draped below pipes and ducts but shall be fished over such obstructions
- .4 Do not attach cables to the ceiling suspension system or to mechanical ductwork or piping.

3.4 IDENTIFICATION, CODING AND BALANCING

- .1 For branch circuit wiring, follow identification system shown on the drawings and as specified in Section 26 05 00 – Common Work.
- .2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on the records drawings.
- .3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.
- .4 Conductors sized No. 10 and smaller are required to be factory coloured, not taped on site.

3.5 TESTING

- .1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by the cable manufacturer.
- .2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 26 05 00 – Common Work.

1.2 REGULATORY REQUIREMENTS

- .1 Restraints shall meet the requirements of the latest edition of the National Building Code and amendments.
- .2 The Seismic Engineer shall be a registered BC Professional Engineer in good standing and should be able to provide a proof of professional insurance and the related practice credentials if requested by the Departmental Representative.
- .3 The Contractor's Seismic Engineer shall submit original signed National Building Code "Letters of Assurance" "Schedules B1, B2, and C-B" to the Departmental Representative.
- .4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

- .1 The total electrical seismic restraint design, field review and inspection will be by a structural engineer who specializes in the restraint of building elements and is registered with the local engineering association. Contractor shall allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .2 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .3 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01.
- .4 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.
- .6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.
- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.
- .9 Include all costs associated with the seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

PART 2 EXECUTION

2.1 GENERAL

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.
- .2 Ensure that seismic restraints do not adversely affect the proper functioning of any vibration isolation mounts or hangers.

2.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
- .2 Vertical Conduit:
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.
 - .3 Riser joints shall be braced or stabilized between floors.
- .3 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing.
- .4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies and pull box locations.
- .5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

- .10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to the Departmental Representative for his reference.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .7 Section 26 05 00 - Common Work Results

1.2 REFERENCES

- .8 Canadian Standards Association (CSA International)
- .9 CSA C22.1-12
- .10 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .11 Transformer grounding shall comply with CSA C22.2 No.41-M87 (R99).
- .12 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

1.3 PRODUCT DATA

- .13 Submit product data in accordance with Division 01.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .14 Separate and recycle waste materials in accordance with Division 01.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Grounding equipment to: CSA C22.2 No.41-M87 (R99).

2.2 EQUIPMENT

- .2 Clamps for grounding of conductor, size as required.
- .3 Copper conductor at least 6m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated. If not indicated, use 3/0AWG which is the maximum in Table 43 CEC.
- .4 Rod electrodes, copper clad steel 20mm dia by 3m long as indicated.
- .5 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified to be green.
- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

3 EXECUTION

3.1 INSTALLATION GENERAL

- .8 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

- .9 Provide separate, insulated, copper bonding conductor in EVERY conduit used for power, fire alarm and every low tension system required in the building. Where wire size is not indicated, provide minimum size per applicable CEC tables.
 - .10 Install connectors in accordance with manufacturer's instructions.
 - .11 Protect exposed grounding conductors from mechanical injury.
 - .12 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors approved for the use.
 - .13 Use mechanical connectors for grounding connections to equipment provided with lugs.
 - .14 Soldered joints not permitted.
 - .15 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.
 - .16 Install separate ground conductor to each outdoor lighting standard.
 - .17 Connect building structural steel and metal siding to ground by welding copper to steel.
 - .18 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
 - .19 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
 - .20 Ground secondary service pedestals in raised computer floors.
 - .21 Coordinate ground rod installation with local soil conditions to assure proper grounding system.
- 3.2 GROUNDING ELECTRODES
- .22 Provide and install an artificial ground consisting typically of a minimum of four 3000mm x 20mm copperweld ground rods, interconnected by bare stranded copper #1 AWG conductors and terminating to the Main Electrical Room ground bus. Conductors shall be connected to the ground rods with compression type fittings and shall be buried 600 mm below grade. Check and measure the installation to ensure an adequate resistance to ground before covering.
 - .23 Provide ground test well over one of the rods on the ground grid to allow access to the grid for testing.
- 3.3 BUILDING SERVICES GROUNDING
- .24 WATER - From the main electrical room ground bus, connect #3 AWG insulated ground conductor in 27mm conduit to water main with approved ground clamp ahead of water meter. Install 1#3/0 ground conductor jumper strapped around water meter and associated unions and valves to ground building side of water system.
 - .25 METALLIC WASTE WATER PIPING - Each metallic waste water piping system to the building to be grounded by bonding it to the interior metallic water supply system by copper bonding jumper of not less than #3 AWG
 - .26 GAS PIPE GROUNDING - All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.

- 3.4 GROUNDING BUS
- .27 Provide ground bus in the main electrical room and main communication room.
 - .28 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #3 AWG or as indicated.
 - .29 Copper or bronze lugs required for termination of all copper conductors at ground busses.
- 3.5 EQUIPMENT GROUNDING AND BONDING
- .30 Install bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, starters, UPS, control panels, building steel work, raised floor systems, generators, distribution panels and outdoor lighting.
 - .31 Provide grounding conductor(s) from all major switchgear to solidly ground the secondary system. This includes equipment located in the main electrical room as well as each sub-electrical room. Grounding conductors to be sized to Canadian Electrical Code and switchgear manufacturer's requirements.
- 3.6 MECHANICAL EQUIPMENT BONDING
- .32 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.
- 3.7 FIELD QUALITY CONTROL
- .33 Perform tests in accordance with Section 26 05 00 – Common Work.
 - .34 Perform ground continuity and resistance tests using method appropriate to site conditions.
 - .35 Measure ground grid resistance with earth test megohmmeter and install additional ground rods and conductors as required until resistance to ground complies with Code requirements and is less than 5Ω. Submit test results to Department Representative.
 - .36 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.
 - .37 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SECTION INCLUDES

- .1 Supports, hangers, and fastenings
- .2 Backboards and wood items

1.3 RELATED SECTIONS

- .1 Section 26 05 01: Electrical General Requirements

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Long standard masonry expansion shields for use on concrete-filled masonry walls: Star "Stazin" or approved equal.
- .2 Clamps for use on structural steel members: Appleton or Unistrut devices manufactured specifically for the purpose.
- .3 Conduit and cable clamps for individual or pair runs:
 - .1 Appleton series 'CL,' one-hole steel or galvanized malleable iron for sizes 50 mm and smaller.
 - .2 Two-hole steel for sizes larger than 50 mm.
- .4 Conductor supports for vertical runs: O-Z Electrical Mfg. Co. Type 'S' or 'R' as required or their approved equal, for not more than 5 wires or cables each not greater than 250 MCM; or Kellems grip Type 022-11 or approved equal for all manufacturer-approved combinations of wires and cables.
- .5 Steel channels:
 - .1 U shape, size 41 x 41 mm, 2.5 mm thick
 - .2 Cantruss series 13R and RH2.
 - .3 Unistrut heavy duty single or double channels.
- .6 Threaded hanger rods: steel, minimum 6 mm diameter; larger sizes as specified herein or as shown on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION OF SUPPORTS, HANGERS, AND FASTENINGS - GENERAL

- .1 Provide fastenings and supports as required for each type of equipment, cable, and conduit, and in accordance with manufacturer's installation recommendations.
- .2 Support equipment, conduit or cables using clips, spring-loaded bolts, and clamps designed as accessories to basic channel members.
- .3 All equipment enclosures and similar materials shall generally be fastened near each corner to the building; directly, by means of fasteners or, indirectly, by means of hanger assemblies; or fastened to backboards as the case directs. Install and size fasteners to the specific load in accordance with first class practice and the specific instructions, where such exist, of the manufacturer of the fasteners used. Wherever practicable, fastenings shall be made to the basic structure. Do not install fasteners supporting more than 9 kg in finish materials.
- .5 In addition, equipment requiring vibration isolation shall be supported as per Section 26 32 11 – Vibration Isolation for Electrical Equipment.
- .6 Unless specifically directed to the contrary, do not use bolts or rods smaller than 6 mm diameter, wood screws smaller than #8, fibre fastenings, fasteners driven by hammer or explosive charge, or perforated strap iron pipe hangers.
- .7 Unless detailed to the contrary, use wood screws only for fastening equipment weighing less than 27 kg per support.
- .8 Make attachments to the following Materials with fasteners complying with the above requirements of this Section and unless otherwise directed, of the following types:
 - .1 To concrete with metal inserts manufactured specifically for the purpose and complete with proper nuts, bolts or hanger devices as required, and installed at the time of placing concrete.
 - .2 To concrete-filled masonry walls with long standard masonry expansion shields.
 - .3 To structural steel members with welded-on studs or clamping devices manufactured specifically for the purpose. Alternatively, and where specifically permitted by the Consultant or seismic engineer, bolt with nuts and lock-washers may be used in holes drilled through the structure.
- .9 Do not use plastic anchors.
- .10 Provide substantial vertical channel iron support with welded 6 mm steel baseplate bolted to floor or housekeeping pad for the free-standing motors away from walls. Paint support channels and baseplate with one coat of zinc chromate primer and two finish coats of enamel paint to match surrounding finishes.

3.2 SECURING OF RACEWAYS, WIRES, CABLE, AND CONDUIT

- .1 Secure conduit and cables to the structure or to steel channel attached to the structure within 300 mm of each outlet and at intervals not greater than that permitted by the Canadian Electrical Code.
- .2 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .3 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .4 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .5 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .6 Support conduits rising vertically through the building at each floor.
- .7 When run individually or in pairs, secure conduits and cables with one-hole or two-hole clamps as specified in this Section.
- .8 Where individual cable or conduit runs require suspended supports, use minimum 6 mm diameter threaded rods and spring clips.
- .9 Where direct fastening of a group of 2 or more cables or conduits runs to building construction is impractical, secure conduits and cables with pipe clamps to steel channels, heavy duty single or double trapeze hangers, or approved equal. Attach trapeze hangers to the structure with one-piece, threaded-end steel hanger rods, sized to suit the specific load but not less than 10 mm diameter. Prepare and submit loading calculations for all trapeze rack runs carrying cable trays, cables and conduits. Design shall allow for a minimum of 25% future loading and shall be based upon a safety factor of four (4) for hanger rod size and spacing. Use concrete inserts or other specified attachments to fasten hanger rods. Submit proposed anchorages and attachments to the seismic engineer for review. The attachment of conduits and cables to the ceiling suspension system will not be permitted.

END OF SECTION

Part 1 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SECTION INCLUDES

- .1 Junction boxes and pull boxes

1.3 RELATED SECTIONS

- .1 Section 26 05 01: Electrical General Requirements
- .2 Section 26 05 05: Seismic Requirements

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for splitters and cabinets, in accordance with Section 26 05 01 – Electrical General Requirements.

Part 2 PRODUCTS

2.1 JUNCTION BOXES AND PULL BOXES

- .1 For conduits 25 mm or smaller, junction and pull boxes shall be galvanized steel type 52171 or 72171 complete with cover plate unless otherwise indicated or required by Canadian Electrical Code.
- .2 For conduits larger than 25 mm, junction boxes and pull boxes shall be manufactured from code gauge steel and painted with ASA 61 grey enamel paint. Pull and junction boxes shall be sized in accordance with Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes.
- .3 For surface-mounted conduits in wet or damp locations and in all instances where surface-mounted conduits are exposed and are located less than 3 m above the floor (other than in Mechanical, Electrical and communication service rooms) junction, and pull boxes shall be cast, Type FS or FD, single- or 2-gang, with threaded hubs and gasketed cover plate.

Part 3 EXECUTION

3.1 JUNCTION BOX AND PULL BOX INSTALLATION

- .1 Do not install junction or pull boxes in finished areas, on finished surfaces, in conspicuous locations, or in public areas. Locate them above accessible ceilings or in mechanical rooms and other similar service areas.
- .2 Install junction and pull boxes in all conduit runs on the basis of not more than two right angle bends (or equivalent) or a distance not exceeding 20m between boxes. Refer to the Drawings and other sections of the Specifications for additional restrictions regarding the location of junction and pull boxes. Generally, install pull boxes in straight runs of conduit. Do not install pull boxes in place of right angle bend.
- .3 Boxes shall be of proper size for the particular use and large enough to accommodate all conductors, connectors and installed devices without crowding. Where standard make boxes are not suitable for a particular device or conduit connection, provide boxes of special design to fit space and other applicable requirements.

- .4 Coordinate the Work carefully with other trades to provide easy and satisfactory access to all junction and pull boxes. Boxes located more than 1200 mm above cosmetic ceilings are deemed inaccessible and shall be lowered and properly supported.
- .5 Relocate pull boxes as directed when proper access has not been provided.
- .6 Provide pull boxes for distribution feeders as required and to the local Inspector's approval.

PART 1 IDENTIFICATION

- .1 Provide identification in accordance with Section 26 05 01 – Electrical General Requirements.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SECTION INCLUDES

- .1 Conduits, Conduit Fastenings, and Conduit Fittings

1.3 RELATED SECTIONS

- .1 Section 26 05 01: Electrical General Requirements
- .2 Section 26 05 05: Seismic Restraints.

1.4 STANDARDS

- .1 Install conduit to be embedded in concrete to CSA Standard A23.3 (current edition).

1.5 INTENT

- .1 All power system wiring in the building shall comprise conductors installed in a concealed raceway system unless indicated otherwise.
- .2 ENT conduit is not permitted.

PART 2 MATERIAL

2.1 CONDUITS, FITTINGS, AND FASTENINGS

- .1 Electrical metallic tubing (EMT) shall be galvanized steel. EMT couplings and connectors shall be malleable steel, set screw type. Connectors shall have insulated throats. Cast fittings are not acceptable. Provide water tight connections (complete with silicone sealant to waterproof panel or equipment with knockouts) and water tight couplings in the vertical portion of the conduits and for the first couplings of the horizontal runs where conduits are installed into the top or the side of panels or electrical equipment.
- .2 Unless otherwise indicated, rigid conduit shall be galvanized steel, threaded type. Couplings and connectors shall be galvanized steel, threaded type.
- .3 Flexible conduit shall be steel with connectors of the type clamping the outside surface of the conduit. Liquid-tight flexible conduit shall be complete with liquid-tight fittings, equivalent to T & B 'Super-Tite' 5000 Series. All connectors shall have insulated throats.
- .4 Rigid PVC conduits: Rigid PVC -lpex equal, to CSA C22.2 No. 211-2 and No. 85. DBII conduit – 'lpex' or equal to CSA C22.2 No. 211-1.
- .5 Nylon-Insulated Conduit Bushings: T&B or approved equal.
- .6 Trapeze conduit racks consisting of steel rod supports, strut channel, and conduit P-clamps or "caddy" clips.
- .7 Pull Cord: For 25 mm or larger trade size conduit, use 6 mm diameter polypropylene cord or other approved product.
- .8 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50mm.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Prior to proceeding with the installation of the raceway system, review the proposed routing with the Consultant to ensure routing will provide maximum security of installation and minimum visual objection.
- .2 Wire all power systems in the building in conduit unless noted otherwise. Where permitted by the Canadian Electrical Code, use galvanized EMT unless otherwise specified.
- .3 Ream and de-burr the ends of each conduit length prior to installation. Conduits entering boxes shall be secured in an approved manner to ensure electrical bonding throughout the system.
- .4 Conceal all conduits except in electrical rooms, service rooms where exposed conduit is acceptable and other locations indicated in this Specification or on the Drawings.
- .5 Do not install conduit through structural members unless approved by the Consultant.
- .6 Use rigid PVC conduit for less than 50mm or DBII conduit for 50mm or larger when direct buried in earth and under (or inside) concrete slabs on grade. Except under concrete slab on grade or unless otherwise noted, buried depth of installed conduit shall not be less than 1000mm. Wiring in PVC conduit shall be provided with a separate grounding conductor. Do not use PVC conduits for surface installations.
- .7 Use solvent-welded joints for all PVC conduits.
- .8 Use rigid steel conduit in masonry and at all locations where EMT cannot or will not be effectively protected from damage during construction.
- .9 Use rigid galvanized steel conduit (RGS) at all exterior locations and all locations where conduit is both exposed and within 450mm of the floor. Joints shall be made watertight.
- .10 Use rigid steel conduit at all points where conduits emerge from concrete floors, columns or walls. Provide concrete curbs for floor penetrations except where noted otherwise.
- .11 During building construction cap all open ended conduits.
- .12 Cap and identify all spare conduits left for future use.
- .13 Refer to Section 26 08 00 – Seismic Requirements for requirements for conduits and raceways within concrete or surface-mounted at points crossing building expansion or seismic joints.
- .14 In areas subject to wide temperature changes, install as necessary in long, straight runs of rigid conduit (PVC or steel), expansion fittings and maintain bonding across fitting.
- .15 Install exposed conduits in close parallel groups wherever two or more conduits running in the same direction would otherwise be within 1800 mm of each other and install them parallel or at right angles to building lines, as the case directs.
- .16 Provide spare conduits as shown or as noted. Where conduit stubs are left for future extension, cap them securely and dimension the location of the capped end clearly and accurately on the record drawings.
- .17 Install a pull cord in all empty conduits where both conduit ends are accessible. 6mm polypropylene pull cord shall be provided in all conduits smaller than 100mm diameter. Conduits 100mm diameter or larger shall have 9.5mm polypropylene pull cords.
- .18 Identify conduits as they are being installed.

- .19 Conductor fill of raceways shall be in accordance with Table 6 of the latest edition of the Canadian Electrical Code, for RW75, R90 – 1000V conductors regardless of the type of conductor installed. Note particularly that the Code in other sections of Table 6 does permit greater conduit fill for other type of conductors. However, the limitations of this paragraph shall nevertheless apply to this Contract.
- .20 Where not applicable, maintain maximum 40% fill.
- .21 Conduits installed in a manner other than that specified above shall be removed and replaced.
- .22 Provide fire and smoke seals, in accordance with Section 26 05 04 – Fire Separation Penetrations.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .38 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1-15 whether indicated on not on the contract drawings.

1.2 PRODUCT DATA

- .39 Submit product data in accordance with Section 26 05 00.

PART 2 PRODUCTS

2.1 DISCONNECT EQUIPMENT

- .1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4.
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA enclosure Type 1, size as indicated.
- .4 Provision for padlocking in 'off' switch position.
- .5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits.
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Weatherproof as required.

2.1 EQUIPMENT IDENTIFICATION

- .10 Provide identification lamacoid for main fused switch.

2.2 MAINTENANCE MATERIALS

- .11 Provide maintenance materials in accordance with Section 26 05 00
- .12 For disconnect switch less than 50A, provide two spares disconnect switches for each different size and type.

PART 3 EXECUTION

3.1 INSTALLATION

- .13 Install disconnect switches complete with fuses where indicated or required.
- .14 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Mechanical: Divisions 21 and 22

1.2 REQUIREMENTS

- .2 Provide a complete system of wiring to motors and mechanical controls as specified herein and as shown on the drawings.
- .3 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under contracts related to this project or relocated as part of the scope. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other divisions.
- .4 Unless specifically noted otherwise, supply all disconnects, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.
- .5 Do not operate motors and controls until approval is obtained from the trade providing equipment.
- .6 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades' drawings and shop drawings.
- .7 Assist in placing in operation all mechanical equipment having electrical connections.
- .8 Provide all power wiring for all motors.
- .9 The motor control work which shall be provided under Division 26 shall include the following:
 - 3.7.1.1 All conduit and control wiring specifically noted on the drawings and outlined in the different parts of the Specification.
 - 3.7.1.2 Control wiring related to air handling shutdown during fire alarm.

PART 2 PRODUCTS

2.1 120 VOLT, 1 PHASE DISCONNECT SWITCHES

- .1 Manual disconnect switch HP rated (starter) without overload relay.

2.2 208 VOLT, 1 PHASE MOTOR DISCONNECT SWITCHES

- .2 Manual disconnect switch HP rated (starter) without overload relay – two pole.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Provide disconnect switches adjacent to all motors.
- .2 Do control wiring as indicated on the drawings.

END OF SECTION

- PART 1 GENERAL**
- 1.1 RELATED WORK
- .1 Section 26 05 21 – Wires and Cables 0-1000 V – Wiring.
 - .2 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings – Conduits.
- 1.2 REFERENCES
- .1 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
 - .2 CAN/ULC-S537, Verification of Fire Alarm Systems.
- 1.3 SCOPE OF WORK
- .1 Mission Medium Institution Mechanical Watermain Replacement DCW & Sprinkler Valves Replacement Project includes new wiring to the new tamper and pressure switches (by div 25) to the nearest isolation module. Provide new isolation module as required and relay for new additions. Installation to follow CAN/ULC-S524 amendment 1 and Verification to follow CAN/ULC-S524-13. Follow other applicable codes and standards for Canadian/British Columbia facilities for installation and verification. Provide same type of wires as existing, assuming wires are per manufacturer's instruction.
 - .2 Allow for re-verification once the tamper, flow and pressure switches is installed with the cabling. Provide the re-verification documentations clearly stated that 'it is a fully functional systems'. Follow the existing wiring method for the new scope.
 - .3 Work to be completed to the level of acceptance by the Authority Having Jurisdiction (AHJ).
- 1.4 REQUIREMENTS OF REGULATORY AGENCIES
- .1 System components: listed by ULC and comply with applicable provisions of National Building Code and meet requirements of local authority having jurisdiction.
- 1.5 OPERATION AND MAINTENANCE DATA
- .1 Provide operation and maintenance data for incorporation into manual specified in Division 1.
 - .2 Include:
 - .1 Technical data – illustrated parts lists with parts catalogue numbers.
 - .2 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .3 List of recommended spare parts for system.
- PART 2 PRODUCTS**
- 2.1 MATERIALS
- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
 - .2 Existing Fire Alarm Panel (FAP) is a manufactured by EST.
- 2.2 WIRING
- .1 Copper conductors.
 - .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

- .3 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
 - .4 Risers: twisted, shielded pairs, configured to eliminate interference and cross-talk.
- 2.3 ANCILLARY DEVICES
- .1 Remote relay unit to initiate fan shutdown.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-4.
- .2 Install central control unit and connect to AC power supply, AC/DC standby power.
- .3 Connect alarm circuits to main control panel.
- .4 Connect signalling circuits to main control panel.
- .5 Install end-of-line devices at end of alarm and signalling circuits.
- .6 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .7 Splices are not permitted.
- .8 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .9 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .10 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.2 FIRE ALARM SYSTEM TESTING AND VERIFICATION

- .1 Under listed work shall be carried out for all fire alarm and emergency voice system installations in the new building, renovated areas of the existing building and any other areas in the existing building affected by the changes and additions to the existing fire alarm and emergency voice systems. Note that in accordance with CAN/ULC-S536, Standard for Inspection and Testing of Fire Alarm Systems, replacement of any Control Panel requires that all existing fire alarm devices be tested. Include for all required work to comply.
- .2 Inspect installations of all components for compliance with the manufacturer's instruction and recommendations.
- .3 Verify the components comply with the ULC standards for fire alarm devices.
- .4 Verify the installation of the fire alarm systems comply with CAN/ULC-S524-M91, Standard for the Installation of Fire Alarm Systems.
- .5 Check wiring is properly terminated and identified.
- .6 In conjunction with the manufacturer, test and verify the system in accordance with:
 - .1 CAN/ULC-S537-M87, Standard for Verification of Fire Alarm System Installations.
 - .2 Requirements of authorities having jurisdiction

- .7 Arrange for authorities having jurisdiction to witness and approve testing of the Fire Alarm system.
- .8 Prepare, complete, sign and submit detailed verification forms.
- .9 Provide final PROM program re-burn for incorporating program changes made during construction.
- .10 Testing and verification to include but not necessarily be limited to the following. Include also for all items required by the pertinent Canadian Standards that may not be in following list:
 - .1 When testing and verifying, the contractor needs to confirm that the signal is received at the existing main institute Fire Alarm Panel in CER Room in Administration building and FireWorks computer graphics.
 - .2 At the completion of the installation of all system equipment and devices and after the connection to all elevators, escalators, motors, fans, ventilation and smoke controls, test and verify the entire system using the supervisory services of the approved independent testing company, under the supervision of a registered professional engineer.
 - .3 After the testing and verification task is completed, and all deficiencies rectified, notify the Departmental Representative and the representatives of the Fire Department and in their presence demonstrate the proper functioning of the entire system.
 - .4 The purpose of a verification procedure for the system is to make certain that all equipment operates as intended. Provide upon completion of the verification procedures, an approved certificate of verification to the Departmental Representative. Display one copy near the control panel, and retain a copy with the system documentation. Provide an equipment schedule, listing each device and showing confirmation that it was verified.
 - .5 The verifying agent is to be a member in good standing of the Canadian Fire Alarm Association (C.F.A.A.) and shall have the work carried out under the supervision of a registered professional engineer.
 - .6 The verifying agent to employ technicians certified and approved for fire alarm system testing and verification by Canadian Fire Alarm Association (C.F.A.A.).
 - .7 Inspect all equipment installed as part of the system for visible damage or tampering which might interfere with its intended operation.
 - .8 Test devices which are field adjustable to ensure that their settings are acceptable under ambient conditions at the location of installation.
 - .9 Operate each and every manual initiating device to verify their proper operation.
 - .10 Use a heat source to test the operation of each and every heat detector, resettable or self-restoring.
 - .11 Each and every heat detector, non-resettable: simulate the detectors operation by shorting terminals on the detector base.
 - .12 Each and every smoke detector, area type: Test detector sensitivity according to the manufacturer's recommendations. Test detector operation by introducing "simulated smoke" into the detector.
 - .13 Test all audible signal appliances for acceptable operation. Make tests to determine that the signal is audible throughout the building above normal ambient noise. Make tests to verify that adequate power is available from both normal and standby sources under the maximum system load.
 - .14 Make installation of additional signals or revisions to power sources to ensure audibility prior to completion of the inspection before a certificate of verification can

- be issued.
- .15 Test annunciators to ensure proper operation, correct voltage, correct zoning and visibility of all legends.
 - .16 Inspect the system power supply to ensure that is properly fused, locked away from unauthorized interruption, adequately sized. A rated load cycle is the total energy consumed by supervisory current plus supervisory alarm signal current for 24 hours followed by 30 minutes of full evacuation alarm operation.
 - .17 Inspect battery units for protection from accidental damage and for adequate ventilation. Connect batteries permanently to a properly fused charging circuit dedicated to the alarm system batteries.
 - .18 Test all control equipment for acceptable operation. Make an inspection and test of all cable terminals, plus connectors, plug-in circuits, lamp sockets and controls to confirm that their mechanical and electrical connections and mounting are acceptable, and where applicable to confirm their electrical supervision.
 - .19 Verify that field wiring is terminated on a single conductor per terminal basis.
 - .20 Test all lamps and indicators for acceptable operation. Operate all control functions to verify correct response. Perform simulation of open circuits, short circuits and ground fault on all relevant components to confirm proper trouble circuit response.
 - .21 Test the remote central station connection for acceptable operation.
 - .22 Test sprinkler flow switches, supervisory valves and pressure switches for acceptable operation.
- .11 On completion of all tests and verification provide the Departmental Representative with a certificate of test and verification and proof of liability insurance for tests and verification.
 - .12 Include all costs involved in this inspection for both the manufacturer and the approved testing agent and the electrical contractor's work.
 - .13 Contractor to provide the required electricians to the testing agent throughout the testing period. Also, the contractor shall provide the testing agent with all lamps, equipment etc. necessary to perform the testing and verification.

END OF SECTION

PART 1

GENERAL

- 1.1. RELATED SECTIONS
 - .1 Section 01 01 50 – General Instructions.
 - .2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
 - .3 Section 32 11 16.01 – Granular Sub-Base.
 - .4 Section 32 11 23 – Aggregate Base Courses.
 - .5 Section 33 05 13 – Manhole Structures.
 - .6 Section 33 11 16 – Watermains.
- 1.2. REFERENCES
 - .1 ASTM; AWWA; CAN – As specified in the contract document.
- 1.3. SAMPLES
 - .1 Submit samples in accordance with Section 01 01 50 – General Instructions.
 - .2 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.
- 1.4. WASTE MANAGEMENT AND DISPOSAL
 - .1 Divert unused granular materials from landfill to local facility as approved by Departmental Representative.

PART 2

PRODUCTS

- 2.1 MATERIALS
 - .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
 - .2 Flat and elongated particles of coarse aggregate: to ASTM D 4791.
 - .1 Greatest dimension to exceed five times least dimension.
 - .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand.
 - .2 Manufactured sand.
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
 - .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Lightweight aggregate, including slag and expanded shale.

- 2.2 SOURCE QUALITY CONTROL
- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.
 - .2 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
 - .3 Advise Departmental Representative 4 weeks in advance of proposed change of material source.
 - .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3

EXECUTION

- 3.1 PREPARATION
- .1 Topsoil stripping:
 - .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas as directed by Departmental Representative after area has been cleared of brush and grasses and removed from site.
 - .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.
 - .4 Dispose of topsoil to location as indicated off site.
 - .2 Aggregate source preparation:
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as approved by authority having jurisdiction.
 - .2 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
 - .3 Trim off and dress slopes of waste material piles and leave site in neat condition.
 - .3 Processing
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Departmental Representative.

- .3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
 - .4 Handling:
 - .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
 - .5 Stockpiling:
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
- 3.2 CLEANING
- .1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
 - .2 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.

END OF SECTION

PART 1

GENERAL

- 1.1. RELATED SECTIONS
 - .1 Section 01 35 43 – Environmental Procedures.
 - .2 Section 31 05 16 – Aggregate Materials.
 - .3 Section 31 23 16 26 – Rock Removal.
 - .4 Section 33 05 13 – Manholes and Catch Basin Structures.

- 1.2. REFERENCES
 - .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM C 117, Standard Test Method for Material Finer than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
 - .3 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

- 1.3. DEFINITIONS
 - .1 Excavation classes: one class of excavation will be recognized; common excavation.
 - .1 Rock: solid material in excess of 1.00m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 1.0m³ bucket. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

- .2 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1.
 - .2 Coarse grained soils containing more than 10 % by mass passing 0.075mm sieve.
- .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4. QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.
- .3 Keep design and supporting data on site.
- .4 Engage Section 31 23 33 01 services of qualified professional Engineer who is registered or licensed in Province of BC, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .5 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety Requirements.

- 1.5. WASTE MANAGEMENT AND DISPOSAL .1 Divert excess materials from landfill to local facility for reuse.
- 1.6. EXISTING CONDITIONS .1 Buried services:
- .1 Before commencing work establish location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify applicable Departmental Representative, establish location and state of use of buried utilities and structures.
 - .6 Confirm locations of buried utilities by careful soil hydrovac methods.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing/re- routing.
 - .9 Record location of maintained, re-routed and abandoned underground lines.
 - .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
- .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

PART 2

PRODUCTS

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties to Section 31 05 16 – Aggregate Materials and the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.2.

.2 Table

Sieve Designation	Percent Passing
100mm	100
75mm	100
50mm	70-100
25mm	50-100
4.75mm	22-100
2.36mm	10-85
0.075mm	0-5

- .3 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, refuse or other deleterious materials.

PART 3

EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENT CONTROL

- .1 All Erosion and Sediment Control to be completed as per Section 01 35 43 – Environmental Procedures 1.6.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION AND PROTECTION

- .1 Protect existing features.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

- 3.4 STRIPPING OF TOPSOIL
 - .1 Begin topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.
 - .2 Strip topsoil to depths as directed by Departmental Representative.
 - .1 Do not mix topsoil with subsoil.
 - .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2m and should be protected from erosion.
 - .4 Dispose of unused topsoil off site.
- 3.5 STOCKPILING
 - .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
 - .2 Protect fill materials from contamination.
 - .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.
- 3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING
 - .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 33 – Health and Safety Requirements.
 - .2 During backfill operation:
 - .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500mm above toe of sheeting.
- 3.7 DEWATERING AND HEAVE PREVENTION
 - .1 Riprap and headwall installation are to be done at low tides and in dry conditions.
 - .2 Keep excavations free of water while Work is in progress.
 - .3 Provide for Departmental Representative's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
 - .4 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
 - .5 Protect open excavations against flooding and damage due to surface run-off.

- .6 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .7 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.8 EXCAVATION

- .1 Excavate to lines, grades, elevations and dimensions as indicated.
- .2 Remove concrete, masonry, paving, walks demolished foundations and rubble and other obstructions encountered during excavation.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material off site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

- .12 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with Type 2 fill compacted to not less than 100% of corrected Modified Proctor maximum density.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected Modified Proctor maximum density.
- .13 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- 3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES
 - .1 Place and compact granular material for bedding and surround of underground services as indicated.
 - .2 Place bedding and surround material in unfrozen condition.
- 3.10 BACKFILLING
 - .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
 - .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
 - .3 Do not use backfill material which is frozen or contains ice, snow or debris.
 - .4 Place backfill material in uniform layers not exceeding 300mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
 - .5 Backfilling around installations:
 - .1 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.30m.

3.11 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as directed by Departmental Representative.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24-hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

PART 1

GENERAL

- 1.1. RELATED SECTIONS
 - .1 Section 01 35 00.06 – Special Procedures for Traffic Control.
 - .2 Section 31 05 16 – Aggregate Materials.
- 1.2. REFERENCES
 - .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 422, Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .6 ASTM D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .7 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .8 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- 1.3. WASTE MANAGEMENT AND DISPOSAL
 - .1 Divert unused granular material from landfill to local facility.

PART 2

PRODUCTS

2.1 MATERIALS

- .1 Granular sub-base material: in accordance with Section 31 05 16 – Aggregate Materials and following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.2.

.3 Table

SIEVE DESIGNATION	PERCENT PASSING
75mm	100
38mm	60-100
25mm	-
19mm	35-80
12.5mm	-
9.5mm	26-60
4.75mm	20-40
2.36mm	15-30
1.18mm	10-20
0.6mm	5-15
0.3mm	3-10
0.180mm	-
0.075mm	0-5

- .4 Other properties as follows:
 - .1 Liquid Limit: to ASTM D 4318, Maximum 25.
 - .2 Plasticity Index: to ASTM D 4318, Maximum 6.
 - .3 Los Angeles degradation: to ASTM C 131. Max% Loss by mass: 40.

PART 3

EXECUTION

3.1 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 Place material to full width in uniform layers not exceeding 300mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 95% Modified Proctor Density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 Compaction of each lift of backfill material shall be verified through in-place density testing by the nuclear densometer method.
- .6 Contractor to provide test reports from an independent testing agency to Departmental Representative indicating specified compaction has been achieved.
- .7 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .8 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

- 3.3 SITE TOLERANCES
 - .1 Finished sub-base surface to be within 15mm of elevation as indicated but not uniformly high or low.

- 3.4 PROTECTION
 - .5 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

PART 1

GENERAL

- 1.1. RELATED SECTIONS
 - .1 Section 01 35 00.06 – Special Procedures for Traffic Control.
 - .2 Section 32 11 16.01 – Granular Sub-Base.
 - .3 Section 31 05 16 – Aggregate Materials.

- 1.2 REFERENCES
 - .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .5 ASTM D 1557-[00], Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .6 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .7 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

- 1.3 WASTE MANAGEMENT AND DISPOSAL
 - .1 Divert unused granular material from landfill to local facility.

PART 2

PRODUCTS

- 2.1 MATERIALS
 - .1 Granular base: material in accordance with Section 31 05 16 – Aggregate Materials and following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.2.

.1 Gradation Method #1 to:

SIEVE DESIGNATION	PERCENT PASSING
19mm	100
12.5mm	75-100
9.5mm	60-90
4.75mm	40-70
2.36mm	27-55
1.18mm	16-42
0.600mm	8-30
0.300mm	5-20
0.075mm	2-8

PART 3

3.1 SEQUENCE OF OPERATION

EXECUTION

- .1 Place granular base after sub-base surface is inspected and approved by Departmental Representative.
- .2 Placing:
 - .1 Construct granular base to depth and grade in areas indicated.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow and ice.
 - .4 Begin spreading base material on crown line or on high side of one-way slope.
 - .5 Place material using methods which do not lead to segregation or degradation of aggregate.
 - .6 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
 - .7 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
 - .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - .9 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment:
 - .1 Compaction equipment to be capable of obtaining required material densities.

- .4 Compacting:
 - .1 Compact to density not less than 100% Standard Proctor Density.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
 - .5 Contractor to provide test reports from an independent testing agency to Department Representative indicating specified compaction has been achieved.
 - .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
 - .5 Where compaction tests reveal areas of defective subgrade:
 - .1 Remove base, sub-base and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with sub-base material and compact in accordance with Section 32 11 16.01 – Granular Sub-Base.
 - .3 Replace sub-base material and compact in accordance with Section 32 11 16.01 – Granular Sub-base.
 - .4 Replace base material and compact in accordance with this Section.
 - .6 Where compaction tests reveals defective base or sub-base, remove defective materials to depth and extent as required and replace with new materials in accordance with Section 32 11 16.01 – Granular Sub-base and this section at no extra cost.
- 3.2 SITE TOLERANCES
- .1 Finished base surface to be within plus or minus 10mm of established grade and cross section but not uniformly high or low.
- 3.3 PROTECTION
- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

PART 1

GENERAL

- 1.1. SECTION INCLUDES .1 Materials and application of asphalt prime to granular base surface prior to asphalt paving.
- 1.2. RELATED SECTIONS .1 Section 01 01 50 – General Instructions.
.2 Section 01 35 00.06 – Special Procedures for Traffic Control.
.3 Section 32 12 16 – Asphalt Paving.
- 1.3. REFERENCES .1 American Society for Testing and Materials.
.2 International, (ASTM):
 - .1 ASTM D 140, Standard Practice for Sampling Bituminous Materials.
.3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-16.1, Cutback Asphalts for Road Purposes.
 - .2 CAN/CGSB-16.2, Emulsified Asphalts, Anionic Type, for Road Purposes.
- 1.4. QUALITY ASSURANCE .1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.
- 1.5. DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials to ASTM D 140.
.2 Provide, maintain and restore asphalt storage area.
- 1.6. WASTE MANAGEMENT AND DISPOSAL .1 Divert unused asphalt materials from landfill to local facility approved by Departmental Representative.
.2 Divert unused aggregate materials from landfill to local facility approved by Departmental Representative.

PART 2

PRODUCTS

- 2.1 MATERIAL .1 Asphalt material: to CAN/CGSB-16.1 grade: RM-20 or CAN/CGSB-16.2 grade: SS-1.
.2 Sand blotter: clean granular material passing 4.75mm sieve and free from organic matter or other deleterious materials.
.3 Water: clean, potable, free from foreign matter.
- 2.2 EQUIPMENT .1 Pressure distributor to be:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5m.

- .3 Applied at controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m².
- .4 Distributed in uniform spray without atomization at temperature required.
- .2 Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
- .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment.
- .8 Cleaned if previously used with incompatible asphalt material.

PART 3

EXECUTION

3.1 APPLICATION

- .1 Obtain Departmental Representative's approval of granular base surface before applying asphalt prime.
- .2 Cutback asphalt:
 - .1 Heat asphalt prime to between 60 and 70°C for pumping and spraying.
 - .2 Apply asphalt prime to granular base at rate as directed by Departmental Representative, but not to exceed 2 L/m².
 - .3 Apply on dry surface unless otherwise directed by Departmental Representative.
- .3 Anionic emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
 - .2 Mix thoroughly by pumping or other method approved by Departmental Representative.
 - .3 Apply diluted asphalt emulsion at rate directed by Departmental Representative, but do not exceed 5 L/m².
 - .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Departmental Representative.
- .4 Apply asphalt prime only on unfrozen surface.

- .5 Do not apply prime when air temperature is less than 5°C or when rain is forecast within 2-hours.
- .6 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .7 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .8 Prevent overlap at junction of applications.
- .9 Do not prime surfaces that will be visible when paving is complete.
- .10 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
- .11 Keep traffic off primed areas until asphalt prime has cured.
- .12 Permit prime to cure before placing asphalt paving.

3.2 USE OF SAND BLOTTER

- .1 If asphalt prime fails to penetrate within 24-hours, spread sand blotter material in amounts required to absorb excess material.
- .2 Allow sufficient time for excess prime to be absorbed as directed by Departmental Representative.
- .3 Apply second application of sand blotter as required.
- .4 Sweep and remove excess blotter material.

END OF SECTION

PART 1

GENERAL

- 1.1. SECTION INCLUDES .4 Materials and application of asphalt tack coat to an existing asphalt or concrete surface prior to asphalt paving.
- 1.2. RELATED SECTIONS .2 Section 01 01 50 – General Instructions.
.3 Section 01 35 00.06 – Special Procedures for Traffic Control.
.4 Section 32 12 16 – Asphalt Paving.
- 1.3. MEASUREMENT PROCEDURES .1 All work included in this section shall be included in the lump sum bid for all materials, equipment and labour for the scope of work shown on the plans and specifications.
- 1.4. REFERENCES .1 American Society for Testing and Materials:
 - .1 International, (ASTM) ASTM D 140, Standard Practice for Sampling Bituminous Materials..2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-16.2, Emulsified Asphalts, Anionic Type, for Road Purposes.
- 1.5. QUALITY ASSURANCE .1 Upon request by Departmental Representative, submit manufacturer's test data and certification that asphalt tack coat material meets requirements of this section.
- 1.6. DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with ASTM D 140.
.2 Provide, maintain and restore asphalt storage area.
- 1.7. WASTE MANAGEMENT AND DISPOSAL .1 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2

PRODUCTS

- 2.1 MATERIALS .1 Anionic emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1.
.2 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

- .1 Pressure distributor to be:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5m.
 - .3 Applied at readily determined and controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.1 L/m².
 - .4 Distributed in uniform spray without atomization at temperature required.
 - .2 Equipped with meter, registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
 - .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
 - .4 Equipped with an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .5 Equipped with accurate volume measuring device or calibrated tank.
 - .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
 - .7 Equipped with nozzle spray bar, with operational height adjustment.
 - .8 Cleaned if previously used with incompatible asphalt material.

PART 3

EXECUTION

3.1 APPLICATION

- .1 Obtain Departmental Representative's approval of surface before applying asphalt tack coat.
- .2 Apply asphalt tack coat only on clean and dry surface.
- .3 Dilute asphalt emulsion with water at 1:1 ratio for application.
 - .1 Mix thoroughly by pumping or other method approved by Departmental Representative.
- .4 Apply asphalt tack coat evenly to pavement surface at rate as directed by Departmental Representative, but not to exceed 5 L/m².

- .5 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.
- .6 Do not apply asphalt tack coat when air temperature is less than 5°C or when rain is forecast within 2-hours of application.
- .7 Apply asphalt tack coat only on unfrozen surface.
- .8 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.
- .9 Where traffic is to be maintained, treat no more than one half of width of surface in one application.
- .10 Keep traffic off tacked areas until asphalt tack coat has set.
- .11 Re-tack contaminated or disturbed areas as directed by Departmental Representative.
- .12 Permit asphalt tack coat to set before placing asphalt pavement.

END OF SECTION

PART 1

GENERAL

- 1.1. SECTION INCLUDES
 - .1 Materials and installation for asphalt concrete paving for roads and airport runways.
- 1.2. RELATED SECTIONS
 - .1 Section 01 01 50 – General Instructions.
 - .2 Section 01 35 00.06 – Special Procedures for Traffic Control.
 - .3 Section 31 05 16 – Aggregate Materials.
 - .4 Section 32 12 15 – Asphalt Tack Coats.
 - .5 Section 32 12 14 – Asphalt Prime Coats.
- 1.3. MEASUREMENT PROCEDURES
 - .1 All work included in this section shall be included in the lump sum bid for all materials, equipment and labour for the scope of work shown on the plans and specifications.
- 1.4. REFERENCES
 - .1 American Association of State Highway and Transportation Officials (AASHTO):
 - .1 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245, Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
 - .2 Asphalt Institute (AI):
 - .1 AI MS2 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
 - .3 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM C 88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM C 117, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C 123, Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C 127, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .5 ASTM C 128, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .6 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .7 ASTM C 136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

- .8 ASTM C 207, Standard Specification for Hydrated Lime for Masonry Purposes.
- .9 ASTM D 995, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- .10 ASTM D 2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- .11 ASTM D 3203, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .12 ASTM D 4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1, Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-16.3, Asphalt Cements for Road Purposes.
- 1.5. PRODUCT DATA
 - .1 Submittals in accordance with Section 01 01 50 – General Instructions.
 - .2 Submit manufacturer's test data and certification that asphalt cement meets requirements of this Section.
 - .3 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least 4 weeks prior to beginning Work.
- 1.6. SAMPLES
 - .3 Submit samples in accordance with Section 01 01 50 – General Instructions.
- 1.7. DELIVERY, STORAGE AND HANDLING
 - .2 Deliver and stockpile aggregates in accordance with Section 31 05 16 – Aggregate Materials.
- 1.8. WASTE MANAGEMENT AND DISPOSAL
 - .1 Separate waste materials for reuse and recycling.
 - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
 - .3 Divert unused aggregate materials from landfill to facility for reuse.
 - .4 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2

PRODUCTS

2.1 MATERIALS

- .1 Asphalt cement: to CAN/CGSB-16.3, grade: 80-100.
- .2 Reclaimed asphalt pavement:
 - .1 Crushed and screened so that 100% of RAP material passes 50mm screen before mixing.

- .3 Aggregates: in accordance with Section 31 05 16 – Aggregate Materials. General following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117.
 - .3 Table:

PERCENT PASSING				
Sieve Designation	Lower Course #1	Lower Course #2	Upper Course #1	Upper Course #2
25.0mm	100	--	--	--
19.0mm	--	100	100	--
12.5mm	70-85	84-99	84-99	100
9.5mm	--	73-88	73-88	--
4.75mm	40-65	50-68	50-68	55-75
2.36mm	32-53	35-55	35-55	38-58
1.18mm	26-44	27-46	27-46	28-47
0.600mm	18-36	18-36	18-36	20-36
0.300mm	10-26	10-26	10-26	10-26
0.150mm	4-17	4-17	4-17	4-17
0.075mm	3-8	3-8	3-8	3-8

Lower Course #1 – Highway 4, lower course only

Lower Course #2 – Local Roadways, lower course only

Upper Course #1 – Highway 4, upper course only

Upper Course #2 – Local Roadways, surface course only

- .4 Coarse aggregate: aggregate retained on 4.75mm sieve and fine aggregate is aggregate passing 4.75mm sieve when tested to ASTM C 136.
- .5 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75mm sieve and stockpile separately from coarse aggregate.
- .6 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .7 Sand equivalent: ASTM D 2419 Min: 40.
- .8 Magnesium Sulphate soundness: to ASTM C 88 Max% loss by mass:
 - .1 Coarse aggregate surface course: 15%.
 - .2 Coarse aggregate lower course: 15%.
 - .3 Fine aggregate, surface course: 18%.
 - .4 Fine aggregate, lower course: 18%.
- .9 Los Angeles degradation: Grading B, to ASTM C 131 Max % loss by mass:
 - .1 Coarse aggregate, surface course: 25%.
 - .2 Coarse aggregate, lower course: 35%.

- .10 Absorption: to ASTM C 127 Max % by mass:
 - .1 Coarse aggregate, surface course: 1.75%.
 - .2 Coarse aggregate, lower course: 2.00%.
- .11 Loss by washing: to ASTM C 117 Max % passing 1.75mm sieve:
 - .1 Coarse aggregate, surface course: 1.5.
 - .2 Coarse aggregate, lower course: 2.0.
- .12 Flat and elongated particles: to ASTM D 4791, (with length to thickness ratio greater than 5); Max% by mass:
 - .1 Coarse aggregate, surface course: 10%.
 - .2 Coarse aggregate, lower course: 10%.
- .13 Crushed fragments: at least 60% of particles by mass within each of following sieve designation ranges, to have at least 2 freshly fractured face. Material to be divided into ranges, using methods of ASTM C 136.

PASSING	RETAINED ON
[25]mm	to 12.5mm
[12.5]mm	to 4.75mm

- .14 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .4 Mineral filler:
 - .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
 - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
 - .3 Mineral filler to be dry and free flowing when added to aggregate.
- .5 Water: to approval of Departmental Representative.

2.2 EQUIPMENT

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Minimum drum diameter: 1200mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5mm for lifts less than 40mm thick.

- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .4 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
 - .2 Tamping irons having mass not less than 12 kg and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative may be used instead of tamping irons.
 - .3 Straight edges, 3.0m in length, to test finished surface.

2.3 MIX DESIGN

- .1 Mix design to be developed by testing laboratory approved by Departmental Representative.
- .2 Mix to contain maximum 20% by mass of RAP. Departmental Representative may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.
- .3 Design of mix: by Marshall method to requirements below.
 - .1 Compaction blows on each face of test specimens: 75.
 - .2 Mix physical requirements:

PROPERTY		PAVEMENT COURSE	
Marshall Stability at 60°C	kN min	6.4	Lower Course
		5.5	Upper Course
Flow Value	mm	2-4	
Air Voids in Mixture	%	3-6	Lower Course
		3-5	Upper Course
Voids in Mineral Aggregate	% min	13	Lower Course 1
		14	Lower Course 2
		14	Upper Course 1
		15	Upper Course 2
Index of Retained Stability	% min	75	

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to ASTM D1559.

- .4 Do not change job-mix without prior approval of Departmental Representative. When change in material source proposed, new job-mix formula to be reviewed by Departmental Representative.

PART 3

EXECUTION

3.1 PLANT AND MIXING REQUIREMENTS

- .1 Batch and continuous mixing plants:
 - .1 To ASTM D 995.
 - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Do not load frozen materials into bins.
 - .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
 - .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .5 Before mixing, dry aggregates to moisture content not greater than 1% by mass or to lesser moisture content if required to meet mix design requirements.
 - .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
 - .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
 - .8 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above 160°C.
 - .9 Maintain temperature of materials within 5°C of specified mix temperature during mixing.
 - .10 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
 - .3 Do not alter mixing time unless directed by Departmental Representative.
 - .11 Where RAP is to be incorporated into mix:
 - .1 Feed from separate cold feed bin specially designed to minimize consolidation of material. Provide 37.5mm scalping screen on cold feed to remove oversized pieces of RAP.
 - .2 Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti-rollback device to prevent material from sliding backward on feed belt.

- .3 Combine RAP and new aggregates in proportions as directed by Departmental Representative. Dry mix thoroughly, until uniform temperature within plus or minus 5°C of mix temperature, as directed by Departmental Representative Consultant is achieved prior to adding new asphalt cement. Do not add new asphalt cement where temperature of dried mix material is above 160°C.
- .2 Dryer drum mixing plant:
 - .1 To ASTM D 995.
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Where RAP is to be incorporated into mix, dryer drum mixer is to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180°C.
 - .5 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.
 - .6 Meter total flow of aggregate and RAP by an electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate RAP and asphalt entering mixer remain constant.
 - .7 Provide for easy calibration of weighing systems for aggregates and RAP without having material enter mixer.
 - .8 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved. Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time. Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 2%.
 - .9 Make provision for conveniently sampling full flow of materials from cold feed.
 - .10 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.
 - .11 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.

- .12 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each [week] [day].
- .13 Mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 0.5%.
- .3 Temporary storage of hot mix:
 - .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 12-hours.
- .4 Mixing tolerances:
 - .1 Permissible variation in aggregate gradation from job mix (percent of total mass).

4.75mm sieve and larger	5.5
2.00mm sieve	4.5
0.425mm sieve	3.5
0.180mm sieve	2.5
0.075mm sieve	1.5
 - .2 Permissible variation of asphalt cement from job mix: 0.3%.
 - .3 Permissible variation of mix temperature at discharge from plant: 5°C.
- .5 Addition of anti-stripping agent:
 - .1 Plant to be equipped with pug mill to thoroughly mix aggregates and lime prior to entering the plant.
 - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
 - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
 - .4 Plant to be equipped to control rate of lime incorporation to within 1/4%.
 - .5 Add water to aggregate prior to entering pug mill.
 - .6 Add water to lime sufficiently in advance to permit time to slake prior to entering pug mill.

- 3.2 TRANSPORTATION OF MIX
- .1 Transport mix to job site in vehicles cleaned of foreign material.
 - .2 Paint or spray truck beds with limewater, soap or detergent solution, or non-petroleum based commercial product, at least daily or as required. Elevate truck bed and thoroughly drain. No excess solution to remain in truck bed.
 - .3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.
 - .4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation. Do not dribble mix into trucks.
 - .5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
 - .6 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than 125°C.
- 3.3 PLACING
- .1 Obtain Departmental Representative's approval of base and existing surface and tack coat and prime coat prior to placing asphalt.
 - .2 Place asphalt concrete to thicknesses, grades and lines as directed by Departmental Representative.
 - .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is above 5°C.
 - .2 When temperature of surface on which material is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
 - .4 Place asphalt concrete in compacted lifts of thickness as follows:
 - .1 Levelling courses to thicknesses required but not exceeding 100mm.
 - .2 Lower course in layers of 50mm each.
 - .3 Surface course in layers of maximum 50mm each.
 - .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300mm.

- .6 Spread and strike off mixture with self-propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings. Departmental Representative to establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30m apart.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .6 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
 - .7 Do not throw surplus material on freshly screeded surfaces.
- .7 When hand spreading is used:
 - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
 - .2 Distribute material uniformly. Do not broadcast material.
 - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
 - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
 - .5 Provide heating equipment to keep hand tools free from asphalt. Control temperature to avoid burning material. Do not use tools at higher temperature than temperature of mix being placed.

3.4 COMPACTING

- .1 Roll asphalt continuously to density not less than 97% of 75 blow Marshall density to ASTM D1559 with no individual test less than 95%. Contractor to provide test reports from an independent testing agency to Departmental Representative indicating acceptable densities have been achieved.
- .2 General:
 - .1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
- .3 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed 8 km/h for finish rolling.
- .4 Use static compaction for levelling coarse less than 25mm thick.
- .5 For lifts 50mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel. For lifts less than 50mm thick, impact spacing not to exceed compacted lift thickness.
- .6 Overlap successive passes of roller by minimum of 200mm and vary pass lengths.
- .7 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
- .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
- .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
- .10 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side. Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
- .11 When paving in echelon, leave unrolled 50 to 75mm of edge that second paver is following and roll when joint between lanes is rolled.
- .12 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.

3.5 JOINTS

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 150mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100°C prior to paving of adjacent lane.
 - .1 If cold joint cannot be avoided, cut back by saw cutting previously laid lane, by at least 150mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .3 Overlap previously laid strip with spreader by 100mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150mm extending onto previously placed and compacted lane.
- .4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade. Location of feather joints as indicated.
- .5 Construct butt joints as indicated.

3.6 FINISH TOLERANCES

- .1 Finished asphalt surface to be within 6mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 6mm when checked with 3m straight edge placed in any direction.

3.7 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

END OF SECTION

PART 1

GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 03 20 00 – Concrete Reinforcing.
- .3 Section 03 30 00 – Cast-in-Place Concrete.
- .4 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2. REFERENCES

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A 48/A 48M, Standard Specification for Gray Iron Castings.
 - .2 ASTM C 117, Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM C 139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .5 ASTM C 478M, Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
 - .6 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ [600 kN-m/m³]).
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA-A3002, Masonry and Mortar Cement.
 - .3 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .4 CAN/CSA-G30.18, Billet Steel Bars for Concrete Reinforcement.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- 1.3. SUBMITTALS
 - .1 Provide submittals in accordance with Section 01 01 50 – General Instructions.
- 1.4. DELIVERY, STORAGE AND HANDLING
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2

PRODUCTS

- 2.1 MATERIALS
 - .1 Cast-in-place concrete:
 - .1 In accordance with Section 03 30 00 – Cast-in-Place Concrete.
 - .2 Cement: to CAN/CSA-A3001, Type GU 50.
 - .3 Concrete mix design to produce 30 MPa minimum compressive strength at 28-days and containing 25mm maximum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1.
 - .1 Air entrainment to CAN/CSA-A23.1.
 - .4 Concrete reinforcement: in accordance with Section 03 20 00 – Concrete Reinforcing.
 - .2 Precast manhole units: to ASTM C 478M, circular or oval:
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
 - .3 Joints: made watertight using rubber rings to ASTM C443 or cement mortar.
 - .4 Mortar:
 - .1 Aggregate: to CSA A82.56.
 - .2 Masonry Cement: to CAN/CSA-A8.
 - .5 Ladder rungs: to CAN/CSA-G30.18, No. 25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.
 - .1 Rungs to be safety pattern (drop step type).
 - .6 Adjusting rings: to ASTM C 478.
 - .7 Concrete Brick: to CAN3-A165 Series.
 - .8 Drop manhole pipe: same as sewer pipe.
 - .9 Galvanized iron sheet: approximately 2mm thick.
 - .10 Steel gratings, I-beams and fasteners: as indicated.

- .11 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames.
 - .1 Frame with grating or cover to constitute one unit.
 - .2 Assemble and mark unit components before shipment.
 - .2 Cast iron manhole and catch basin frames and covers must conform to ASTM A48 and be designed to withstand H₂O loading.
 - .1 Must bear manufacturer identification on castings.
- .12 Granular bedding and backfill: in accordance with Section 31 05 16 – Aggregate Materials.
 - .1 Concrete mixes and materials: in accordance with Section 03 30 00 – Cast-in-Place Concrete.
- .13 Unshrinkable fill: in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

PART 3

EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS
 - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 EXCAVATION AND BACKFILL
 - .1 Excavate and backfill in accordance with Section 31 23 33.01 – Excavating Trenching and Backfilling and as indicated.
- 3.3 CONCRETE WORK
 - .1 Do concrete work in accordance with Section 03 30 00 – Cast-in-Place Concrete.
 - .2 Place concrete reinforcement in accordance with Section 03 20 00 – Concrete Reinforcing.
 - .3 Position metal inserts in accordance with dimensions and details as indicated.
- 3.4 INSTALLATION
 - .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
 - .2 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
 - .3 Set precast concrete base on 100mm minimum of granular bedding compacted to 95%. Modified proctor density in compliance with ASTM D1557.

- .4 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with Departmental Representative's approval rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with concrete plugs set in cement mortar or mastic compound.
- .5 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.75 times diameter of sewer.
 - .2 Slope adjacent floor at 1-in-20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.
- .6 Compact granular backfill to 95% Modified Proctor Density.
- .7 Place unshrinkable backfill in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .8 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .9 Set frame and cover to required elevation on no more than three courses of brick.
 - .1 Make brick joints and join brick to frame with cement mortar.
 - .2 Parge and make smooth and watertight.
- .10 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .11 Install safety platforms in manholes having depth of 6m or greater, as indicated.

- 3.5 ADJUSTING TOPS OF EXISTING UNITS
- .1 Remove existing gratings, frames and store for re-use at locations designated by Departmental Representative.
 - .2 Sectional units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
 - .1 When amount of raise is less than 300mm use standard manhole brick, moduloc or grade rings.
 - .3 Monolithic units:
 - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150mm or less alteration.
 - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 When monolithic units with tapered upper section are lowered more than 150mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
 - .4 Install additional manhole ladder rungs in adjusted portion of units as required.
 - .5 Re-use existing gratings, frames and I-beams.
- 3.6 SEALING OVER EXISTING UNITS
- .1 Fill with material approved by Departmental Representative.

END OF SECTION

PART 1

GENERAL

- 1.1. DIRECTIONAL DRILLING METHOD
- .1 Directional drilling is the installation of a pipe by drilling a pilot bore from the entry pit to a pre-determined exit location. The drilling head is then replaced with a reamer and the drilling string is pulled back to the entry hole, enlarging the hole while simultaneously pulling the pipeline product into place.
 - .2 Horizontal Directional Drilling (HDD) rig is a mechanical drilling device used to create a borehole through which a pipe or conduit is installed.
 - .3 Return and spoils are the drilling mud and cuttings collected in the entry and exit pits as well as any fluid, which escapes from the borehole to the surface.
- 1.2. MATERIAL CERTIFICATION
- .1 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 4 weeks prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.
- 1.3. SHOP DRAWINGS
- .8 Submit shop drawings in accordance with Division 1.
- 1.4. DESIGN
- .1 Submit methodology design and construction details for the proposed directional boring operation.
 - .2 Methodology to include:
 - a) Drilling, reaming and pipe pulling procedures.
 - b) Equipment specifications and capabilities, size of pilot hole, number and size of pre-reams, use of rollers, baskets and side booms to suspend and direct pipe during pull back, type and capabilities of tracking system, and number of sections in which product is to be installed.
 - c) Schedule of Work.
 - d) Drawing of work site, including location and footprints of equipment, and the locations of the entry, exit and slurry containment pits.
 - e) Drawing of pullback installation showing partial or full closure of roadways and their approximate duration
 - f) Drilling fluid management plan, including drilling fluid containment, recycling/transport and approved disposal site.
 - g) Emergency procedures for inadvertently boring into a live power line, natural gas line, water line, sewer line, or fibre-optic cables. Procedures must comply with regulations.

- h) Method of dealing with inadvertent returns or surface seepage of drilling fluids and spoils.
- i) Design to include:
 - a) Pipe stress calculations for each stage of the installation process as the pipe is pulled through the pilot bore. Stress calculations as follows:
 - I. Internal pressure stress.
 - II. Bending stress.
 - III. Thermal stress.
 - IV. Net longitudinal compressive stress (bending included).
 - V. Equivalent tensile stress available to induce progressive creep strain.
 - VI. Total longitudinal stress from sustained loads.
 - VII. Short term and long-term external differential pressure.
 - b) Submit design analysis and calculations in the form of a technical report, under the seal of a professional engineer, registered in the Province of British Columbia.

1.5. SCOPE OF WORK

- .2 Include all engineering services, plant, labour, material and services for the following:
 - .2 Preparation of the site including removal of vegetation, location of all existing utilities along the proposed path, excavation of all utilities crossing, excavation of entry, exit, and slurry containment pits.
 - .3 Installation of new watermains by the directional drilling method
 - .4 Testing of installed section and restoration of all affected surfaces to their pre-construction conditions.

1.6. RECORD DRAWING:

- .15 Provide record drawings, including details of pipe material, and alignment and location.

PART 2

PRODUCTS

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyethylene pressure pipe:
- .2 CGSB 41-GP-25, ASTM F714 type PE 3408, minimum series:
- .3 150 & 200 num dia. Watermain - DR11
- .4 Diameters as indicated.
- .5 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D2657 where indicated ends to be flanged with ductile iron backing flanges.

- .6 Polyethylene fittings: to CAN/CSA B137.1.
 - .7 Tensile strength and minimum bending radius shall satisfy project requirements. DR ratio indicated is the minimum required to satisfy operational conditions.
 - .8 The pipe shall be free from visual defects such as foreign inclusions, concentrated ridges, pitting, discoloration, varying wall thickness and other deformities.
-
- 2.2 PIPE BEDDING AND SURROUND MATERIAL
 - .1 Refer to section 33 11 16 Watermains
 - .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 – Cast-in-Place Concrete.
 - 2.3 BACKFILL MATERIAL
 - .1 As indicated.
 - 2.4 PIPE DISINFECTION
 - 1 Refer to section 33 11 16 Watermain.

PART 3

EXECUTION

- 3.1 EQUIPMENT
 - .1 Be responsible for the directional drilling method and equipment. Confirm that the drilling rig and mud mixing system have the capacity required to successfully complete the installation as indicated and considering ground and groundwater conditions that can be reasonably foreseen.
 - .2 Operating range and degree of accuracy of proposed tracking system shall be adequate to meet project conditions. Tracking/steering equipment shall allow for continuous monitoring of the drilling head along the entire proposed alignment. If a poor contact with the sound is expected to occur at any section, this should be communicated to the engineer prior to commencement of construction.
 - .3 The drilling unit must be equipped with an electric strike safety package. The package should include warning sound alarm, grounding mats and protective gear.
- 3.2 PRE-COMMENCEMENT
 - .1 Notify owners of subsurface utilities along and on either side of the proposed drill path of the impending work. All utilities along and on either side of the proposed drill path are to be located
 - .2 All utility crossings shall be exposed using hydro-excavation, hand excavation or another approved method to confirm depth.
 - .3 The proposed drill path should be determined and documented, including its horizontal and vertical alignments and the location of buried utilities and substructures along the path.

- .4 Excavations for entrance and exit pits are to be of sufficient size to avoid a sudden radius change of the pipe, and consequently excessive deformation.

3.3 INSTALLATION PROCEDURES

- .1 Only trained operators permitted to operate the drilling equipment, follow manufacturer's operating instructions and safety practices shall always be followed.
- .2 Limit drilling mud pressure in the borehole to not exceed that which can be supported by the overburden to prevent heaving or hydraulic fracturing of the soil ("Frac-out").
- .3 Entrance and exit angles of the drill string should range between 8 and 20 degrees and 5 and 10 degrees, respectively. Any deviation from these values shall first be approved by the Engineer.
- .4 If a drilled hole beneath road or railway must be abandoned, fill the hole with grout or bentonite to prevent future subsidence.
- .5 Use drilling mud during drilling and back-reaming operations.
- .6 Utilize a sufficient number of pre-reams as required to avoid heaving while enlarging the hole to the final diameter.
- .7 During back-reaming, seal the conduit either end with a cap or plug to prevent water, drilling fluids and other foreign materials from entering the pipe as it is being pulled back.
- .8 Use pipe rollers, skates or other protective devices in the installation of the pipe.
- .9 The pilot hole shall be back-reamed to accommodate and permit free sliding of the product inside the borehole according to the following specifications:

<i>Nominal Pipe Diameter (mm)</i>	<i>Back Ream Hole Diameter (mm)</i>
50	75 to 100
75	100 to 150
100	150 to 200
150	250 to 300
200	300 to 350
250	350 to 400
> 300	At least 1.5 times product OD

3.4 PIPE JOINTING

- .1 High density polyethylene
 - 1.1. Assemble and join sections of pipe on the job site above ground, by the butt-fusion method in strict conformance with the manufacturer's printed instructions.

- 1.2. The butt-fusion method for pipe joining shall be carried out in the field by qualified fusion technicians following the pipe and fittings manufacturer's specifications. The joints shall have a smooth, uniform, double rolled back bead made while supplying the proper melt, pressure and alignment. It shall be the sole responsibility of the contractor to provide an acceptable butt-fusion joint.
 - 1.3. All joints shall be made available for inspection by the Engineer before insertion.
- .2 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
 - .3 Shape transverse depressions in bedding as required to suit joints.
 - .4 Compact each layer full width of bed to at least 95% maximum density to ASTM D 698.
 - .5 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 – Excavating Trenching and Backfilling.
- 3.5 DRILLING FLUIDS – COLLECTION AND DISPOSAL PRACTICES
- .1 Excess drilling mud slurry shall be contained in a lined pit or containment pound at exit and entry points until recycled or removed from the site. Entrance and exit pits must be of sufficient size to contain the expected return of drilling mud and spoils.
 - .1 Take all necessary precautions to keep drilling fluids out of streets, manholes, storm sewers, drainage systems and water courses.
 - .2 Recycling drilling fluids is an acceptable alternative to disposal.
 - .3 All diligent efforts to minimize the amount of drilling fluids and cuttings spilled during the drilling operation. Provide complete clean-up of all drilling mud overflow or spills.
- 3.6 ALIGNMENT TOLERANCES
- .1 Install pipe to within plus or minus 0.5 m in any direction of alignment shown on drawings. Provide minimum horizontal clearance of 3.0 m between water main and sewage forcemain.
- 3.7 HYDROSTATIC AND LEAKAGE TESTING
- .1 Refer to Section 33 11 16 – Watermains.

- 3.8 DEFLECTION TESTING
- .1 After the pipe is in place supply and run a sizing pig or mandrel through the completed installation to verify the integrity and roundness of the pipe.
 - .3 Locate point of connection in advance and advise Departmental Representative.
 - .4 Cap or seal end of pipe and place temporary marker to locate pipe end.
 - .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of watermain.
 - .3 Ovality tolerance is 4.5 % measured as ring deflection. Ring deflection is defined as:
$$\Delta R \equiv \frac{D^1 - D^2}{D^1} \times 100\%$$
Where: D1 = pre-installation pipe diameter
D2 = post-installation pipe diameter at its smallest dimension.
- 3.9 FLUSHING AND DISINFECTING
- .1 Refer to Section 33 11 16 – Watermains
- 3.10 SURFACE RESTORATION
- .1 After installing and backfilling over watermains, restore surface to original condition as approved by the Department Representative.
- 3.11 ACCEPTANCE CONDITIONS
- .1 Provide a set of as-built drawings including both alignment and profile. Construct drawings from actual field reading. Submit raw data upon the Engineer's request.
 - .2 Install pipe markers to identify pipe location on either side of under crossings.
 - .3 Install pipeline product within the pre-specified alignment and grade tolerances as appear on the drawings and/or project specifications.
 - .4 The installed pipe shall meet the leakage requirements as specified in this Section.

END OF SECTION

PART 1

GENERAL

- 1.1. SECTION INCLUDES
 - .1 Materials and installation for watermains, hydrants, valves, valve boxes, and valve chambers, including service connections.
- 1.2. RELATED SECTIONS
 - .1 Section 01 01 50 – General Instructions.
 - .2 Section 01 78 00 – Closeout Submittals.
 - .3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
 - .4 Section 03 20 00 – Concrete Reinforcing.
 - .5 Section 03 30 00 – Cast-in-Place Concrete.
- 1.3. REFERENCES
 - .1 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 ANSI/AWWA B300, Hypochlorites.
 - .2 ANSI/AWWA C153/A21.53-11, Ductile-Iron Compact Fittings for Water Service.
 - .3 ANSI/AWWA C500-09, Metal-Seated Gate Valves for Water Supply Service
 - .4 ANSI/AWWA C651-14, Disinfecting Watermains.
 - .5 ANSI/AWWA C800-12, Underground Service Line Valves and Fittings.
 - .6 ANSI/AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 inch through 60 inch (100mm – 1200mm).
 - .2 American Society for Testing and Materials International, (ASTM).
 - .3 American Water Works Association (AWWA)/Manual of Practice:
 - .1 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.
 - .4 Canadian General Standards Board (CGSB).
 - .5 Canadian Standards Association (CSA International).
- 1.4. SUBMITTALS
 - .1 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.
 - .2 Submit complete construction schedule for watermains. Include method for installation of watermain.
 - .3 Submit samples in accordance with Section 01 01 50 – General Instructions.
 - .4 Contractor to provide to the Departmental Representative for approval 1 week prior to start of laying pipe the results of a sieve analysis of the proposed bedding materials.
 - .5 Submit manufacturer's pipe certification.
 - .6 Pipe certification to be on pipe.

- 1.5. CLOSEOUT SUBMITTALS
 - .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 in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

- 1.6. WASTE MANAGEMENT AND DISPOSAL
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Place materials defined as hazardous or toxic in designated containers.
 - .3 Handle and dispose of hazardous materials in accordance with the Canadian Environmental Protection Act (CEPA), Transportation of Dangerous Good Act (TDGA), Regional and Municipal regulations.
 - .4 Ensure emptied containers are sealed and stored safely.
 - .5 Divert unused materials from landfill to metal recycling facility.
 - .6 Divert unused concrete materials from landfill to local facility.
 - .7 Divert unused aggregate materials from landfill to facility for reuse.
 - .8 Dispose of unused disinfection material at official hazardous material collections site.
 - .9 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
 - .10 Fold up metal banding, flatten and place in designated area for recycling.

- 1.7. SCHEDULING OF WORK
 - .1 Schedule Work to minimize interruptions to existing services.
 - .2 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to interruption schedule as approved by Departmental Representative.
 - .3 Notify Departmental Representative a minimum of 48-hours in advance of interruption in service.
 - .4 Do not interrupt water service for more than 3-hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.
 - .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.
 - .6 Provide "Out of Service" sign on hydrant not in use.
 - .7 Advise local police department of anticipated interference with movement of traffic.

PART 2

PRODUCTS

- 2.1 PIPE, JOINTS AND FITTINGS
- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end.
 - .2 HDPE DR11 pressure pipe: to AWWA C906 and certified to CSA-B137.1
 - .3 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
 - .4 Ductile Iron fittings: to ANSI/AWWA C153/A21.53-06.
 - .5 All water mains shall conform to NFPA 24
- 2.2 VALVE BOXES
- .1 Valves to open counter clockwise.
 - .2 To be Terminal City or approved equal suitable for buried service complete with key operated nut, 100mm diameter riser pipe and 100MM diameter TC flagged surface box.
 - .3 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.
 - .1 Fabricate valves of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure.
 - .2 Valves to expel air at high rate during filling, at low rate during operation, and to admit air while line is being drained.
 - .3 Valve complete with surge check unit.
 - .4 Ends to be flanged to ANSI/AWWA.
- 2.3 TRACER WIRE
- .1 Direct Burial #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength tracer wire, 1150# average tensile break load, 45 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30-volt rating.
 - .2 Tracer Box shall include:
 - .1 Tube material shall be of high grade ABS, or equivalent rigid plastic that meets or exceeds ASTM D-1788, Type 1 requirements.
 - .2 Lid material shall be of cast iron or ductile iron. Tensile strength or ductility of such material shall be equal or superior to hi-tensile cast iron ASTM A126-B requirements.
 - .3 Lid-locking bolt material shall be made of aluminum material equal or superior to ASTM B253.
 - .4 Lid-locking mechanism material shall be made of plastic to meet or exceed ASTM A126-B requirements.
 - .5 Box shall be designed to be easily detected by magnetic and electronic locators even when box is covered by a minimum of 100mm of soil, sod and / or paving material.
 - .6 A magnet shall be securely attached at the top of the upper tube of the box for locating purposes.
- 2.4 VALVE CHAMBERS
- .1 Concrete and reinforcing steel to Section 03 30 00 – Cast-in-Place Concrete and Section 03 20 00 – Concrete

Reinforcing.

- .2 Precast concrete sections to ASTM C478M. Cast ladder rungs integral with unit; field installation not permitted.
- .3 Valve chamber frames and covers:
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER"/"EAU".
- .4 Ladder rungs for valve chambers: 20mm diameter deformed rail steel bars to CAN/CSA-G30.18, hot-dipped galvanized after fabrication to CAN/CSA-G164. Rungs to be safety pattern.

2.5 SERVICE CONNECTIONS

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end.
- .2 HDPE DR11 pressure pipe: to AWWA C906 and certified to CSA-B137.1.
- .3 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
- .4 Ductile Iron fittings: to ANSI/AWWA C153/A21.53-06
- .5 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .6 Polyethylene pipe joints: thermal butt fusion welded.
- .7 Brass corporation stops: compression type having threads to ANSI/AWWA C800.
- .8 Brass inverted key-type curb stops: compression type with drains.
 - .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury.
 - .2 Top of cast iron box marked "WATER"/"EAU".
- .9 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.
- .10 Service connections for PVC pipe:
 - .1 Service connections less than 100mm: Mueller Corporation stop or equivalent, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100mm and over: Use tee fitting or tapping valve and sleeve. Provide Mueller corporation stop or equivalent.
- .11 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.
- .12 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same

standards as specified pipe fittings and to have ends matching pipe to which they are joined.

.13 All water mains shall conform to NFPA 24

2.6 YARD HYDRANTS

- .1 Yard Hydrants: Terminal City type C71P or equivalent as approved by departmental representative self-draining stand pipe, factory assembled unit:
 - .1 Hydrants to open threads to local standard, Provide metal caps and chains.
 - .2 Yard Hydrant to be manufactured with bronze operating and draining components.
 - .3 The stuffing box and draining mechanism to have "O" ring rubber gaskets for sealing purposes.
 - .4 Polyurethane anti-score seating material is used for the valve disc facing.
 - .5 Provide key operated gate valve located 1m from hydrant.
 - .6 Depth of bury 1.2m.
- .2 Hydrant paint: exterior enamel to CAN/CGSB-1.88, MPI #96.

2.7 PIPE, BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16 – Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Table:

SIEVE DESIGNATION	PERCENT PASSING	
	Type 1*	Type 2*
25.0mm	100	100
19.0mm	90-100	90-100
12.5mm	65-85	70-100
9.5mm	50-75	-
4.75mm	25-50	40-70
2.36mm	10-35	25-52
1.18mm	6-26	15-38
0.600mm	3-17	6-27
0.300mm	-	3-20
0.075mm	0-5	0-8

*Type 1: Standard Gradation

*Type 2: To be used only in dry trench conditions and with prior approval of Departmental Representative.

2.8 BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

2.9 PIPE DISINFECTION

- .1 Contractor must submit a copy of final pipe disinfection procedure per ANSI/AWWA 651 for review and comments/acceptance by the Departmental Representative. Water samples, to confirm successful disinfection procedures, to be collected by consultant and

submitted to an accredited laboratory for analysis. Results must be reviewed by Departmental Representative prior to commissioning.

PART 3

EXECUTION

- 3.1 PREPARATION
 - .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of the Departmental Representative.
 - .2 Remove defective materials from site as directed by Departmental Representative.

- 3.2 TRENCHING
 - .1 Do trenching work in accordance with Section 31 23 33.01 – Excavating Trenching and Backfilling.
 - .2 Trench depth to provide cover over pipe of not less than 1.2m from finished grade or alternative to meet H-20 live load requirements as approved by the Departmental Representative.
 - .3 Trench alignment and depth require Departmental Representative approval prior to placing bedding material and pipe.

- 3.3 CONCRETE BEDDING AND ENCASEMENT
 - .1 Do concrete work in accordance with Section 03 30 00 – Cast-in-Place Concrete.
 - .2 Place concrete to details as indicated.
 - .3 Do not backfill over concrete within 24-hours after placing.

- 3.4 GRANULAR BEDDING
 - .1 Place granular bedding material in uniform layers not exceeding 150mm compacted thickness to depth of 150mm below bottom of pipe.
 - .2 Do not place material in frozen condition.
 - .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
 - .4 Shape transverse depressions in bedding as required to suit joints.
 - .5 Compact each layer full width of bed to at least 95% maximum density to ASTM D 698.
 - .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 – Excavating Trenching and Backfilling.

- 3.5 PIPE INSTALLATION
 - .1 Lay pipes to manufacturer's standard instructions and specifications. Do not use blocks except as specified.
 - .2 Join pipes in accordance with manufacturer's recommendations.
 - .3 Bevel or taper ends of PVC pipe to match fittings.
 - .4 Handle pipe by methods recommended by pipe

manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

- .5 Lay pipes on prepared bed, true to line and grade:
 - .1 Minimum grade on watermains to be 0.1%.
 - .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .3 Take up and replace defective pipe.
 - .4 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10mm in 3m.
- .6 Minimum clearances to be as follows (unless otherwise noted):
 - .1 3.0m wall to wall horizontal and 1.0m wall to wall vertical clearance from storm and sanitary sewers.
 - .2 1.0m wall to wall horizontal and 0.3m wall to wall vertical clearance from other utilities.

Where minimum vertical or horizontal separation are not achieved relative to any storm and sanitary mains and utilities, or the watermain crosses under a sewer main, the watermain joints are to be wrapped with TC Envirotape (50Mil) manufactured by Tapecoat Canada Inc. or equivalent.

- .7 All watermains at tie-in points to be capped 1.5m from existing watermains unless otherwise specified. Tie-ins to existing watermains to be performed by the contractor under direct supervision by the site representative unless otherwise directed. A minimum notice of 72 hours shall be given for any tie-in. Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .8 Do not exceed one half of permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods approved by Departmental Representative.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.

- .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
 - .15 Complete each joint before laying next length of pipe.
 - .16 Minimize deflection after joint has been made.
 - .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
 - .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Departmental Representative.
 - .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
 - .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
 - .21 Install tracer wire along entire length of watermain with Test boxes located at maximum 1000m separation.
 - .22 Do not lay pipe on frozen bedding.
 - .23 Do hydrostatic and leakage test and have results approved by the Departmental Representative before surrounding and covering joints and fittings with granular material.
 - .24 Backfill remainder of trench.
- 3.6 VALVE INSTALLATION
- .1 Install valves to manufacturer's recommendations at locations as indicated.
- 3.7 VALVE CHAMBERS
- .1 Use precast units as approved by the Departmental Representative.
 - .2 Construct units as indicated, plumb and centered over valve nut, true to alignment and grade, and not resting on pipe.
 - .3 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar.
 - .5 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
 - .6 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.
- 3.8 SERVICE CONNECTIONS
- .1 The contractor is to confirm with the Mechanical Engineer prior to construction, the location and size of all building connections.
 - .2 Terminate building water service 1m outside building wall or as indicated opposite point of connection to main.
 - .1 Locate point of connection in advance and advise Departmental Representative.
 - .2 Cap or seal end of pipe and place temporary marker to

locate pipe end.

- .3 Complete with shut-off valve. Building service manifold and chamber to be as per Mechanical consultants drawings, to be installed by Plumbing contractor.
- .3 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of watermain.
- .4 Construct service connections at right angles to watermain unless otherwise directed.
- .5 Tappings on ductile iron, or PVC-C900 pipe, may be threaded without service clamps:
 - .1 Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used.
 - .2 Tappings PVC-C900 pipe to conform to following:

PIPE DIAMETER (mm)	MAX. TAP WITHOUT CLAMP (mm)	MAX. TAP WITH CLAMP (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .6 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .7 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .8 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .9 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .10 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300mm apart along pipe.
- .11 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1m, whichever is greater.
- .12 Leave corporation stop valves fully open.
- .13 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .14 Install rigid stainless-steel liners in small diameter plastic pipes with compression fittings.
- .15 Install curb stop with corporation box on services NPS 2 or less in diameter.

- .1 Equip larger services with gate valve and cast-iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
 - .16 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89mm stake extending from pipe end at pipe level to 600mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.
 - .17 Service fittings to be set at proposed finished grades
- 3.9 YARD HYDRANTS
- .1 Install yard hydrants at locations as indicated and to be set at proposed finished grades.
 - .2 Set hydrants plumb, with hose outlets parallel with edge of pavement with outlet facing roadway.
 - .3 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
 - .4 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5m deep and backfill with coarse gravel or crushed stone to level 150mm above drain holes.
 - .5 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.
- 3.10 THRUST BLOCKS AND RESTRAINED JOINTS
- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 – Cast-in-Place Concrete and MMCD Std. Dwg W1.
 - .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative.
 - .3 Keep joints and couplings free of concrete.
 - .4 Do not backfill over concrete within 24-hours after placing.
 - .5 For restrained joints: only use restrained joints approved by Departmental Representative.
- 3.11 HYDROSTATIC AND LEAKAGE TESTING
- .1 Do tests in accordance with ANSI/AWWA C600 and B.C. Building Code 2018.
 - .2 The contractor shall ensure that all sections of watermains have test points and temporary blow-offs suitable to ensure adequate pressure testing, chlorination and flushing in accordance with AWWA C651-14.
 - .3 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

- .4 Notify Departmental Representative and Engineer at least 48 hours in advance of proposed tests:
 - .1 Perform tests in presence of Departmental Representative and Engineer.
- .5 Where section of system is provided with concrete thrust blocks, conduct tests at least 5-days after placing concrete or 2-days if high early strength concrete is used.
- .6 Test pipeline in sections not exceeding 365m in length, unless otherwise authorized by the Departmental Representative.
- .7 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed as directed by Departmental Representative.
- .8 Leave hydrants, valves, joints and fittings exposed.
- .9 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .10 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .11 Open valves.
- .12 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .13 Thoroughly examine exposed parts and correct for leakage as necessary.
- .14 Apply hydrostatic test pressure of 1035 kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1-hour.
- .15 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .16 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .17 Repeat hydrostatic test until defects have been corrected.
- .18 Define leakage as amount of water supplied in order to maintain test pressure for 2-hours.
- .19 Locate and repair defects if leakage is greater than amount specified.
- .20 Repeat test until leakage is within specified allowance for full length of watermain.

3.12 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.

- .2 Hand place surround material in uniform layers not exceeding 150mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% maximum density to ASTM D 698.

3.13 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under roadways and pathways, compact backfill to at least 95% maximum density to ASTM D 698.

3.14 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants red.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.15 FLUSHING AND DISINFECTING

- .1 Flushing and Disinfecting to Ministry of Health and AWWA standards.
- .2 The site representative shall be responsible for taking water samples for testing and presenting them to an approved testing facility. All test results, whether failed or passed shall be submitted to the Departmental Representative. The contractor shall pay for all tests.
- .3 Flushing and disinfecting operations: witnessed by Departmental Representative.
 - .1 Notify Departmental Representative at least 4-days in advance of proposed date when disinfecting operations will begin.
- .2 Flush watermains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear. The contractor shall supply all water for flushing and testing.

.3 Flushing flows as follows:

PIPE SIZE NPS	FLOW (L/S) MINIMUM
6 and below	38
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections

to ensure thorough flushing.

- .6 When flushing has been completed to Department Representative approval, introduce strong solution of chlorine as approved by Departmental Representative into watermain and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.
- .8 Chlorine application to be close to point of filling watermain and to occur at same time.
- .9 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .10 Flush line to remove chlorine solution after 24-hours.
- .11 Discharge of chlorinated water into storm sewers or watercourses is strictly prohibited.
- .12 Measure chlorine residuals at extreme end of pipeline being tested.
- .13 Perform bacteriological tests on watermain, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2-days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Specialist contractor to submit certified copy of test results.
- .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .15 After adequate chlorine residual not less than 50 PPM has been obtained leave system charged with chlorine solution for 24-hours.
- .16 After 24-hours, take further samples to ensure that there is still not less than 10 PPM of chlorine residual remaining throughout system.

3.16 SURFACE RESTORATION

- .1 After installing and backfilling over watermains, restore surface to original condition as approved by the Department Representative.

END OF SECTION