

## **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 Divisions 26, 27, 28, and 33 in the Master Format Specifications.
- .3 Reference to "Mechanical Divisions" shall mean all related Mechanical Sections and components including Divisions 23 and 25 in the Master Format Specifications.
- .4 The word "Provide" shall mean "Supply and Install" 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, 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, piping and ductwork.
- .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 C22.1-2009 except where specified otherwise.
- .2 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction...

### **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.

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#### **1.4 DESIGN REQUIREMENTS**

- .1 Operating voltages to CAN3-C235-83.
- .2 Motors, electric heating, 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 1 for hours of work.
- .2 Component subsystems of the electrical system will include, but are not limited to the following:
  - .1 Provide electrical power distribution system complete with partial underground ductbank. Tie into existing service via a network of underground ducts and manholes.
  - .2 Provide receptacles and direct connections for all equipment.
  - .3 Provide lighting equipment including emergency and non-emergency lighting and exit signs.
  - .4 Provide fire alarm system.
  - .5 Provide power feeders to all mechanical equipment.
  - .6 Provide all required motor starters and control wiring associated.
  - .7 Provide complete raceway for power, lighting, life safety, security and communications systems.
- .3 Provide grounding/bonding equipment as per CEC or as indicated in the contract drawings and specifications.
- .4 Provide fire stopping in accordance with Division 01.
- .5 Perform commissioning in accordance with Division 01.
- .6 As-built drawings and maintenance manuals.
- .7 Seismic restraint for all electrical equipment and installations.

#### **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.

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- .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 Information shall include all scheduled data.
    - .5 Advertising literature will be rejected.
    - .6 The project and equipment designations shall be identified on each document.
    - .7 Information shall be given in S.I. units
    - .8 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 - Quality Control
    - .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.
    - .3 Submit, upon completion of Work, the electrical "load balance" report.
  - .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.

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**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, and as follows.
- .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 fixtures and 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 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 SECURITY FASTENERS**

- .1 Fastening devices used in areas accessible to inmates shall be TORX (5 Lobe) with pin, stainless steel screws, which require a special tool to remove the fastener.
- .2 Standard screws are not acceptable in areas accessible to inmates.
- .3 Use fasteners compatible with material through which they pass.

#### **1.17 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.

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**1.18 TENDER INQUIRIES**

- .1 All contractor queries during the tender period shall be made in writing to the Departmental Representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental Representative's office during tender. All tender queries may be emailed, faxed, mailed or couriered to the Departmental Representative's office. No telephone questions will be answered.

**1.19 EXAMINATION**

- .1 Visit the site before preparing the tender and examine all existing conditions are beneficial to the contractor. No extra cost will be considered for any misunderstanding of work to be done resulting from not visiting the site.
- .2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. 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.

**1.20 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 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 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.
- .5 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.
- .6 Refinish damaged or marred factory finish to factory finish.
- .7 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.

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**1.21 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.

**1.22 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 Site services
  - .2 Distribution
  - .3 Feeders
  - .4 Cable tray
  - .5 Branch circuit wiring, conduit and boxes
  - .6 Wiring devices
  - .7 Lighting
  - .8 Mechanical equipment and wiring
  - .9 Low tension; each system listed under Division 27 to be separately identified
  - .10 Testing and commissioning
  - .11 As-built drawings and maintenance manuals
  - .12 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

**1.23 PROJECT CLOSE-OUT REQUIREMENTS**

- .1 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.

- .2 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.

#### **1.24 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 above have been completed or addressed.
  - .2 Certificate of Penetrations through separations have been sealed 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.

## **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, motor starters, 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
Main distribution centre	A	Year installed and name of facility Name of Electrical Engineer and Electrical Contractor
Main Breaker	A	Voltage, phase, amps
Sub-distribution panel	A	Name of panels it is feeding (i.e. Panel A, Panel B)
Panelboards	B	Panel designation (i.e. Panel A, Panel B)
Terminal Cabinet	B	System and Voltage
Disconnect switches	B	Indicate equipment controlled and voltage

Starters/contactors	B	Indicate equipment controlled and voltage
Motor control centre	B	Indicate equipment controlled and voltage
Transformer	B	Transformer designation Circuit and Panel designation
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)
Receptacles	C	Circuit/panel designation
Special receptacles	C	Circuit/panel designation and voltage, phase, amps

.2 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

.3 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.

.4 Provide plastic covered panel directory with circuits and areas served print in, and mounted on inside of door. Directory shall conform to Record Drawings.

## 2.7 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.

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

## 2.8 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 All junction boxes, pull boxes and their cover 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)

## 2.9 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.

## 2.10 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.

## **2.11 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.

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**2.12 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 prime and undercoat painted ready for finish under the related Division.

**2.13 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.
- .4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Consultant before printing.
- .5 Submit a draft copy to the Departmental Representative for approval thirty days prior to start up of the systems and equipment.
- .6 Submit three copies in the final approved form.

- .7 Submit three CDs containing all record as-built drawings and maintenance manual in interactive pdf format.

## **2.14 PROJECT RECORD DRAWINGS**

- .1 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.
- .2 "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.
- .3 At completion of construction and prior to substantial performance of the work, the Contractor shall arrange and pay for a computer drafting service to update the electronic drawing files showing the "As-Built" drawing markings. The "As-Built" drawings must conform to the electronic file structure already established on the drawing files (for example, layering schemes, fonts, dimensioning, etc.).
- .4 Provide hard and soft copies of the "As-Built" drawings as specified in Division 01.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 2009 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 to be 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 LOCATION OF OUTLETS

- .1 Coordinate outlet locations with Architectural Drawings.
- .2 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm and information is given before installation.
- .4 Locate light switches on latch side of doors unless otherwise indicated.
- .5 Locate disconnect devices in mechanical and elevator machine rooms on latch side of doors.

### 3.5 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.

### 3.6 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.

### 3.7 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, MCCs, transformers and switchgear shall be meggered for insulation integrity and 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 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.

### **3.8 SYSTEM COORDINATION STUDY**

- .1 Provide with shop drawings a family of neatly drawn coordination curves on standard EEI-NEMA sheets, showing service feeder relays (including ground fault), together with manufacturer's proposed tripping characteristics for main service and feeder overcurrent relays, transformer, thermal damage curves. The curves shall also include ground fault coordination. For each coordination curve, attach a separate blank page with a neatly drawn single-line diagram with cross-reference between protecting devices and their corresponding coordination curves. The coordination study shall include for selective tripping such that downstream loads are isolated at the point as far downstream in the distribution system as possible. The Consultant reserves the right to make changes in the rating and setting of the protection devices without change to the tender price to ensure a properly coordinated "selective" protection system.
- .2 The approved coordination study will be the basis for the verification testing of all other applicable equipment.
- .3 Ensure circuit protective devices such as overcurrent trips, relays, and fuses are installed to required values and settings and further adjusted in accordance with the approved coordination study.
- .4 Coordination study shall be signed and sealed by a Professional Engineer registered with the local engineering association.

### **3.9 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, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .2 Systems: fire alarm system, communications systems.
  - .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 and load balance. Indicate test hour and date.

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### **3.10 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.

### **3.11 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 09.

### **3.12 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.

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**3.13 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.

**3.14 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.

**3.15 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.

**3.16 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS**

- .1 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.
- .2 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.
- .3 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.
- .4 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.
- .5 Contractors are expected to submit system information detailing firestopping product, backing, penetration, penetrated assembly, fire and temperature rating, and ULC or cUL system number.



- .6 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.
- .7 Allow openings for 100% capacity of raceway.
- .8 Provide split systems where existing cables are involved.

### **3.17 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.

### **3.18 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.

### **3.19 ACCESSIBILITY AND ACCESS PANELS**

- .1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.
- .2 Locate equipment and junction boxes in service areas wherever possible.

### **3.20 EQUIPMENT INSTALLATION**

- .1 Provide means of access for servicing equipment.

- .2 CSA identification and equipment labels to be clearly visible after installation.

### **3.21 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.

### **3.22 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

## **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.
- .2 Refer to specialty "Communication" Sections for particular wiring systems and types. (i.e. Fire Alarm, Security and Voice/Data).

### **1.2 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work

### **1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International)
- .2 CSA C22.1-09
- .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 Aluminium conductors are 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 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 having a PVC jacket with FT-4 flame spread rating.
- .5 Provide all control wiring except HVAC controls as specified in Mechanical Divisions. Refer to Equipment Schedule(s) for detailed responsibilities.

- .6 Non-metallic sheathed wiring is not to be used on this project.

## **2 PRODUCTS**

### **2.1 WIRING & CABLES – GENERAL**

- .1 Conductors: stranded for 12 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .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 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 flame test rated.
- .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 R90, cross-linked polyethylene insulated 600 volts rated for not less than 90°C.
- .3 All conductors within cable trays shall have FT4 type outer jacket to comply with all applicable regulations and bylaws.
- .4 Use of NMD90 (Loomex) is 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.

# **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 Results.
- .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



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**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 should be able to provide a proof of professional insurance and the related practice credentials if requested by the Consultant.
- .3 The Contractor's Seismic Engineer shall submit original signed National Building Code "Letters of Assurance" "Schedules B1, B2, and C-B" to the Consultant.
- .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.

### **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 Consultant for his reference.

## **2.3 FLOOR MOUNTED EQUIPMENT**

- .1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.
- .2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

## **2.4 LIGHT FIXTURES**

- .1 Fluorescent fixtures in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two taught cables which are connected to the fixture at diagonal points.
- .2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.
- .3 Fixtures which are hung independently of ceiling systems shall have minimum of one seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.
- .4 Cables shall be corrosion resistant and approved for the application.

- 
- .5      Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

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**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
- .2 CSA C22.1-09
- .3 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .4 Transformer grounding shall comply with CSA C22.2 No.41-M87 (R99).
- .5 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

**1.3 PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

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

**2 PRODUCTS**

**2.1 MATERIALS**

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

**2.2 EQUIPMENT**

- .1 Clamps for grounding of conductor, size as required.
- .2 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.
- .3 Rod electrodes, copper clad steel 20mm dia by 3m long as indicated.
- .4 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified to be green.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

- .6 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**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Provide separate, insulated, copper bonding conductor in EVERY conduit used for power, lighting, fire alarm and every low tension system required in the building. Where wire size is not indicates, provide minimum size per applicable CEC tables.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors approved for the use.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 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.
- .9 Install separate ground conductor to each outdoor lighting standard.
- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .13 Ground secondary service pedestals in raised computer floors.
- .14 Coordinate ground rod installation with local soil conditions to assure proper grounding system.

### **3.2 GROUNDING ELECTRODES**

- .1 Provide and install an artificial ground consisting typically of a minimum of four 3000mm x 20mm copperweld ground rods, interconnected by bare stranded copper #3 AWG conductor 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.
- .2 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**

- .1 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.
- .2 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
- .3 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 BUSESSES**

- .1 Provide a ground bus in the main electrical room and main communication room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #3 AWG or as indicated.
- .3 Copper or bronze lugs required for termination of all copper conductors at ground busses.

### **3.5 EQUIPMENT GROUNDING AND BONDING**

- .1 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.
- .2 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.

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**3.6 MECHANICAL EQUIPMENT BONDING**

- .1 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 LOW TENSION SYSTEMS GROUNDING**

- .1 Install home run a #6 AWG insulated bonding conductor in conduit from the main ground bus to the:
  - .1 Fire alarm panel
  - .2 Security panel
  - .3 Public address system panel
  - .4 Telephone systems head end equipment
  - .5 CATV system.

**3.8 DATA & VOICE GROUNDING**

- .1 Install home run insulated ground conductor in conduit from the building main ground bus as follows:
  - .1 #2/0 AWG to main ground bus in the telecom entrance room.
- .2 Unless otherwise solidly bonded, bond all data and telephone incoming and outgoing steel conduits with insulated #6 AWG from the nearest "Communication" ground bus.
- .3 Provide communications grounding system in accordance detail drawing.

**3.9 POST MOUNTED LUMINAIRE GROUNDING**

- .1 Provide #10 AWG bonding conductor with green RW90 X-link insulation to luminaire standards. Connect to luminaire corrosion resistant ground stud or ground clamp.

**3.10 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .3 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 1Ω. Submit test results to Department Representative.
- .4 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.
- .5 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION



**1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

**1.2 RELATED WORK**

- .1 Section 26 05 00 – Common Work:
- .2 Section 26 05 25 - Seismic Restraints:

**2 PRODUCT**

**2.1 FRAMING AND SUPPORT SYSTEM**

- .1 Materials:
  - .1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures connecting components and fasteners for a complete system.
  - .2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.
- .2 Finishes:
  - .1 Outdoors, wet locations: Hot dipped galvanized.
  - .2 Indoors, dry locations: Galvanized when available, prime painted if not available.
  - .3 Nuts, bolts, machine screws: Cadmium plated.
- .3 Unistrut:
  - .1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

**2.2 CONCRETE AND MASONRY ANCHORS**

- .1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.
- .2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.
- .3 Manufacturer: Hilti (Canada) Limited or approved equal.

**2.3 NON-METALLIC ANCHORS**

- .1 Material: Plastic anchors for sheet metal screws.

- .2 Manufacturer: Fischer.

## **2.4 CONDUIT SUPPORTS**

- .1 General: Malleable iron two-hole conduit straps where exposed to weather. Stamped steel two-hole straps indoors.
- .2 Structural Steel: Crouse-Hinds "Wedgetite" supports or equivalent manufactured by Appleton.
- .3 Masonry, concrete, stone, etc.: Anchors.
- .4 Title: Toggle bolts.
- .5 Metal studs, ceiling hangers, etc.: "Caddy-Clips".
- .6 Unistrut: Unistrut conduit clamps.

## **2.5 CABLE SUPPORTS AND CLAMPS**

- .1 General: As per conduit supports, except that for single conductor cables, suitable non-ferrous or approved stainless steel or aluminum clamps shall be used.

# **3 EXECUTION**

## **3.1 GENERAL**

- .1 Do not cut or drill beams, joists or structural steel unless written permission of the Engineer is obtained.
- .2 Distance between conduit or cable supports not to exceed code requirements.
- .3 Supports to be suitable for the real loads imposed by equipment.
- .4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.
- .5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .6 Provide conduit rack with 25% spare capacity for multiple runs.
- .7 Provide channel support with fittings for vertical runs of conduit and cables.

## **3.2 INSTALLATION**

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.

- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .5 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.
- .6 Shot driven pins may only be used with written approval of the structural engineer.
- .7 Use round or pan head screws for fastening straps, boxes, etc.
- .8 Do not support heavy loads from the bottom chord of open web steel joists.
- .9 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.
- .10 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.
- .11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.

END OF SECTION

## **1 GENERAL**

### **1.1 WORK INCLUDED**

- .1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

### **1.2 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Division 01.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

## **2 PRODUCTS**

### **2.1 SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

### **2.2 JUNCTION BOXES AND PULL BOXES, INDOOR DRY LOCATIONS**

- .1 Materials:
  - .1 Code gauge sheet steel, welded construction, phosphatised and/or galvanized.
- .2 Components:
  - .1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.
  - .2 Use rolled edges for surface boxes.
  - .3 Size shall be in accordance with Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes.
  - .4 Surface or flush with trim and hinged door, latch and lock and two keys and keyed to match panelboard keys.
  - .5 Backboards: 19 mm GIS Fir plywood backboard.
- .3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

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## **2.3 CABINETS**

- .1 Materials:
  - .1 Cabinets: Code gauge sheet steel, welded construction, phosphatised and factory paint finish, suitable for field painting.
  - .2 Locks: to match panelboards.
  - .3 Backboards: 19 mm GIS fir plywood, one piece per cabinet, covering entire cabinet interior.
- .2 Components:
  - .1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.
  - .2 Surface or flush with trim and hinged door, latch and lock and two keys, size as indicated or to Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes. Keyed to match panelboard keys.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Junction Boxes and Pull Boxes:
  - .1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.
  - .2 Boxes installed in party walls to be offset by a minimum of one stud space.
  - .3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.
  - .4 Identify with system name and circuit designation as applicable.
  - .5 Size in accordance with the Canadian Electrical Code, as a minimum.
- .2 Cabinets:
  - .1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.
  - .2 Install terminal block where indicated.
- .3 Identification
  - .1 Provide equipment identification in accordance with drawings.

END OF SECTION

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work

**1.2 REFERENCES**

- .1 CSA C22.1-09 - Canadian Electrical Codes, Part 1.

**1.3 PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

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

**2 PRODUCTS**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

**2.2 OUTLET BOXES FOR METAL CONDUIT**

- .1 Materials:
  - .1 Surface or recessed concealed type: Die formed steel, hot dip galvanized, 350 g/m<sup>2</sup> minimum zinc coating.
  - .2 Surface mounting exposed: Cast ferrous for threaded conduit, with attached lugs, corrosion resistant two coats finish.

**2.3 JUNCTION & PULL BOXES**

- .1 Electro-galvanized sheet steel type boxes for flush mount in walls with matching extension and plaster rings as required.

- .2 Install pull boxes in inconspicuous but accessible locations.
- .3 Install pull boxes after cumulative bend total of 270 degrees between boxes.
- .4 Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

## **2.4 CONDUIT BOXES**

- .1 Cast FS or electro-galvanized sheet steel boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

## **2.5 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

# **3 EXECUTION**

## **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, and armoured cable connections. Reducing washers are not allowed.
- .5 Install all outlets flush and surface mounted as required for the installation.
- .6 Surface mount above suspended ceilings, or in unfinished areas.
- .7 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.
- .8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.
- .9 Use plaster rings to correct depth. Use 30 mm on concrete block.
- .10 Do not use sectional boxes.
- .11 Provide boxes sized as required by the Canadian Electrical Code.

- .12 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.
- .13 Outlets installed in partition walls to be offset by a minimum of one stud space.
- .14 Ceiling outlet boxes shall be provided for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.
- .15 Primary bushings in termination box for cable connection.
- .16 Secondary bushings in termination box for bus duct connection.
- .17 For telecom raceways provide a pull box where: (1) the length is over 30 m and (2) where there are more than two 90 degree bends.

END OF SECTION



## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work

### **1.2 REFERENCES**

- .1 CSA C22.1-09 - Canadian Electrical Codes, Part 1.
- .2 Canadian Standards Association (CSA) .CAN/CSA C22.2.

### **1.3 PRODUCT DATA**

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

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

### **1.5 SCOPE OF WORK**

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.
- .3 Note particular requirements for routing of conduits where detailed.
- .4 Provide polypropylene pull cord in all "empty" conduits.

## **2 PRODUCTS**

### **2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.
- .3 Flexible conduits: to CSA C22.2 No. 56.
- .4 Minimum conduit size in the project to be 21mm [3/4"] diameter (for power as well as low tension services).

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## **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 27 mm and smaller. Use two hole steel straps to conduits larger than 27 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 10 mm threaded rods to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90 degree bends are required for 35 mm and larger conduits.
- .3 EMT couplings and connectors shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.
- .2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

## **2.5 RIGID P.V.C. CONDUIT**

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" Schedule 40.
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.
- .3 Solvent: as recommended by conduit manufacturer.

## **2.6 OUTLET AND CONDUIT BOXES IN GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.
- .4 Blank cover plates for boxes without wiring devices.

- .5 Combination boxes with barriers where outlets for more than one system are grouped.
- .6 Bushing and connectors with nylon insulated throats.
- .7 Knock-out fillers to prevent entry of foreign materials.
- .8 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.
- .9 Double locknuts and insulated bushings on sheet metal boxes.

## **2.7 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. Larger 102 mm square x 54 mm deep outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.
- .2 For larger boxes use GSB solid type as required.
- .3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.
- .4 Lighting fixture outlets: 102 mm square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

## **2.8 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi gang type MDB boxes for devices flush mounted in exposed block walls.

## **2.9 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.10 SURFACE CONDUIT BOXES**

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

# **3 EXECUTION**

## **3.1 CONDUIT - GENERAL**

- .1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.

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- .2 Install all conduit and wiring concealed, unless otherwise shown on the drawings. Do not recess conduit in columns, except as noted, without permission.
  - .3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.
  - .4 At all recessed panels cap 4 - 27 mm empty conduits from panel into ceiling above for future use.
  - .5 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
  - .6 Any conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.
  - .7 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.
  - .8 Ensure grounding continuity in all conduit systems.
  - .9 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5 m [5'] above the finished floor.
  - .10 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.
  - .11 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
  - .12 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
  - .13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: e.g. where conduits emerge from ground level slab.
  - .14 Conduits are not permitted in terrazzo or concrete toppings.
  - .15 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.
  - .16 Locate conduits more than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.
  - .17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.
  - .18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
  - .19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.

- .20 Damaged conduits to be repaired or replaced.
- .21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .22 Conduits shall not pass through structural members except as indicated.
- .23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.
- .24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.
- .25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.
- .26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.
- .27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits shown on the drawings are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.
- .28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.
- .29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.
- .30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.
- .31 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.
- .32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.
- .33 Use explosion proof flexible connection for connection to explosion proof motors.
- .34 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

### **3.2 SURFACE CONDUITS**

- .1 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.
- .2 Run parallel or perpendicular to building lines.
- .3 Locate conduits behind infrared or gas fired heaters with minimum 1.5 m clearance.

- .4 Conduits to be run in flanged portion of structural steel.
- .5 Group conduits wherever possible on suspended and/or surface channels.
- .6 Surface conduits will not be accepted in finished areas unless detailed.

### **3.3 SPARE CONDUITS**

- .1 Provide spare conduits as indicated.
- .2 Provide 4x27 mm spare conduits up to ceiling space and 4x27 mm spare conduits down to ceiling space below from each flush panel. Terminate the conduits in 150x150x100 mm junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide coverplates for all junction boxes.

### **3.4 BOXES INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .8 No sectional or handy boxes to be installed.
- .9 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .10 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- .11 Outlets installed back to back in party stud walls to be off-set by one stud space.

- .12 Refer to wiring device and communication specification sections and to architectural layouts for mounting heights of outlet boxes.
- .13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.
- .14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.
- .15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work.
- .3 Section 26 05 29 - Hangers and Supports for Electrical Systems.
- .4 Section 26 05 25 - Seismic Restraints.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.1 No. 126.1-02, Metal Cable Tray Systems.

### **1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Division 01.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cable trays used.
- .5 Show actual cable tray installation details and suspension system.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Division 01.

## **2 PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- .1 Ladder-type cable tray: CSA Class C, 75 mm deep, width as noted on drawings, constructed of hot-dipped galvanized steel to form a cable supporting surface consisting of cross-pieces (rungs) alternating with ventilated slots of equal width. Cable tray construction shall utilize turned down outer edges so as to form a smooth finish and provide additional lateral rigidity. The cable support surface shall be smooth and flat. Rung spacing is to be 50 mm maximum.
- .2 Cable tray barrier strips to separate the different systems. Upper edge of the barrier to be turned down so as to form a smooth finish and provide additional lateral rigidity, lower edges shall form an 'L' shape. Installed in the field using self-tapping screws.



- .3 Complete with factory-produced straight lengths, fittings, connectors, elbows, tees, dead ends, crosses, reducers, supports, covers and drop-outs.
- .4 Sections of cable tray and fittings shall be connected using factory-produced connection plates fitted on the outside faces of the tray in order to maintain a smooth interior joint.
- .5 Conduit bushings for wiring to and from cable trays.
- .6 Acceptable products: B-Line, Cablofil or approved equal

### **3 EXECUTION**

#### **3.1 CABLE TRAYS**

- .1 Provide a complete continuous totally enclosed metal cable tray system for the support of communication system cables and install where shown on the drawings.
- .2 Cable tray layouts and routing shown on the drawings are for general reference and estimating purposes only and do not show the exact final layout or all the required fittings, offsets, bends, and changes in elevations required to avoid obstacles such as ducts, beams, pipes, structural members, ceiling system supports, etc. Final layout of cable trays shall be coordinated with other trades and the Departmental Representative.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .4 Conduits extending services to or from cable tray shall have insulated throat grounding bushings on connectors and shall be properly supported and terminated on the side wall of the cable tray. Provide #6 AWG (or larger if required by Code) stranded bare copper bonding jumper from cable tray to each conduit grounding bushing serving the tray.
- .5 Provide a continuous #2/0 AWG bare copper ground conductor along the entire length of the cable tray and provide additional grounding as required in accordance with the Canadian Electrical Code. Connect ground wire to each cable tray section using approved CSA mechanical lug/connector. Cable tray for telecommunications cabling shall be connected to ground bus in telecommunications rooms.
- .6 Horizontal runs through walls which are fire, smoke, or sound barriers shall be sealed and be of a solid (no slots) type complete with solid top cover for 450 mm on both sides of the wall.
- .7 Vertical runs shall be totally enclosed up to 2000 mm above floor level and shall be fire and smoke sealed.
- .8 Cable trays shall be supported using the manufacturer's standard supports such that wherever possible one side of the tray is both accessible and unencumbered by support members so as to permit convenient laying in of cables. Otherwise utilize suspended trapeze racks, with cable trays securely bolted to the support assemblies. Provide additional supports under all fittings of 600 mm radius or larger. Brace all supports to withstand the loads due to pulling in of cable. All supports shall permit a minimum of 150 mm vertical adjustment.

- .9 Minimum access clearances between cable trays and adjacent conduits, pipes, ductwork, etc., shall be 305 mm vertically and 600 mm horizontally for cable trays. Coordinate closely with other trades to ensure a convenient space-conserving and accessible installation.
- .10 Maintain minimum 450 mm separation between communication cable trays and any power feeders in conduits and cables to minimize electromagnetic interference. Do not attach conduits and cables containing power conductors to communication cable tray supports.
- .11 Conduits containing communication cables only may be clamped to the communication cable tray support system. However, such conduits will not be permitted to be installed across the projected cross-section (i.e. width) of the cable tray in order not to impede access to the tray.
- .12 Complete a typical portion of the cable tray installation and obtain the approval of the Consultant prior to proceeding with the remainder of the tray installation.

### **3.2 CABLES IN CABLE TRAYS**

- .1 Use manufacturer-approved cable installation techniques in order to protect cables during installation. Do not install cables until the tray installation has been completed and the cables are safe from damage from construction operations. Damaged cables shall be replaced at no additional cost.
- .2 Lay cables into cable tray. Use rollers when necessary to pull cables.
- .3 Secure cables in cable tray at 6 m centres, with nylon ties.
- .4 Identify cables every 30 m in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .5 Cables of different systems and of different voltage shall be separated from one another by specified manufacturer's barrier strips. The final position of barriers shall be as directed in the field. Barriers shall be continuous along the entire length of the cable tray.
- .6 Communication cables shall be fastened together on a system-by-system basis by use of nylon cable ties on maximum 1200 mm centres.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Section 26 05 00: Common Work

## **2 PRODUCTS**

### **2.1 CUSTOMER METERING SYSTEM**

- .1 To consist of Measurement Canada Approved electronic meters, current transformers, and communications system as shown on drawings and described herein.
- .2 The meters will be capable of remote communication, utilizing Modbus protocol:
- .3 Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system.

### **2.2 SYSTEM MEASUREMENT**

- .1 Meters shall be complete with a Liquid Crystal Display (LCD) to access all measurements and phase diagnostics.
- .2 Measurement Parameters:
  - .1 KWHR real consumption
  - .2 KW average demand
  - .3 KW instantaneous demand
  - .4 KVAH apparent consumption
  - .5 KVA apparent demand

### **2.3 METERS**

- .1 Powerlogic ION 7330.

### **2.4 METER COMMUNICATIONS**

- .1 Modbus protocol for data communications.
- .2 Ethernet LAN/WAN communications.
- .3 RS232, port for modem connections.

## **3 EXECUTION**

### **3.1 WIRING AND CONNECTIONS**

- .1 Refer to manufacturer's installation drawings for wiring details.

- .2 Provide metering points as shown on Drawings.
- .3 Provide circuit breakers for power feeding the meters.

**3.2 FIELD VERIFICATION, ACCEPTANCE & TRAINING**

- .1 Manufacturer's representative shall verify, adjust and test the system. Verification to be carried out with the assistance of the electrical contractor. Upon completion, the manufacturer shall issue a "CERTIFICATE OF ACCEPTANCE" to the owner, electrical consultant and contractor.
- .2 Manufacturer's representative shall demonstrate operation of the system as follows:
  - .1 Meter readings at the meter
  - .2 Provide training and software manual for owner's staff.

END OF SECTION

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – Submittal Procedures
- .2 Section 26 05 00 - Common Work
- .3 Section 26 05 25 – Seismic Restraints

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
- .2 CAN/CSA-C22.2 No. 47-M90 (R2001), Air-Cooled Transformers (Dry Type)
- .3 CSA C9-M1981 (R2001), Dry-Type Transformers
- .4 National Electrical Manufacturers Association (NEMA)

**1.3 PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

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

**2 PRODUCTS**

**2.1 TRANSFORMERS**

- .1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No. 47, CSA-C802.2-00.
- .2 Design:
  - .1 Ventilated: Type ANN
  - .2 3-phase, 3-winding, 600 V delta primary, 120/208 V grounded 3-winding Wye secondary, 60 Hz.
  - .3 Voltage taps: four 2½% primary taps (2FCAN, 2FCBN) brought out to a terminal board.
  - .4 Insulation: Class 220, 150°C average temperature rise.
  - .5 Basic Impulse Level (BIL): standard.
  - .6 Hi-pot: standard.
  - .7 Windings: copper (K factor of 13).
  - .8 The core and coil shall be isolated from the enclosure to reduce noise and vibration by means of neoprene rubber or isomode vibration dampening effect based on the weight of the core and coil unit.
  - .9 Finish: in accordance with Section 26 05 00 Common Work Electrical.

- .10 Average sound level: standard.
- .11 Impedance at 170°C: standard.
- .12 Enclosure: EEMAC 1
- .13 Transformer shall be specifically designed to supply 100% of the 60 Hz fundamental rated current,
  - .1 33% of the fundamental current as third harmonic
  - .2 20% of the fundamental current as fifth harmonic
  - .3 14% of the fundamental current as seventh harmonic
  - .4 11% of the fundamental current as ninth harmonic
  - .5 and lower proportional percentages of the fundamental current through the 25th harmonic. Mark transformers with a label stating "Suitable for Non-Sinusoidal Current Load with K-Factor not to exceed 13".
- .14 The core flux density shall be well below the saturation point to prevent core saturation caused by the harmonic even with a 10% primary overvoltage. The transformer core shall be constructed of grain oriented M6 or better; high grade non-aging silicon steel laminations of the mitre type construction.
- .15 The secondary neutral shall be twice the ampacity of the secondary phase conductors and the primary winding conductor shall be of sufficient size to limit the temperature rise to its rated value even with the circulation third harmonic current.
- .16 Transformers shall be complete with sprinkler-proof hoods.
- .17 Transformers shall be manufactured and tested (production tests) in accordance with CSA C802.2-00 incorporating modifications as specified herein.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work.
- .2 Nameplate wording to match Single Line Diagram.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Mount dry type transformers on floor, unless otherwise noted.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram. Conductors shall not enter the transformer through the top of the enclosure
- .7 Make flexible conduit connections on both primary and secondary sides of all transformers.

- .8 Ground transformer per Canadian Electrical Code.
- .9 Energize transformers after installation is complete.
- .10 Provide seismic support and restraint for all new transformers.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED SECTION**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work
- .3 Section 26 28 16 – Molded Case Circuit Breaker

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Division 01.
- .2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3 Shop drawings to include matching tub and trim details for factory installed low voltage relay cabinets where specified.

### **1.3 PLANT ASSEMBLY**

- .1 Install circuit breakers in panelboards before shipment from plant.
- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 All panelboards to be of a common manufacturer.

### **1.4 FINISH**

- .1 Apply finishes in accordance with Section 26 05 00.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

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

## **2 PRODUCTS**

### **2.1 PANELBOARDS - GENERAL**

- .1 Panelboards: product of one manufacturer.
- .2 Surface-mounted panelboards in sprinklered areas shall be complete with water shields, approved by the authorities having jurisdiction, to prevent water due to sprinkler operation entering the equipment. Seal all conduits penetrating the panelboard using watertight hubs or "O" rings DSM.



- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Two keys for each panelboard and key panelboard alike.
- .5 Copper bus with neutral bus of same ampere rating as phase busses.
- .6 Where panelboards have been specified with Main Circuit Breaker, the main breaker shall not be installed in a position that is normally occupied by a branch circuit breaker. Breaker position shall be in a location that is normally provided in a panel that is suitable for service entrance use.
- .7 Finish panelboards grey except in public areas where panel trim and front of panel door shall be provided with a prime coat only. The interior of all panelboards shall be painted white.

## **2.2 DISTRIBUTION PANELBOARDS**

- .1 Provide all switch/fuse type and breaker type distribution panelboards for use in the 600 V, 3-phase, 3-wire system and the 208/120 V, 3-phase, 4-wire system. Main sizes, switch and fuse sizes, breaker sizes, and number of branch units shall be as shown on the drawings and panel schedule.
- .2 When more than one section is required, the panelboard shall be made up of individual sections bolted together to form a complete panel. All distribution panelboards shall be of the totally enclosed dead front type. The panelboards shall be constructed from formed code gauge galvanized or bonderized steel panels. All front covers shall be hinged with "hold down" bolts.
- .3 The panelboards shall be front accessible and shall not exceed the dimensions shown. Panelboards shall be shipped in sections compatible with available access routes.
- .4 Main bus bars shall be of tin-plated copper and equipped with pressure type solderless lugs. The copper shall be thoroughly cleaned and pre-plated before the final tin-plating is applied. All bus work shall be suitably supported to withstand maximum short circuit current RMS amperes symmetrical as noted on drawings. The bus bars and mounting frames shall be so arranged that any standard size unit can be readily mounted in place and connected. Adequate wiring and gutter space shall be provided to permit installation and connection of the panelboard feeder conductors and standard conductors for all branch units to the maximum capacity of these units.
- .5 Molded Case Circuit Breakers
  - .1 Main circuit breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker. Main Circuit breakers that are located in Branch circuit breaker position shall not be used.

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## 2.3 LIGHTING AND POWER PANELBOARDS

- .1 Panelboards shall be moulded case circuit breaker type.
- .2 Panel type, mounting, system voltage, main bus, main breaker, spare breakers, spaces, breaker ampere rating, number of poles, breaker arrangement and breaker type as well as special panelboard details shall be as noted in the panel schedules on the drawings. Bus bar material shall be copper. Provide all necessary jumpers, connectors, etc., for simple field installation of future circuit breakers. Provide integral main breaker, contactor, double lugs for double neutral conductors, insulated ground buses, and other special features when called for in the panel schedules or as indicated by feeder data.
- .3 All panelboards shall be fitted with a branch circuit grounding terminal bus firmly bonded to the inside of the panelboard case and consisting of a length of copper grounding bus with one terminal for each circuit position available in the panel. Branch circuit equipment grounding conductors shall terminate at the ground bus.
- .4 Provide, where noted, for certain panelboards, an insulated technical ground bus similar to the above except insulated from the case of the panelboard and complete with one lug capable of accepting the incoming insulated technical ground conductor from the master ground bus.
- .5 All panelboards shall be fitted at the bottom or top of the panels as appropriate with a custom fabricated cabinet of the same dimensions, construction and finish as the panelboards and with a separate hinged door with catch and lock all to match the panelboard. Size cabinet to permit incoming cables to be splayed apart such that clamp-on current sensors can be temporarily installed around all phase and neutral conductors for energy metering.
- .6 Panelboard enclosures capable of containing not more than 24 single-pole breakers rated 70 A or less shall not be less than 350 mm wide and 103 mm deep. Panelboard enclosures capable of containing more than 24 such breakers shall be not less than 500 mm wide unless specific approval for the use of narrower enclosures is obtained from the Engineer. Panelboard enclosures containing breakers rated above 70 A shall be at least 500 mm wide. All of the above notwithstanding, provide adequate wiring space as required by current CSA Specifications.
- .7 Provide panelboards with trim, door, catch and lock. Provide 2 catches per door where necessary to ensure panel doors are flush with trim.
- .8 Provide surface-mounted panelboards with "shoe box" trims.
- .9 Flush-mounted panelboards shall have doors with concealed hinges. Panel trims shall not have any exposed screws or bolt heads. Panelboard trim shall be completely flat. Installations exhibiting a space between panel cover and the wall will be rejected.
- .10 All breakers in all panelboards shall be of the same manufacturer.
- .11 Plug-in type circuit breakers shall not be used.
- .12 Two- and three-pole circuit breakers shall have a common tripping mechanism and single handle. Handle ties are not acceptable.

- .13 Surface-mounted panelboards shall be of sprinkler-proof construction complete with water shields approved by the authorities having jurisdiction to prevent water due to sprinkler operation entering the equipment. All conduits penetrating the panelboard shall be sealed using water-tight hubs or "O" rings DSM.

## **2.4 PANELBOARD IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a "letter sized" paper copy of each directory in the project maintenance manual.
- .4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a "letter sized" paper copy of each information card in the project maintenance manual.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
- .2 Mount panelboards to height given in Section 26 05 00 or as indicated.
- .3 Connect loads to circuits as indicated.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Install 4 x 27 mm empty conduits (or equivalent) from each flush mounted panelboard single tub to accessible ceiling space above. Refer also to Section 26 05 34 – Conduits , Conduit Fastenings and Conduit Fittings.

END OF SECTION

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**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work

**1.2 REFERENCES**

- .1 CSA C22.1-09 - Canadian Electrical Codes, Part 1.

**1.3 PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

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

**2 PRODUCTS**

**2.1 SWITCHES**

- .1 Extra heavy duty specification grade.
- .2 20 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.
- .3 Manually-operated general purpose ac switches as indicated and with following features:
  - .1 Terminal holes approved for No.10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine molding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White toggle (red toggle for emergency power circuits).
- .4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rating capacity of motor loads.
- .5 Switches of one manufacturer throughout project.
- .6 Acceptable products or approved equal:
  - .1 Arrow Hart 1900 series
  - .2 Bryant 4900 series
  - .3 Hubbell HBL 1221 series
  - .4 Leviton 1221-2 series
  - .5 Pass & Seymour PS20AC1 120V series

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## **2.2 RECEPTACLES – GENERAL**

- .1 Extra heavy duty specification grade.
- .2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
  - .1 White nylon molded housing (red for emergency power circuits, blue for surge protection)
  - .2 Suitable for No.10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and non riveted grounding contacts.
- .3 Duplex receptacles with a CSA Configuration of 5-15R and 5-20R installed within the Living Unit shall be tamper-resistant. Receptacles dedicated for microwaves, refrigerators, freezers or kitchen counters are excluded.
- .4 Receptacles of one manufacturer throughout project.
- .5 Acceptable products or approved equal:
  - .1 Arrow Hart 6262
  - .2 Bryant 5262.
  - .3 Hubbell 5262 series
  - .4 Leviton 5262 series
  - .5 Pass & Seymour 5262 series

## **2.3 RECEPTACLES – 20A**

- .1 Extra heavy duty specification grade.
- .2 Duplex receptacles, CSA type 5-20 RA, 125 V, 15/20 A, U ground, with following features:
  - .1 White nylon molded housing (red for emergency power circuits)
  - .2 Suitable for No.10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and non riveted grounding contacts.

## **2.4 DIMMERS**

- .1 Flush mounted - Specification grade.
- .2 Incandescent application: 600 watts to 1500 watts based on connected load plus 25% spare.
- .3 Electronic ballast application: compatible with ballasts specified.
- .4 LED application: compatible with specified fixture
- .5 Radio interference suppression.
- .6 Thin profile: slide to OFF feature.

- .7 Finished in white or as indicated.
- .8 Acceptable product or approved equal: Lutron Diva Series.

## **2.5 INTERVAL TIMERS**

- .1 Range: 0-30 minutes.
- .2 Spring wound without hold feature.
- .3 Single pole 120 volt, 20 Amp contacts to open at end of timing cycle.
- .4 Flush mounting.
- .5 White finish.
- .6 Acceptable products: Intermatic, Paragon or approved equal.

## **2.6 COVER PLATES**

- .1 Stainless steel: Type 302 or 304, No. 4 finish, 1mm thick, accurately die cut, protective cover for shipping. For general interior flush mounted wiring devices and surface type FS or FD type boxes.
- .2 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.
- .3 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.
- .4 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.
- .5 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.
- .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Coverplates to fasten to box by four screws.
- .7 Gaskets: resilient rubber or close cell foam urethane. All gaskets inside inmate cells shall be air tight type to maintain negative air pressure in the cells.
- .8 Cover plates for all wiring devices to be from one manufacturer throughout project.

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**3 EXECUTION**

**3.1 INSTALLATION GENERAL**

- .1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.
- .2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.
- .3 All plates to be installed parallel or perpendicular to building lines.

**3.2 INSTALLATION PARTICULAR**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .2 Receptacles:
  - .1 Install all receptacles in the vertical plane unless otherwise noted.
  - .2 Generally install the 5-15/20R U ground pin down unless otherwise noted.
  - .3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.
  - .4 Where split receptacles has one portion switched, mount vertically and switch the upper portion.
  - .5 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.
- .3 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
  - .4 Use weatherproof cover plates in wet locations and where indicated.
  - .5 Provide a label on every switch and receptacle cover plate indicating panel and circuit number.

END OF SECTION

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work
- .3 Section 26 24 17 – Panelboards Breaker Type

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Division 01.
- .2 Include time-current characteristic curves for breakers with ampacity of 100A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

**2 PRODUCTS**

**2.1 BREAKERS - GENERAL**

- .1 Moulded-case circuit breakers, and ground-fault circuit-interrupters, and accessory high-fault protectors: to CSA C22.2 No. 5
- .2 Bolt-on moulded-case circuit breaker: quick- make, quick-break type, for manual and automatic operation [with temperature compensation for 40°C ambient.
- .3 Plug-in moulded-case circuit breakers shall not be used.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers with interchangeable trips as indicated.
- .7 Main circuit breaker for Panelboard 'DP-1' and the new circuit breaker added to the 'Generator Building H' Panelboard shall be equipped with electronic trips adjustable from 200A to 400A.



**2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded-case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

END OF SECTION

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**1 GENERAL**

**1.1 RELATED WORK**

- .1 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.

**1.2 PRODUCT DATA**

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

**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.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide identification lamacoid for main fused switch.

**2.3 MAINTENANCE MATERIALS**

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

- 
- .3 For disconnect switch 50A or larger, provide one spare disconnect switches for each different size and type.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses where indicated or required.
- .2 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

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work – Electrical

**1.2 SUBMITTALS**

- .1 Provide submittals in accordance with Division 01.
- .2 Submit product data sheets for sills, bus bars, and compartments. Include product characteristics, physical size, and finish.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.
- .4 Submit shop drawings and indicate:
  - .1 Outline dimensions.
  - .2 Configuration of identified compartments.
  - .3 Floor anchoring method and dimensioned foundation template.
  - .4 Cable entry and exit locations.
  - .5 Dimensioned position and size of bus bars and details of provision for future extension.
  - .6 Schematic and wiring diagrams.
- .5 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Division 01.
- .6 Include data for each type and style of starter.

**1.3 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

**1.4 MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with Section 26 05 00
- .2 Provide listed spare parts for each different size and type of starter:
  - .1 1 starter heater.
  - .2 1 control transformer.
  - .3 5 pilot lights.
  - .4 3 contacts, stationary.
  - .5 3 contacts, movable.
  - .6 1 contact, auxiliary.
  - .7 1 operating coil.
  - .8 5 fuses.

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## 2 PRODUCTS

### 2.1 MOTOR STARTERS

- .1 All motor starters supplied under Division 26 shall be of the same manufacturer.
- .2 Motor starters are indicated in the Mechanical Equipment Schedule (Appendix B) by letter types in conjunction with numerical suffixes. The letters indicate the type of starter and the numerals indicate special features which must be incorporated into or placed adjacent to the starters as specified.
- .3 The following letter types shall apply:
  - .1 Type A - Magnetic in general purpose enclosure
  - .2 Type B - Magnetic in Motor Control Centre
  - .3 Type C - Manual starter in general purpose enclosure
  - .4 Type D - Manual open type flush mounted in switchbox and fitted with plate to match other switch plates in the area
  - .5 Type E - Manual with special features
  - .6 Type F - Combination breaker/magnetic starter in an EEMAC I enclosure. Overcurrent device rating shall be as noted in the Mechanical Equipment Schedule. Overcurrent devices to be capable of being locked "OFF" and "ON"
  - .7 Type G - Combination unfused switch/magnetic starter in an EEMAC I enclosure
  - .8 Type H - Fusible switch in Motor Control Centre
  - .9 Type R-2(2SP) - Two-speed relay type starter w/o overload heaters. Locate in EEMAC I enclosure. Refer to drawings for wiring diagrams.
- .4 The following suffixes shall apply:
  - .1 Reset only in cover.
  - .2 Reset and HAND-OFF-AUTOMATIC or LOCAL-OFF-REMOTE switch in cover.
  - .3 Reset and START-STOP pushbuttons in cover.
  - .4 Run (red) and Stop (green) PUSH-TO-TEST pilot lights in cover.
  - .5 Fitted with special features - see Mechanical Equipment Schedule.
  - .6 Reset and ON-OFF selector switch in cover.
- .5 All individual starters shall have RUN and STOP pilot lights, with PUSH-TO-TEST feature, and START/STOP pushbuttons or selector switches as required or indicated.
- .6 Starters located in finished areas (other than service spaces) shall be of a flush-mounted type with stainless steel cover.
- .7 Fit all motor starters supplied under Division 26 with adjustable electronic overload trips in all normally ungrounded lines.
- .8 All magnetic starters, including combination starters provided under Division 26 shall be complete with 4 sets of spare auxiliary contacts (2 sets N/C, 2 sets N/O, all sets reversible). Each and every starter shall have a separate control transformer complete with fused secondary protection at 120 volt, 60 Hz AC. Transformer volt-ampere rating will be confirmed with Mechanical Division prior to ordering. Where line over current protection exceeds 15 amperes, provide primary fuses for the control transformers.
- .9 Minimum magnetic starter size shall be CEMA Size 1.

- .10 Coordinate with the BMS Controls contractors. Interposing relays required to interface BMS system to the wiring in motor starters shall be provided by BMS Controls Contractor.

- .11 Provide interposing relays for fire alarm shutdown of motors as noted in the Mechanical Equipment Schedule.

## **2.2 MISCELLANEOUS CONTROL DEVICES**

- .1 Pushbuttons: Heavy Duty Oil-Tight
- .2 Selector Switches: Heavy Duty Oil-Tight
- .3 Indicating (Pilot) Lights: Transformer Base PUSH-TO-TEST Type, 12 volt LED indicator lamps. Coordinate the pilot light transformer and circuit voltages such that not more than 12 volts are available at the lamp terminals.
- .4 Control Circuit Transformers: Confirm the volt-ampere rating of the control transformer with Mechanical Division prior to ordering.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work.

# **3 EXECUTION**

## **3.1 MOTOR STARTERS**

- .1 Install, and wire adjacent to the starters, all devices, equipment, and enclosures described in the Mechanical Equipment Schedule with applicable special letter types and suffixes.
- .2 Furnish and install for every motor in the building, unless otherwise noted, either a manual or magnetic motor starter as indicated in the Mechanical Equipment Schedule.
- .3 Check the actual nameplate current rating of all motors installed before ordering the electronic overloads for motor starters.

## **3.2 MOTOR CONTROL WIRING**

- .1 All motor control wiring (120 V line voltage and 24 V low voltage) including conduit as well as supply and installation of control devices will, except where specifically noted on the electrical drawings, in the Mechanical Equipment Schedule, or outlined below, be provided as described in Mechanical Division of the Specification. Except where specifically directed to the contrary, motor control wiring, associated conduits, and control devices do not form a part of Division 26 work.
- .2 The motor control work which shall be provided under Division 26 shall include the following:
  - .1 All conduit and control wiring specifically noted on the drawings and outlined in the different parts of the Specification.

- .2 All control wiring as specified in the Mechanical Equipment Schedule.
- .3 Control wiring related to air handling shutdown during fire alarm.

### **3.3 MOTOR POWER WIRING**

- .1 Connect all motors shown on the drawings or mentioned in this Specification. The locations of motors are approximate only. Check to determine correct locations and install wiring to these points.
- .2 Responsibility of supplier and installer is indicated in the Mechanical Equipment Schedule. Related mechanical responsibility is indicated on the Mechanical Equipment Schedule on mechanical drawings.
- .3 Check motor rotation before mechanically coupling to load.
- .4 Except where otherwise directed, connect all motors with flexible conduits. Ground the conduit system with a separate grounding conductor installed in the flexible conduit.

### **3.4 STARTER VERIFICATION**

- .1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:
  - .1 Check of control circuits.
  - .2 Verify that overload relay installed is correctly sized for motor used.
  - .3 Record overload relay size and motor nameplate amperage.
  - .4 Visual inspection of fuses and contactors.
  - .5 Ensure all connections are tight.
- .2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running.
- .3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

### **3.5 OVERLOAD RELAYS**

- .1 For starters provided, select overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time loads, provide special overload relays to suite the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection.

### **3.6 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 98 00 - Testing, Adjusting and Balancing of Electrical Equipment and Systems and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.

- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION



## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work – Electrical
- .3 Section 26 05 25 – Seismic Restraints

### **1.2 REFERENCES**

- .1 Uninterruptable Power Supply (UPS), battery and all related system accessories designed, manufactured, and tested in accordance with all requirements of latest editions of:
  - .1 Canadian Electrical Code and B.C. amendments and Bulletins.
  - .2 CSA requirements for protection of equipment installed in sprinklered electrical rooms.
  - .3 UL/cUL approved (1778).
  - .4 Canadian Standards Association (CSA), or equivalent certified testing/certification agencies, which are acceptable to CSA and local Authorities. Provide CSA labels on UPS, battery cabinet, battery breaker panel, manual bypass cabinet, UPS distribution panel.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA C813.1-01, Performance Test Method for Uninterruptible Power Supplies.

### **1.3 REQUIREMENTS**

- .1 Provide one rack mounted 5 kVA, 208 V, single phase, 2-wire input, 120/208V, single phase, 3 wire and ground output 60 Hz static uninterruptible power supply (UPS) system. Provide all equipment and installation materials necessary to make a complete functional system when installed as indicated on the drawings.
- .2 System shall include:
  - .1 UPS equipment cabinets configured as one self-contained assembly. If cabinets or components require separation or removal for shipment or installation, the supplier shall include on-site reassembly and retesting by factory qualified service personnel. UPS equipment cabinets shall include the following general equipment or equivalents as required to meet the specified performance requirements:
    - .1 CSA required backfeed prevention equipment for separate normal and bypass sources.
    - .2 Input filter with protection fuses.
    - .3 AC to DC controlled rectifier with protection fuses.
    - .4 DC link and filter.
    - .5 Input/output connections for external battery including protection fuses.
    - .6 Pulse width modulation type on-line DC to AC inverter, double conversion type, IGBT type.
    - .7 Output filter.

- .8 Continuous rated static bypass switch with protection fuses.
- .2 Network management card for future remote monitoring via the Building Management System.
- .3 UPS battery capacity shall be 20 minutes at 100% of UPS rating.
- .4 Batteries shall be sealed, lead-acid, maintenance free cells.
- .5 Batteries both internal and external shall be hot-swappable and include all connectors and accessories to form a fully functional operational assembly.
- .6 Power distribution module containing maintenance bypass switch configured for a hardwired connection to a UPS distribution panel supplied by others.
- .7 Manuals and documentation.
- .8 Delivery to site.
- .9 UPS site commissioning and training.

#### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings and product data which are appropriate for the specific equipment/accessories being supplied. Drawings or data pertaining to a variety of similar products or containing irrelevant information will be rejected without review. Incomplete submissions will be rejected without review.
  - .1 Include dimensioned drawing of UPS and related system equipment/accessories to be supplied.
  - .2 Schematic power and control diagrams showing all UPS components.
  - .3 Cooling air flows and permissible restrictions.
  - .4 Maximum current flow in all system interconnection wiring.
  - .5 Heat rejection data at conditions of:
    - .1 100% rated load/maximum recharge
    - .2 65% rated load/maximum recharge
    - .3 65% rated load/float charge
  - .6 Certification that UPS system equipment will comply with specified performance requirements. In the event that there are deviations to specified requirements, these must be clearly identified and may be cause for rejection of equipment for non-compliance with requirements. In the absence of clearly defined performance deviations the specification requirements shall be the standard of acceptance for all performance testing.
  - .7 Complete materials list for all equipment to be supplied. Include make and model of all equipment and components supplied which are not specifically listed in the standard UPS drawings or operation/ maintenance manuals. This shall include breakers, fuses, meters, panelboards, batteries and accessories, etc. Provide technical and performance data for individual equipment.
  - .8 Nameplate schedule for all equipment supplied.

#### **1.5 OPERATION AND MAINTENANCE DATA**

- .1 Provide 3 copies of Operation and Maintenance Manuals for UPS and batteries and all system accessories. Ensure that information is for specific equipment supplied and not general description of data applicable to a range or type of units manufactured. Provide appropriate section dividers and overall index to contents.
- .2 Include:
  - .1 Operation and maintenance instructions for all equipment and accessories to permit effective operation, maintenance, and repair.

- .2 As-built schematic wiring diagram of all electrical power and controls. Drawings shall indicate actual set-point of all variable controls, timers and protective devices.
- .3 Flow diagrams for cooling air systems.
- .4 Bill of materials showing all major components utilized in manufacture of UPS and related equipment, complete with name, description, and model numbers of original component manufacturer. Data shall be sufficiently complete to permit proper ordering of spare parts. Where required, data shall include serial numbers if pertinent to ordering replacement parts.
- .5 Space to insert copy of field commissioning records and acceptance test results.
- .6 Certified copy of warranty.

## **1.6 STORAGE AND DELIVERY**

- .1 Store all UPS system equipment in an indoor, dry, heated (to 15°C minimum) location until scheduled delivery to site.
- .2 Coordinate site delivery schedule with site contractor. Do not ship until equipment can be off-loaded and immediately placed in its installed location in the completed building.

## **1.7 WARRANTY**

- .1 Provide a written warranty stating that the UPS equipment and accessories, including batteries, are warranted by the manufacturer against defects in material and workmanship for a period of one year from the date of on-site commissioning and final acceptance for automatic service. Include copy of warranty in Operation Manuals. Warranty shall include 100% on site parts and labour for repair of defects.

# **2 PRODUCTS**

## **2.1 RATING AND PERFORMANCE REQUIREMENTS**

- .1 UPS and related equipment shall comply with the following minimum rating and performance requirements:
  - .1 UPS continuous Output Rating (100% load): when serving up to 100% non-linear loads having peak current up to 3 times fundamental RMS current [i.e. Crest Factor (CF) = 3:1].
  - .2 UPS inverter output conditions when operating on either rectifier output or variable voltage battery power at 100% load:
    - .1 Output frequency:  $\pm 0.5\%$ .
    - .2 Output voltage regulation:  $\pm 2\%$ .
    - .3 Transient voltage:  $\pm 5\%$  for 100% step load change with recovery initiated within 8 ms and recovery to steady state bandwidth within 50 ms.
    - .4 Phase displacement: less than 1° with balanced load; less than 3° with 50% unbalanced load; less than 5° with 100% unbalanced load.

- .5 Output voltage distortion: THDU  $\pm$  3%.
  - .3 Input source inrush current at initial energization limited to 200A for 1 ms.
  - .4 EMI suppression to FCC Part 15, Subpart J, Class A.
  - .5 Input source surge withstand capability to ANSI C62.41 (IEEE 587) Categories A and B.
- .2 UPS and related equipment shall comply with the rating and performance requirements when operated under conditions of:
- .1 Rectifier input power source: 208 V, single phase, 3-wire, +10% to -15%.
  - .2 Source frequency: 60 Hz  $\pm$ 5%. Inverter synchronized to bypass source frequency for 60 Hz  $\pm$ 1%.
  - .3 Source voltage distortion: 5% THD or less.
  - .4 UPS room ambient conditions of:
    - .1 Temperature up to 40°C at 150 m above sea level.
    - .2 Humidity up to 95%.
  - .5 UPS noise level at any load up to 100% rated load, float charge conditions shall not exceed 66 dBA measured at 1 meter from cabinet and 1.2 m above a reflective floor surface (e.g. concrete), and reading adjusted to free field conditions.
- .3 Overall UPS efficiency: minimum 90% at 100% rated load; minimum 88% at 50% rated load.
- .4 Manufacturer's published mean time before failure (MTBF) of not less than 50,000 hours with calculation based on IEEE-recommended practice for establishing equipment reliability/availability.

## **2.2 UPS MONITORING AND DIAGNOSTICS**

- .1 Provide an operator control, monitoring and diagnostics system consisting of an electronic panel which includes the following features.
- .2 LED display of UPS operating status configured for at-a-glance recognition of overall operating conditions.

## **2.3 SHIPPING AND DELIVERY**

- .1 Prepare UPS and accessories for shipment. Perform all necessary blocking, tie-down, protection, and removal and storage of external extremities for safe loading, transit, unloading, lifting, and setting in place in the indicated UPS room.
- .2 Store UPS and coordinate shipping method and necessary crating/weather protection with Site Works Contractor as per Part 1 of this Section.

## **2.4 STANDARDS OF ACCEPTANCE**

- .1 Eaton 9135 UPS or approved equal.

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### **3 EXECUTION**

#### **3.1 INSTALLATION COORDINATION**

- .1 Physical installation details shown on plans and defined in these Specifications are typical of equipment which would conform to Specifications for equipment supply.
- .2 Coordinate with actual UPS equipment supplier for all final installation dimensions, locations, connections, and miscellaneous installation materials.
- .3 Obtain approval from Consultant for any significant changes in equipment location or connection.

#### **3.2 ELECTRICAL SYSTEM**

- .1 Make all necessary electrical connections to UPS equipment and accessories as shown on electrical plans and suppliers' drawings.
- .2 All power and control wiring to be installed to comply with the requirements for sprinklered equipment rooms. As a minimum, that shall include O-ring or equivalent seals at all joins or entry into junction boxes, panels, switchboards, etc.

#### **3.3 COMMISSIONING THE WORK**

- .1 Following completion of installation, the UPS Equipment Supplier is required to provide a qualified representative for commissioning, testing, and training for UPS and associated equipment. Schedule and coordinate these activities with the UPS supplier.
- .2 Ready UPS system for service. Check phase rotation of UPS output prior to switching loads.
- .3 Qualified personnel shall commission system for correct operation and suitability for service.
- .4 Consultant and Departmental Representative shall be notified and a date set for Site Acceptance Test.

#### **3.4 TRAINING**

- .1 Conduct a familiarization and training session for Owner's operating personnel. Schedule training session to coordinate with shift schedules of operating personnel.
- .2 Training shall be conducted by a qualified UPS service technician who is familiar with both technical and operating/service characteristics of UPS systems.
- .3 Session to be conducted after equipment is installed and fully operational.
- .4 Include a minimum of the following items:
  - .1 Familiarization with instruction manual.

- .2 Review of electrical schematics and controller logic ladder diagram - how to read them and how to use them to troubleshoot system function or control problem.
- .5 Physical check-over of equipment noting device locations and relationship to schematics.
  - .1 Equipment functional tests and checks.
  - .2 Equipment operating instructions, including tuning and adjusting for operation.
  - .3 Equipment routine service requirements.
  - .4 Emergency troubleshooting instructions - define most likely problems, symptoms, and corrective actions.
  - .5 Battery system safety, operation, and maintenance.
- .6 Owner's personnel will be a maximum of 4 persons who will be qualified electricians and/or electronics service personnel.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 - Common Work

### **1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Division 01.
- .2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.
- .3 Photometric data to include VCP Table and spacing criterion.

### **1.3 SAMPLE LUMINAIRES**

- .1 Submit sample luminaires for review prior to manufacturing when requested by the Departmental Representative.
- .2 Sample luminaires to be operable and complete with lamps, accessories and a plug-in power cord if requested by the Departmental Representative.
- .3 Deliver samples to the Departmental Representative's office or to another location as directed. Collect the sample(s) at the conclusion of the review.

### **1.4 INTENT**

- .1 Provide lighting fixtures and accessories for all outlets as listed in the Lighting Fixture Schedule (Appendix A) and as shown on drawings.
- .2 Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.
- .3 Ground all lighting equipment to grounding system.
- .4 Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Consultant before ordering fixtures.
- .5 Fixtures of the same or similar type shall be supplied by the same manufacturer.

### **1.5 MAINTENANCE MATERIAL**

- .1 Provide listed spare parts:
  - .1 Spare incandescent lamps equal to 20% of the original number of lamps installed.

- .2 Spare H.I.D. lamps equal to 20% of the original number of lamps installed.
- .3 Spare 1220mm fluorescent lamps equal to 20% of the original number of lamps installed.
- .4 5 spare of each other sizes of fluorescent lamps used.
- .5 5 spare 2-lamp fluorescent ballast.
- .6 2 spare 1-lamp fluorescent ballast.

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Provide lighting fixtures new and complete with all mounting accessories, junction boxes, trims, frames, and lamps.
- .2 All products of the same specified type are to be of the same manufacturer.
- .3 Fixture type catalogue numbers do not necessarily denote required mounting equipment or accessories. Provide all appropriate mounting accessories for all mounting conditions.

### **2.2 FLUORESCENT ELECTRONIC BALLASTS**

- .1 The electronic ballast shall as a minimum meet the following characteristics:
  - .1 Ballast shall comply with CSA, UL 935, NEMA C82.11, and NFPA 70 unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.
  - .2 Power factor shall be 0.95 (minimum).
  - .3 Ballast shall operate at a frequency of 20,000 Hertz (minimum).
  - .4 Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems.
  - .5 Provide ballasts operating at or above 40,000 Hertz where available.
  - .6 Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation.
  - .7 Ballast shall be normal light output 90% (minimum) or better.
  - .8 Ballast shall have 10 percent flicker (maximum) using any compatible lamp.
  - .9 Ballast shall be ULC listed with a sound rating of "A."
  - .10 Ballast shall have circuit diagrams and lamp connections displayed on the ballast.
- .2 Ballasts shall be instant start.
- .3 Instant start ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Programmed rapid start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.
- .4 Ballasts for compact fluorescent fixtures shall be programmed rapid start.
- .5 Ballast shall be capable of starting and maintaining operation at a minimum of -17 degrees C 0 degrees F unless otherwise indicated.



- .6 Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.
- .7 T-8 Lamp Ballast
  - .1 Total harmonic distortion (THD): Shall be 10 percent maximum.
  - .2 Input wattage:
    - .1 32 watts (maximum) when operating one F32T8 lamp
    - .2 62 watts (maximum) when operating two F32T8 lamps
    - .3 92 watts (maximum) when operating three F32T8 lamps
    - .4 114 watts (maximum) when operating four F32T8 lamps
  - .3 Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.
  - .4 Single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.
- .8 T-5 Lamp Ballasts
  - .1 Total harmonic distortion (THD): Shall not be greater than 25 percent when operating one lamp, 15 percent when operating two lamps.
  - .2 Input wattage:
    - .1 28 watts (maximum) when operating one T5 28W lamps
    - .2 56 watts (maximum) when operating two T5 28W lamps
  - .3 Provide four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.
  - .4 Single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.
- .9 Electronic Dimming Ballasts
  - .1 Ballast shall comply with CSA, NEMA C82.11, UL 935, and NFPA 70, unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41. Ballast dimming capability range shall be from 100 to 1 percent (minimum range) of light output, flicker free.
  - .2 Ballast shall start lamp at any pre-set light output setting without first having to go to full light output. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.
  - .3 Power factor shall be 0.95 (minimum) at full light output and 0.90 (minimum) over the entire dimming range.
  - .4 Ballast shall operate at a frequency of 20,000 Hertz (minimum).
  - .5 Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems.
  - .6 Provide ballasts operating at or above 40,000 Hertz where available.
  - .7 Ballast factor at full light output shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).
  - .8 Ballast shall be ULC listed with a sound rating of "A".
  - .9 Ballast shall have circuit diagrams and lamp connections displayed on the ballast.
  - .10 Ballast shall be programmed start. Ballast may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.
  - .11 Ballasts for compact fluorescent fixtures shall be programmed start.
  - .12 Ballast shall be capable of starting and maintaining operation at a minimum of -17 degrees C 0 degrees F unless otherwise indicated.

- .13 Total harmonic distortion (THD): Shall be 20 percent (maximum) over the entire dimming range.
- .14 Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as applicable.
- .10 Dimming Ballast Controls
  - .1 The dimming ballast controls shall be a slide dimmer with on/off control.
  - .2 The slide dimmer shall be compatible with the ballast and control the ballast light output over the full dimming range. Dimming ballast controls shall be approved by the ballast manufacturer.
  - .3 Light Level Sensor UL listed. Light level sensor shall be capable of detecting changes in ambient lighting levels, shall provide a dimming range of 10 percent to 100 percent, minimum, and shall be designed for use with dimming ballast and voltage system to which they are connected. Sensor shall be capable of controlling 40 electronic dimming ballast, minimum. Sensor light level shall be adjustable and have a set level range from 10 to 100 foot-candles 100 to 1000 lux, minimum. Sensor shall have a bypass function to electrically override sensor control.
- .11 All fluorescent ballasts shall be constructed by the same manufacturers.
- .12 Coordinate with Mechanical Division for compatibility between Mechanical Division supplied low voltage control and Electrical Division supplied ballasts.

## 2.3 LAMPS

- .1 All fluorescent lamps shall be low mercury lamps when available.
- .2 T-8 lamp shall be rated 32 watts (maximum), nominal length of 1220 mm 48 inches, 3100 initial lumens (minimum), CRI of 85 (minimum), color temperature of 4100 K, and an average rated life of 20,000 hours.
- .3 T-5 lamp shall be rated 28 watts (maximum), nominal length of 46 inches, 4100 K, 2900 initial lumens.
- .4 Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:
  - .1 T-4, twin tube, rated 5 watt, 250 initial lumens (minimum) 7watts, 400 initial lumens (minimum), 9 watts, 600 initial lumens (minimum) and [13 watts, 825 initial lumens (minimum).
  - .2 T-4, double twin tube, rated 13 watts, 900 initial lumens (minimum), 18 watts, 1200 initial lumens (minimum), and 26 watts, 1800 initial lumens (minimum)
  - .3 T-4, Triple tube, rated 26 watts, 1800 initial lumens (minimum), 32 watts, 2400 initial lumens (minimum), and 42 watts, 3200 initial lumens (minimum)
- .5 All fixtures shall be provided with proper, new, and operable lamps. Provide lamps indicated on the Light Fixture Schedule (Appendix A), or, if not indicated, as recommended by the fixture manufacturer.
- .6 Unless otherwise specified, all incandescent lamps shall be 2500hr - 120 Volt, inside-frosted, with wattage as noted or specified.

- .7 All fluorescent lamps of the same type and colour shall be by the same manufacturer.
- .8 Unless otherwise specified, all fluorescent lamps shall be 'premium' quality and manufactured by General Electric, Philips, Osram/Sylvania, or other specifically approved manufacturer.
- .9 High Intensity Discharge (HID): All metal halide sources shall have a warm colour temperature, i.e. 3000°-3200°K, unless otherwise noted in the Light Fixture Schedule (Appendix A). Metal halide lamps deemed to have excessive colour variation by the Departmental Representative, will be replaced by the Contractor.
- .10 Acceptable manufacturers shall be General Electric, Osram/Sylvania, Venture Lighting, and Philips. All lamps of each given type shall be by the same manufacturer. If the words "or equivalent" or "or equal" are not indicated after lamp manufacturer and catalogue number in the fixture schedule, then no other manufacturer will be acceptable for that particular type.

## **2.4 SOCKETS**

- .1 Sockets for incandescent fixtures shall be standard medium base.
- .2 Sockets for fluorescent fixtures shall be standard medium bi-pin unless otherwise noted.

## **2.5 FIXTURES**

- .1 All fixtures shall comply with CSA Standard C22.2 No.9-latest edition. Accessories and components shall comply with relevant CSA Standards applicable to accessory or components.
- .2 Recessed incandescent fixtures shall be of the approved prewired type with junction box forming an integral part of the fixture assembly and so located in relation to the fixture that the junction box is CSA approved for 60 degree C wire. The electrical trade shall supply and install all necessary plaster rings, supports, etc., required for complete and proper installation.
- .3 Close ceiling mounted type incandescent fixtures shall be provided with insulating and reflective pad or ventilation slots so that temperature in the outlet box is satisfactory for 60 degree C conductors. Fixtures with pads shall be CSA approved with an enclosed pad that is normally visible.
- .4 Except where otherwise noted in the Fixture Schedule, depth of recessed fluorescent fixtures shall not exceed 150 mm, including mounting yokes, or bridges and the distance from the back face of the diffuser or lens to the centre of the lamp shall be not less than 75 mm. Design of reflector and lamp position shall be to provide high efficiency, even brightness and lack of lamp lines.
- .5 Fluorescent fixtures shall be constructed of not less than code gauge steel. All metal parts shall be thoroughly cleaned and finished in high reflectance baked white enamel over corrosion-resistant primer. Reflecting surfaces and exposed surface shall have not less than two coats of baked white enamel with reflectance of not less than 85%.

- .6 All fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.
- .7 Fixtures shall incorporate adequate gasketting, stops and barriers to form light traps and prevent light leaks.
- .8 Fixtures shall be designed for adequate dissipation of ballast and lamp heat to avoid short ballast life, nuisance thermal tripping and decreased lamp output. Heat test reports by independent laboratories shall be provided where required by the Department's Representative.
- .9 Construction of all fixtures shall be such as to provide a rigid well aligned fixture. Formed or ribbed backplates, end plates, reinforcing channel, heavy gauge sockets, straps, etc., shall be used where required to accomplish this.
- .10 The construction and performance of all fluorescent fixtures shall be subject to the strict approval of the Department's Representative. Full photometric data from independent testing laboratory shall be provided where required by the Departmental Representative.

## **2.6 LIGHTING FIXTURE SCHEDULE**

- .1 Refer to Appendix A
- .2 It is the responsibility of the Contractor to ensure that all lighting fixtures carried in his bid include all features as specified in the Schedule.
- .3 Submit sample luminaire complete with all specified options, mounting hardware and finishes for the Departmental Representative's review before ordering product. Contractor to allow the cost of sample submission and returning the luminaires.

## **3 EXECUTION**

### **3.1 INSTALLATION AND SUPPORTS**

- .1 Provide complete and proper support for all fixtures, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.
- .2 Provide extra strong anchors and bolts for surface mounted fixtures in inmate areas.
- .3 Support fixtures at locations shown on the drawings, level, plumb and true with the structure and other equipment in a horizontal or vertical position as intended. Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.
- .4 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.

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- .5 Self aligning seismically rated ball joint hangers shall be used for rod suspended fixtures. Ceiling canopies or hood assemblies intended to cover the suspension attachments shall be installed to fit tightly to the ceiling without restricting the alignment of the hanger. Support fixtures by hangers and mounting arrangements which will not cause the fixture frame, housing, sides or lens frame to be distorted; or prevent complete alignment of several fixtures in a row.
  - .6 The suspension length of all ceiling mounted suspended types of lighting fixtures as listed in the Lighting Fixture Schedule shall be the overall length from the ceiling to the lowest point of the fixture body, reflector or glassware in its hanging position.
  - .7 Metal inserts, expansion bolts or toggle bolts in concrete slabs for stems which do not carry wiring must be accurately located in relation to the outlet boxes, to allow perfect alignment and spacing of suspension stems.
  - .8 Where fixtures are surface mounted on the underside of an inverted tee bar ceiling, the fixture shall be supported either directly from the building structure by means of rod hangers and inserts or by means of metal angle headers, supported from the tee bar framing structure above the tile. Fixtures shall be supported from the quarter points.
  - .9 Wiring from outlet boxes to fluorescent fixtures and wiring through fluorescent fixture channels shall be rated for 90 degrees C.
  - .10 Connection to incandescent fixtures shall be by means of approved fixture type wiring.
  - .11 All recessed fixtures to be installed so that they are removable from below to gain access to outlet box or prewired fixture box. Connect all recessed fixtures to boxes with flexible conduit and approved fixture wire. Provide approved drywall enclosures in insulated ceilings. Volume of enclosure to comply with Electrical Code.
  - .12 Install fixture lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Departmental Representative.

END OF SECTION

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Division 01 - Common Work
- .3 Section 26 05 30: Seismic Restraints

**2 PRODUCTS**

**2.1 EMERGENCY BATTERY UNITS**

- .1 The emergency lighting system shall consist of fully automatic equipment. Refer to drawings for battery capacity and integral lamp (2 -12W quartz lamps) requirements.
- .2 Battery capacity shall be rated for 30 minute operation.
- .3 Each unit shall contain a fully automatic, solid-state charger with test switch and 'AC ON' LED indicating light.
- .4 The unit shall contain a sealed transfer circuit and low-voltage disconnect circuit. The battery shall be 12V DC with design life of 5 years.
- .5 The unit shall be CSA C22.2 No 141 certified.
- .6 Acceptable product: READY-LITET LDX Series or approved equal.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Provide a complete emergency battery lighting system including all necessary conduit and wiring, outlet boxes, devices, etc., as described herein and as shown on the drawings.
- .2 Provide seismically restrained mounting platform in the same finish as the battery unit. Provide flush mounted duplex receptacle adjacent to battery unit and flush mounted outlet box behind unit for wiring to remote lighting heads and exit signs.
- .3 Install remote emergency lighting heads (2 -12W quartz lamps) to battery units as shown on the drawings.

- .4 Contractor shall adjust heads and lenses after installation to give maximum lighting.

END OF SECTION

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**1 GENERAL**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 00 – Common Work.
- .2 Exit lights shall be in compliance with CAN/CSA-C860-01.

**2 PRODUCTS**

**2.1 EXIT SIGNS GENERAL**

- .1 197 mm [7.74"] high, 305 mm [12"] or 470 mm [18.5"] wide Running Man in accordance with CSA C22.2 #141.
- .2 Universal mounting.
- .3 Wall, end, or ceiling mounted as shown on drawings.
- .4 Single or double-faced as indicated.
- .5 120 V LED light source.
- .6 Designed for 50,000 hours of continuous operation.
- .7 Housing shall be constructed of rugged extruded aluminium.
- .8 Faceplate shall be constructed of extruded aluminium and be supplied with standard knockout chevrons.
- .9 Acceptable product: AimLite RPVR Series or approved equal.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install Exit Signs as indicated.
- .2 Connect Exit Signs to dedicated 120V circuits and breakers as required by the Canadian Electrical Code.
- .3 Provide circuit breaker locks for Exit Sign circuits.
- .4 All Exit Sign wiring to be installed in separate conduit and boxes.
- .5 All conductors to be minimum #12 AWG with RW90 X-link insulation.



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- .6 Support Exit Signs from ceiling tile in tee bar installation locations so as to provide a flush/neat installation and minimize tile lift.
  - .7 Provide approved support hardware to the tee bar rail assembly to minimize tile stress and provide independent seismic cable(s) restraint from building structure.
  - .8 Wall mounted exit lights to be mounted 2290mm [7' 6"] to underside or as detailed.
  - .9 Ceiling mounted exit lights in all service spaces to be suspended to 2290mm [7' 6"] to the underside.
  - .10 Install stem-mounting kits and canopy brackets where required.
  - .11 Where directional arrows are shown on the drawings, provide same on the exit lights pointing left, right, or both directions as indicated.

### **3.2 FINAL ACCEPTANCE**

- .1 Position exit lights to optimize viewing angles and to avoid line of site obstructions.
- .2 Attend the building occupancy review with the Authority Having Jurisdiction and adjust any locations as required.

END OF SECTION

**1 GENERAL**

**1.1 RELATED WORK**

- .1 Mechanical: Divisions 23 and 25
- .2 Section 26 29 10 – Motor Starters and Controls

**1.2 REQUIREMENTS**

- .1 Provide a complete system of wiring to motors and mechanical controls as specified herein and as shown on the drawings.
- .2 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.
- .3 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.
- .4 Do not operate motors and controls until approval is obtained from the trade providing equipment.
- .5 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.
- .6 Assist in placing in operation all mechanical equipment having electrical connections.
- .7 Provide three phase starters with fused 120 volt control transformers and overload relays.
- .8 Provide all power wiring for all motors.
- .9 Provide power wiring for heating ventilating and air conditioning equipment. Provide terminations in starters and MCCs for control wiring so that starter control circuits may be extended. Where 120 volt power is required for mechanical equipment, i.e. roll type filters, refrigerated aftercoolers, control cabinets, etc. wiring to the equipment terminals is the work of this Division.
- .10 Refer to Mechanical Equipment Schedule (Appendix B).
- .11 The motor control work which shall be provided under Division 26 shall include the following:
  - .1 All conduit and control wiring specifically noted on the drawings and outlined in the different parts of the Specification.
  - .2 Conduit and control wiring for baseboard heaters, unit heater and force flow heater thermostats.

- .3 All control wiring as specified in the Motor Schedule.
- .4 Control wiring related to air handling shutdown during fire alarm.

## **2 PRODUCTS**

### **2.1 3 PHASE MOTOR DISCONNECT SWITCHES**

- .1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use EEMAC 4 enclosures outdoors, and EEMAC 1 indoors, switches to be H.P. rated, heavy duty type.

### **2.2 120 VOLT, 1 PHASE DISCONNECT SWITCHES**

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

### **2.3 208 VOLT, 1 PHASE MOTOR DISCONNECT SWITCHES**

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

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Provide disconnect switches adjacent to all motors.
- .2 Provide all wiring between all force flow and unit heaters and their thermostats. Install wiring between all mechanical components to provide a functional system.
- .3 Do control wiring as indicated on the drawings and the motor control schedules.

END OF SECTION

**1 GENERAL**

**1.1 RELATED WORK**

- .1 Common Work Requirements: Section 26 05 00
- .2 Section 26 98 00 - Testing, Adjusting and Balancing of Electrical Equipment

**1.2 COORDINATION**

- .1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:
  - .1 Electrical equipment and systems specified in Division 26.
  - .2 Mechanical equipment and systems specified in Division 21, 22, 23 & 25.
  - .3 Other equipment and systems specified in other Divisions.
- .2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

**2 PRODUCTS (NOT USED)**

**3 EXECUTION**

**3.1 STARTING MOTORS**

- .1 Prior to starting motors:
  - .1 Verify phase rotation at motor control centres.
  - .2 Confirm motor nameplate data with motor starter heater overloads.

**3.2 ENERGIZING EQUIPMENT**

- .1 Complete all testing and provide testing result to Departmental Representative prior to energizing equipment.
- .2 Confirm equipment nameplate data with characteristics of power supply.

END OF SECTION

**1 GENERAL**

**1.1 INTENT**

- .1 Except where otherwise specified, arrange testing, adjusting, balancing and related requirements specified herein.
- .2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.
- .3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.
- .4 All tests shall be witnessed by persons designated by the Departmental Representative, who shall also sign the test documentation.

**1.2 RELATED WORK**

- .1 Section 26 05 00: Common Work
- .2 Section 26 96 00: Starting of Electrical Equipment and Systems

**1.3 MANUFACTURER'S PRODUCTION TEST RECORDS**

- .1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

**1.4 SITE TESTING REPORTS**

- .1 Log and tabulate test results on appropriate test report forms.
- .2 Submit forms to Departmental Representative for approval prior to use.
- .3 Submit completed test report forms as specified, immediately after tests are performed.

**1.5 REFERENCE DOCUMENTS**

- .1 Perform tests in accordance with:
  - .1 The Contract Documents
  - .2 Requirements of authorities having jurisdiction
  - .3 Manufacturer's published instructions
  - .4 Applicable CSA, IEEE, IPCEA, EEMAC and ASTM standards
- .2 If requirements of any of the foregoing conflict, notify Departmental Representative before proceeding with test and obtain clarification.

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## **1.6 SEQUENCING AND SCHEDULING**

- .1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.
- .2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

## **2 PRODUCTS**

### **2.1 TEST EQUIPMENT**

- .1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

## **3 EXECUTION**

### **3.1 FIRE ALARM SYSTEM TESTING - GENERAL**

- .1 Contractor will be responsible for directing verification of fire alarm system installation in accordance with:
  - .1 CAN/ULC-S537, Standard for Verification of Fire Alarm System Installations; and
  - .2 Requirements of authority having jurisdiction.
- .2 Contractor shall be responsible for:
  - .1 Installing the devices as shown on contract drawings;
  - .2 Performing prerequisites to verification procedure; and
  - .3 Assisting and cooperating with certified company in verification procedure
- .3 Fire alarm verification shall be performed with owner's representative present. Notify the owner's representative five working days before the final verification.

### **3.2 FIRE ALARM SYSTEM TESTING - VERIFICATION**

- .1 The contractor and system manufacturer shall assist and cooperate with the Departmental Representative in verification procedure. The contractor shall provide and pay for the following:
  - .1 Arrange and ensure that the following parties are present at all times during verification procedures:
    - .1 Electrical Subcontractor
    - .2 Fire alarm system manufacturer's representative
  - .2 Provide the following equipment:
    - .1 Voltmeter
    - .2 Sound pressure level meter
    - .3 Smoke generator or aerosol test smoke
    - .4 Four (4) portable communication devices
    - .5 Scaffolding and ladders
  - .3 Disassemble and reassemble system components.
  - .4 Disconnect and reconnect wiring.
  - .5 Perform required field adjustments.
  - .6 Repair defective work and replace defective components.

.7 Perform all work and tests on system required by verification procedure.

.2 Do not proceed with verification unless Departmental Representative's representative responsible for directing verification procedure is present.

### **3.3 TESTING OF WIRING AND WIRING DEVICES**

.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 cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

### **3.4 LOAD BALANCE TESTING**

.1 Perform load tests when as many loads as possible, prior to Interim Acceptance of the Work, are operable.

.2 Turn on all possible loads.

.3 Test load balance on all feeders at distribution centres, motor control centre and panelboards.

.4 If load imbalance exceeds 15%, reconnect circuits to balance loads.

### **3.5 VOLTAGE TESTING AND ADJUSTING**

.1 Test voltage at all panelboards.

.2 Test voltage at motor starters.

.3 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by Departmental Representative.

END OF SECTION

**1 GENERAL**

**1.1 RELATED WORK**

- .1 Section 26 05 28 - Grounding and Bonding
- .2 Section 26 05 29 - Hangers and Supports for Electrical Systems
- .3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .5 Section 26 05 36 - Cable Trays for Electrical Systems
- .6 Section 27 11 19 – Structure Cabling for Communication Systems

**1.2 SYSTEM DESCRIPTION**

- .1 Provide a complete telephone, Access Control, CCTV, and communication raceway system including:
  - .1 Outlet boxes.
  - .2 Pullboxes.
  - .3 Conduits.
  - .4 Cable tray.
  - .5 Sleeves and caps.
  - .6 Communication racks
  - .7 System cabinets.
  - .8 Underground ducting.
- .2 Provide all other requirements for a complete the raceway system, including pull boxes, covers, mounting hardware and accessories.
- .3 Ensure that all communication wire and cable is installed in conduit and cable trays.

**2 PRODUCTS**

**2.1 MATERIAL MISCELLANEOUS**

- .1 Refer to appropriate section in Division 26.
- .2 Communication rooms shall be equipped with fire treated/rated plywood backboards.

**2.2 CEILING SOUND PULL BOXES**

- .1 To facilitate future additions, provide 100 x 100 mm pull boxes above the nearest accessible ceiling where speakers are indicated.



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**2.3 WALL OUTLETS**

- .1 Provide flush 100 x 100 mm deep boxes with plaster rings.

**2.4 CONDUITS**

- .1 System conduits shall not be less than 27 mm. Conduit shall be installed in accordance with Division 26.
- .2 Conduits to be sized in accordance with the cabling manufacturer recommended fill capacity. This capacity shall not exceed the 40% fill capacity of the conduit in which it is being installed.

**2.5 PULL BOXES**

- .1 Where required or indicated, provide communication pull boxes complete with covers. Locate pull boxes such that cables can be installed without being pulled through more than two 90 degree bends, or their equivalent, i.e.: multiple bends totalling more than 180 degrees.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Conduit shall be fished, blocks cleared and outlet and pullboxes cleaned out at completion of installation. Conduit shall be left free of water or excess moisture. A nylon pull wire shall be installed continuously for outlet to outlet, through all conduits and shall be fastened at each box.
- .2 Conduit bends shall have a bending radius of not less than ten times conduit diameter.

END OF SECTION

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**1 GENERAL****1.1 SCOPE**

- .1 Supply and install complete Category 6A telephone and data cabling system as indicated on the drawings and specified herein.
- .2 System to be complete with all data/telephone outlets, patch panels, equipment racks, cable management systems, punch-down blocks, wire and cable to form a complete system.
- .3 Entire system to be approved to Category 6A Standard.
- .4 Systems installer to coordinate all labelling with Departmental Representative.

**1.2 APPLICABLE STANDARDS**

- .1 ANSI/TIA-568-C.0 (2009) Generic Telecommunications Cabling for Customer Premises. & Annex "E" (Testing).
- .2 ANSI/TIA-568-C.1 (2009) Commercial Building Telecommunications Cabling Standard.
- .3 ANSI/TIA-568-C.2 (2009) Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
- .4 ANSI/TIA-568-C.3 (2008) Optical Fibre Cabling Components Standard.
- .5 ANSI/TIA-568-C.4 (2011) Broadband Coaxial Cabling and Components Standard.
- .6 ANSI/TIA-569-C (2012) Commercial Building Standard for Telecommunications Pathways and Spaces.
- .7 ANSI/TIA-606-B (2012) Administration Standard for Commercial Telecommunications Infrastructure.
- .8 ANSI/TIA-607-B (2011) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .9 ANSI/TIA-758-B (2012) Customer Owned Outside Plant Telecommunications Infrastructure Standard.
- .10 CSA C22.1-09 Canadian Electrical Code
- .11 Building Industries Consulting Services, International (BICSI) Telecommunications Distribution Methods Manual (TDMM), Latest Issue.

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**1.3 SHOP DRAWINGS**

- .1 Shop drawings in accordance with Division 01.
- .2 Shop drawings to include a complete material list with manufacturer, style, model number and quantity. Wire and cable to be included in material list.
- .3 Shop drawings to include manufacturer's specification sheets with photographic depiction of all system components. Specification and descriptive data to include dimension, weight, appearance, connection provisions, materials, metal gauges and operating specification, characteristics, features and controls.
- .4 Shop drawings to include the following diagrams:
  - .1 Front backboard punchdown block elevations for each backboard. Elevations to indicate component layouts, cable routing and component functions.
  - .2 System room plan drawings depicting backboards and cable routing.
  - .3 Layout drawings for patch panels and jackfields.
  - .4 Cable details, including type and electrical characteristics.
  - .5 Complete engineering drawings of all custom made components indicating all materials, gauges, finishes and wiring diagrams.
  - .6 Complete system block diagrams indicating all components, interconnection and cabling.
  - .7 Complete detailed system circuit diagrams depicting how components are interconnected component functions, cable terminations, terminal identification and cable designation.
  - .8 Complete system wire and cable designation schedule indicating origin, terminus, origin terminal identification, terminus terminal identification, cable function, cable type and cable designation, at each demarcation point.
  - .9 Under no circumstances will wiring schematics or typical wiring details be considered as circuit diagrams.

**1.4 APPROVALS**

- .1 Submit in accordance with Section 26 05 00 – Common Work.

**1.5 OPERATING MANUALS**

- .1 Operating manuals to be furnished as specified in Section 26 05 00 – Common Work. Operating instructions to consist of following:
  - .1 Individual factory issued manuals containing all technical information on each type of equipment installed. In event such manuals are not available from the factory, system installer to establish same and compile within the manual to satisfaction of the Departmental Representative.
  - .2 Each manual to contain a system parts list, a parts list for individual components, detailed schematics and recommended maintenance procedures. Advertising brochures or operational instructions shall not be considered as technical manuals.
  - .3 Engineering drawings depicting layout and interconnection of all system components and as-built conduit layout.

- .2 In addition to the above described manuals, system installer to include all shop and circuit drawings, wiring schedules and single line block drawings in the manuals.

## 1.6 GENERAL REQUIREMENTS

- .1 System to be complete with all necessary components to provide functions required whether or not each and every item is necessarily mentioned. All components to be production proven models. Custom designed units will only be considered for those items that are not currently available on commercial market. System to be supplied and installed by an established communications contracting firm that is Vendor approved for the System supplied.
- .2 Selection of system to be made on the basis of quality and suitability of equipment, service facilities, and past performance of contracting firm.
- .3 Before proceeding with installation, successful system installer to submit to Departmental Representative for approval a complete detailed proposal.
- .4 All conduit, pullboxes, junction boxes and terminal panels are to be installed to provide a complete conduit system for the communication system.
- .5 All wiring for systems to be PVC insulated, unshielded, twisted pair.
- .6 All wiring to be installed in conduit and cable tray system unless otherwise specified.
- .7 The system, when complete, must perform to complete satisfaction of Departmental Representative and must be free of all interference from cross-talk, hum, switch and relay noise, etc. All wiring in Communication Rooms to be terminated on punchdown blocks and to be neatly installed and tagged.
- .8 Personnel installing communications cabling shall be trained and conversant with communications cabling practices required for this project. Proof of certification must be provided prior to commencement of work.
- .9 The system shall be certified. The system shall be installed by a contractor designated and trained by the manufacturer of being capable to do so and shall provide written confirmation of this fact.

## 1.7 SYSTEM DESCRIPTION

- .1 The communication cabling data system consists of horizontal and vertical wiring.
- .1 **Horizontal:** 4-pair Category 6A UTP unshielded twisted pair FT4 cables from patch panels in Communication Rooms to computer outlets as shown on drawings.
- .2 **Riser / Back Bone:** Multi pair Cat 3 unshielded twisted pair and MM OM3 Fibre Optic cabling from patch panels interconnecting communication rooms.
- .3 Multi-pair unshielded twisted pair from IDC Termination blocks interconnecting communications rooms.

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**1.8 WARRANTY/SERVICE**

- .1 The System installer is to include with his base tender price a guarantee that:
  - .1 The Manufacturer's Warranty shall be a 25 year performance warranty and component warranty and shall be applied to all work performed.
  - .2 Submit these warranties on each item in list form with shop drawings. Detail specific parts within the equipment list that are subject to separate conditional warranty. Warranty proprietary equipment and systems involved in this contract during the guarantee period. Final payment shall not relieve the Contractor of these obligations.
- .2 The Contractor shall supply all supporting documentation as follows:
  - .1 Shall cover all material and labour.
  - .2 The Warranty is directly from the Manufacturer to the Owner
  - .3 The Warranty is based on Industry Standards.
  - .4 Service to be provided on system within 24 hours of call origination during the warranty period.
  - .5 During warranty period system installer at his expense to repair and replace all such defective work and other work to new system damaged thereby which fails or becomes defective during term of warranty, provided that such failure is not caused by improper usage or physical damage.
  - .6 Warranty date to commence from date of Final Acceptance of this work.
  - .7 System to be certified to meet and or exceed Category 6A Standards of performance for the duration of the warranty as specified by the manufacturer.

**1.9 TRAINING**

- .1 System installer to conduct training program for designated maintenance and operating personnel. This program to include but not be limited to the following:
  - .1 Operation: designated personnel to be trained to accomplish and understand all aspects of system operation.
  - .2 Maintenance: designated personnel to be trained to perform routine maintenance on the system.
  - .3 Training period schedule to be established by Departmental Representative. Training periods to take place after building completion and prior to system use.

**2 PRODUCTS****2.1 CABLE**

- .1 Horizontal Cabling
  - .1 All horizontal data and telephone cable to be 4 pair Cat 6A UTP. Cable to be UL listed type NEC-CMR
- .2 Backbone Cabling Copper:
  - .1 Provide Telephone Backbone cables as shown on the plans.
  - .2 Telephone Backbone to be approved inter-building Backbone OSP Flooded Cable, minimum 50 pairs per run.

- .3 Provide one spare 25 pair, Category 3, outside plant cable from the Building A, Penthouse IT Room to the Twenty Bed Living Unit Comm. Room 136 for future. Cable shall be terminated on both ends. Provide enough slack in the cable to reach the farthest point in the room. Termination locations to be coordinated with the Departmental Representative on site.

.3 Backbone Cabling Fibre:

- .1 Provide Fibre Optic Backbone cables as shown on the plans.
- .2 All fibre optic cabling to be OSP (Loose Tube) multi-mode LO OM3
- .3 Provide one spare 12 fiber, multi-mode, 50/125, OM3, outside plant cable from the Building A Penthouse IT Room to the Twenty Bed Living Unit Comm. Room 136 for future. Cable shall be tested and terminated into a lockable cabinet at both ends. Provide enough slack in the cable to reach the farthest point in the room. Termination locations to be coordinated with the Departmental Representative on site.

## 2.2 COMMUNICATIONS OUTLET ASSEMBLIES COMMUNICATIONS OUTLET - BOXES

- .1 Double gang recessed box, 63 mm minimum depth comes with 19 mm deep two-device ring. Single gang wallboard adapter ring, 1.6 mm 16 AWG thickness.
  - .1 27 mm EMT, stubbed from box to cable tray as part of communications conduit system Grommeted or bushed cable exit(s).
- .2 Communications Faceplates
  - .1 To be SS to match electrical outlet plates, complete with TORX screws.
- .3 Accepts minimum of 4 modular inserts.
- .4 Mounts to standard one-device, two-device, electrical box, or adapter ring opening.
- .5 Communications Outlet - Jacks:
  - .1 Category 6A modular jacks
  - .2 Side or regular entry as appropriate
  - .3 Clamp & integrated strain relief
  - .4 Colour: white for data, black for voice

## 2.3 WIRING HARDWARE

- .1 Communications Rack:
  - .1 Free standing 2075 mm (84") high rack units, gang-able.
  - .2 Shall be Certified NEBS-Telcordia, GR-63-Core Compliant Zone 4. Shall be secured with a seismic bolt down kit.
  - .3 Shall be equipped with 2 sets of rails.
  - .4 Must provide 482.6 mm (19") rack mount capability for rack mountable components.
  - .5 Must provide 1925mm (77") of vertical mounting space. (44U)
  - .6 Shall be 24"/610mm wide X 30"/762mm deep.
  - .7 Must have threaded mounting holes (EIA) front and rear.
  - .8 Shall be black in colour.

- .9 Shall be equipped with side panels, perforated door on the front & louvered Door on the rear, both equipped with locks.
- .10 Shall be equipped with a vented top.
- .11 Shall be equipped with High Density Vertical Cable Managers for Cabinets, front & rear of cabinet, both sides.
- .2 Rack Power Bar:
  - .1 Vertically mounted complete with 6 – 5-20RA receptacles mounted on the rear post, 2400 mm shielded cord, two power bars per communication rack.
- .3 Patch Panels: Copper
  - .1 48 Port high density Modular 2U Panels, ports may be individually replaced.
  - .2 Category 6A Patch Panels
  - .3 Rear-mount Cable Management Bracket
  - .4 Grounding: grounding lug hardware kit.
- .4 Patch Panels: Fibre Optic
  - .1 Shall be 1U LC Rack Mount Patch Enclosure
  - .2 E/W LC Duplex 12 fibre snap-in Adapter Plate E/W 12 fibre MM LC 50/125 OM3 Adapters.
  - .3 Provide 24" Fibre Optic Cable Managers at each end of the Fibre Cable to manage the service loop.

## **2.4 TELEPHONE BACKBONE CABLING**

- .1 Provide BIX IDC punch down blocks for telephone riser cabling.
- .2 Mount neatly adjacent the communication racks.
- .3 Provide a Voice Tie from the wall mounted BIX blocks to the patch panels on the racks. To be used for cross connection between the racks & the voice backbone terminated on BIX
- .4 Voice tie to be 2 X 25 pair, terminate one pair per jack as shown, in each communication room.

## **2.5 PATCH CABLES**

- .1 Cat 6A UTP Patch Cables
  - .1 CMR / FT-4 compliant.
  - .2 4-Pair stranded, UTP 26AWG conductors.
  - .3 Colour matched snagless boots.
  - .4 Provide 100 – 4.6 m patch cables. Confirm lengths with Departmental Representative before ordering.
- .2 Optical Fibre Type:
  - .1 LC Duplex LO, 50/125 OM3, Aqua in Colour
  - .2 Provide 10 – 4.6 m fibre patch cables. Confirm lengths and quantity with Departmental Representative before ordering.

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**3 EXECUTION****3.1 INSTALLATION****.1 Cable Installation:**

- .1 Install data cable and telephone cable in conduit and cable trays, wireways and surface raceways indicated on drawings.
- .2 Install Fibre Optic cable in conduit & or Innerduct where necessary.
- .3 The Division 27 Contractor is responsible to, install, terminate and test all fibre optic cable as indicated on the drawings.

**.2 Cable Trays, Wireways and Surface Raceways:**

- .1 Install cable management raceway on the backboard in Communications Rooms.
- .2 Install vertical cable management inside the Communications Cabinets.

**.3 Boxes and Fittings:**

- .1 Ensure in advance that outlet box/data outlet installation methods yield vertically-mounted data outlets.

**.4 Cabinets, Enclosures, Racks, Backboards:**

- .1 Install at locations and heights indicated on drawings.
- .2 Use green insulated 6 AWG ground conductors for grounding racks. Use grounding bushing, solderless lug, clamp, or cup washer and screw.
- .3 Protect ground conductors from mechanical injury.
- .4 Install ground conductors such that neither ground conductors nor data cables interfere with one another in regards to future servicing of patch panel rear connections.
- .5 Anchor or stabilize racks. Racks must be secured with seismic bolt down kit. Seismic report from a qualified Seismic Engineer is required

**.5 Wire and Cable:**

- .1 Swab raceway system before installing wiring.
- .2 Do not exceed manufacturer's maximum pulling force specifications.
- .3 Maintain not less than minimum bending radius for fiber and copper conductors.
- .4 Install cable along or at right angles to building lines unless impractical to do so. Verify specific cases of deviation in advance with Departmental Representative.
- .5 Maintain open copper-conductor cable at maximum practical distance from fluorescent ballasts and other EMF - or discharge-generating equipment.
- .6 Ensure that cable is not flattened, squeezed, or crimped at any point along entire run. No splices or intermediate terminations in cable runs.
- .7 Install cables in raceway in communications room and fan individual cables to applicable patch panels in neat, logical fashion.
- .8 Tie wrap cables neatly into logical bundles. No nylon tie straps acceptable use only Velcro style tie wraps.
- .9 Minimum 3 m of slack cable per run.

**.6 Connectors:**

- .1 Use tooling specific to connector types in use.



- .2 Use connectors suitable for nature of conductor in cable, e.g. stranded vs. solid copper.
- .3 Ensure that connectors' strain relief provisions are used. Strip jackets only amount required.
- .4 Maintain pair twists within 13 mm of termination.
- .7 Patch Panels:
  - .1 Mount patch panels in orderly fashion. Submit rack layouts for approval prior to installation.
  - .2 Ground as required by system.
  - .3 Attach horizontal wiring in an ordered fashion following grid numbering of outlets, alpha character first, e.g. a-1, a-2, etc.
  - .4 Attach horizontal wiring in order of grid number of outlets.
  - .5 Mount panels to racks with as many screws as there are mounting holes or slots in panels.
  - .6 Provide and install necessary strain reliefs and cable support brackets, plus trays for fibre cable loop behind panel and install cables utilizing such devices.
  - .7 UTP Connection Configuration in accordance with ANSI/TIA/EIA 568 A.
- .8 Cabling System Labelling:
  - .1 The contractor shall develop and submit for approval a labelling system for the cable installation. Customer will negotiate an appropriate labelling scheme with the successful contractor. At a minimum, the labelling system shall clearly identify all components of the system: racks, cables, panels, and outlets. The labelling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labelled to identify the location within the cabling system infrastructure. All labelling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labelling scheme.
  - .2 All label printing will be machine generated using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end and behind each faceplate. Outlet labels will be the manufacturer's labels provided with the outlet assembly.

### 3.2 TESTING

- .1 Test all runs upon completion of permanent terminations, using instrumentation acceptable to the Departmental Representative. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.
- .2 Random testing on all cabling mediums may be done by the Consultant or Client. Where any portion of the system does not meet the specifications, the Contractor shall correct the deviation and repeat all applicable testing at no additional cost to the Owner.
- .3 Supply a complete set of tests in CD format of all UTP and fibre optic tests performed.
- .4 The Contractor shall submit printed test results that will be compared with the cable manufacturer's specifications.

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- .5 The Contractor shall document the manufacturers name and model of power meter and light sources used.
- .6 Equipment used shall be factory calibrated. Calibration Certificates shall be provided to the Consultant upon request.
- .7 Category 6A:
- .1 Test Instrument shall be Fluke DSX-1800, Cable Analyser.
  - .2 The latest Fluke revision upgrade shall be installed on all testers. Permanent link testing procedures shall be used to certify the system. NO SUBSTITUTE TESTERS WILL BE ALLOWED. The tester shall be calibrated within the calibration period recommended by the vendor.
  - .3 All installed horizontal and data riser cables and associated termination hardware shall be tested (Permanent Link Test) to ensure a full compliance with Category 6A testing procedures.
  - .4 Autotest settings provided in the field tester shall be set to default parameters for the cable used (NVP shall be properly set for the type of cable being tested).
  - .5 Any autotest settings that have been modified to change testing parameters may disqualify the test results.
  - .6 Category 6A UTP Testing shall conform to current ANSI/TIA/EIA-568-C0, C.2 & C.2.1
  - .7 All "PASS" test results shall be downloaded into the database software that has been provided from the field tester manufacturer and saved on a DVD. The software must be Fluke Networks Link Ware.
  - .8 100% of the installed cabling links must be tested and must pass. Conditional passes will not be accepted. Any failing link must be diagnosed and corrected.
  - .9 Data drops not meeting TIA 568-C.0 & C.2 requirements for 4-pair Category 6A cabling shall be repaired and retested at no additional cost to Departmental Representative.
- .8 Category 3 UTP:
- .1 Multi-pair Category 3 backbone cable testing shall consist of testing each cable pair for continuity and polarity only. Examine any open and shorted pairs to determine if the problem is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets. A maximum allowable pair failure is 2%. Failure rates in excess of this shall require replacement of damaged or faulty cables or connectors at no cost to the Owner.
  - .2 A wiremap test is to be done on all Cat 3 cables.
- .9 Fibre Optic Cabling:
- .1 Test every fibre within the fibre optic cable with a light source and power meter & an OTDR. Test utilizing procedures as stated in:
  - .2 TIA/EIA-568-C.0 & Annex "E" (Testing), referenced are TIA/EIA-526-14-B, insertion loss testing of Multimode Fibre Cable Plant & IEC-61300-3-35.
  - .3 Measured results shall be within manufacturers' loss budget calculations. If loss figures are outside this range, correct improper splices and replace damaged cables or connectors at no cost to the Owner.
  - .4 All fibre cables (each strand) are to be tested for length, continuity and attenuation, including the connectors and patch panel adapters.
  - .5 Attenuation shall be measured at 850 and 1300 nm for multi-mode fibre.
  - .6 Attenuation shall be measured at 1300 and 1550 nm for single-mode fibre.

- .7 Testing procedures shall utilize "Method B" – one jumper reference.
- .8 Bi-directional testing of optical fibres is required.
- .9 The Contractor shall document the manufacturers name and model of power meter and light sources used.
- .10 Equipment used shall be factory calibrated. Calibration Certificates shall be provided to the Consultant upon request.
- .11 Each spool of fibre optic cable shall be tested for continuity prior to being installed.

### **3.3 REPORT**

- .1 Record results in tabular form.
- .2 Segregate horizontal runs, inter-room runs, and risers by category or run and by type of cable.
- .3 Present horizontals - results in ascending order.
- .4 Report Submission:
  - .1 Submit three (3) reports printed on 215 mm by 280 mm white paper.
  - .2 Submit two (2) reports prepared in electronic form on CD-R's housed in jewel cases using Microsoft Excel.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 27 01 00 - General Requirements

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 Install in accordance with CSA C22.1 Current Edition, except where specified otherwise
  - .2 Comply with CSA Electrical Bulletins and local by laws
  - .3 Install overhead and underground systems in accordance with CSA C22.3 No.1-M1979 except where specified otherwise
- .2 Electronic Industries Association
  - .1 EIA-310E Standard for Racks, Panels and Associated Equipment
- .3 CSC Specifications
  - .1 ES/SOW-0101 Electronics Engineering Statement of Work, Procurement and Installation of Electronic Systems
  - .2 ES/SOW-0102 Electronics Engineering Statement of Work, Quality Control for Procurement and Installation of Electronic Security Systems
  - .3 ES/SOW-0110 Electronics Engineering Statement of Work, Structured Cable System for Electronic Security Systems
  - .4 ES/SOW-0502 Electronics Engineering Statement of Work, Electronic Systems/Equipment Test & Evaluation Guidelines
  - .5 ES/SPEC-0005 Electronics Engineering Specification, Electronic Systems Integration into the Main Communications and Control Post in Federal Correctional Institutions
  - .6 ES/SPEC-0006 Electronics Engineering Specification, Conduit, Space and Power Requirements for use in Federal Correctional Institutions
  - .7 ES/SPEC-0101 Electronics Engineering Specification, Public Address System for use in Federal Correctional Institutions

### **1.3 SYSTEM DESCRIPTION**

- .1 The Public Address (PA) System shall be used for communication between staff members and/or inmates with the master station in the CER Room which is situated in the Administration Building.
- .2 The integrated PA system to include the following components:
  - .1 Auxiliary power supplies
  - .2 Paging amplifiers
  - .3 Paging Zone expansion modules
  - .4 Loudspeakers
  - .5 Interconnections, terminations, wiring and cabling

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#### **1.4 SYSTEM OPERATION**

- .1 Public Address Paging:
  - .1 Master stations to have the ability to page to pre-determined groups of intercom stations and/or loudspeaker zones
  - .2 Paging selection to be made by selecting the page function and a group or zone from the selection list. Alternately, the zone number may be entered after the page function has been selected

#### **1.5 FUNCTIONAL REQUIREMENTS**

- .1 Identification numbers for each category of device, group, zone, etc. to range from 1 to 99,999.
- .2 Alphanumeric description for each device, group, zone, etc. is to allow up to 20 characters and spaces.
- .3 On-line factory support to be available through network connectivity.

#### **1.6 PERFORMANCE REQUIREMENTS**

- .1 System frequency response: 300 to 3,500 Hz.
- .2 All system equipment to comply with the radiation limits for Class A, digital devices of FCC Rules Part 15, Subpart B.

#### **1.7 SCOPE OF WORK**

- .1 Provide a completed system with high quality voice intelligibility, all necessary components, programming, commissioning, patch cables, and interface devices as required and regardless of mention to provide a complete functioning system.
- .2 Provide Public Address Paging as follows:
  - .1 Stand alone system equipped with a telephone interface module to permit remote paging within the Institution via the existing telephone system.
  - .2 Individual and group zone paging from within the building via a dedicated telephone located Open CX 133.
  - .3 Provide the necessary interface to integrate the new equipment into the existing facility's Public Address System
  - .4 Provide paging zones as shown on drawings
- .3 Provide all required software updates and telephone technical support for no less than five years from the date of substantial completion.
- .4 All cables must be installed in conduit. Conduit installation will be provided by Division 26, coordinate requirements with the Division 26 Contractor prior to rough-in installation.
- .5 Use Category-6 UTP cable with specific colour from the rest of the facility's colour coding to clearly identify the cable as for use with intercom.
- .6 Provide a list of recommended spare parts and service manuals for maintenance of the PA system.

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## **1.8 SUBMITTALS**

- .1 General: Submit three copies of each hard and electronic copies of all documents in accordance with ES/SOW-0101.
- .2 Operational Manuals: Submit ten copies in accordance with ES/SOW-0101.
- .3 Preliminary Design Report (PDR): Provide documentation defined by ES/SOW-0101 Section 4.1.
- .4 Final Design Report (FDR): Provide documentation defined by ES/SOW-0101 Section 4.3.
- .5 Acceptance Testing Plan (ATP): Provide documentation defined by ES/SOW-0101 Sections 6.1 and 7.2. ATP shall also include test procedure and certificate for fiber optic communications channels.
- .6 Training Plan and Course Materials: Provide documentation defined by ES/SOW-0101 Section 8.2.
- .7 Maintenance Manual: Provide documentation defined by ES/SOW-0101 Section 9.5.

## **2 PRODUCTS**

### **2.1 MANUFACTURER**

- .1 The following manufacturer and their named products are approved for use in this Work:
  - .1 Bogen PCM-2000

### **2.2 PAGING AMPLIFIERS**

- .1 Provide paging amplifiers and zone switching as required to perform the functions described herein and indicated on the drawings.
- .2 Paging amplifiers to be the constant voltage output type with power output capacities to drive the loudspeakers connected at sufficient levels with no more than 90% amplifier loading.

### **2.3 LOUDSPEAKERS**

- .1 Loudspeakers to be nominal 8" diameter dual cone type units. Loudspeakers to incorporate 6-ounce permanent magnet and include a 5-watt multi tap transformer for use on 25-volt and 70-volt constant voltage type distribution systems.
- .2 Each loudspeaker to be provided with a security baffle plate and flush mounted enclosure. Baffle and enclosure to be all metal construction and finished in polar white baked on enamel.

### **2.4 WIRE AND CABLE**

- .1 Factory manufactured field interface cables to be provided, as required, for all devices.
- .2 Field wiring to conform to manufacturer's recommendations and shall be supervised for opens, shorts or tampering.

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### **3 EXECUTION**

#### **3.1 DOCUMENTATION PRE-REQUISITES**

- .1 Installation shall not commence until Preliminary and Final Design Reports (PDR/FDR) defined by document ES/SOW-0101 have been submitted by Contractor and reviewed/accepted by CSC Technical Authority.
- .2 Acceptance testing shall not commence until project-specific Acceptance Testing Procedures (ATP) defined by document ES/SOW-0101 have been submitted by Contractor and reviewed/accepted by CSC Technical Authority.
- .3 Operator and Maintenance Technician Training shall not commence until project-specific Training course outlines and trainee handouts defined by document ES/SOW-0101 have been submitted by Contractor and reviewed/accepted by CSC Technical Authority.
- .4 System substantial performance and commencement of the warranty period shall not commence until acceptable ATPs have been completed and signed off by both Contractor and CSC Technical Authority, and Operator training is complete. Substantial performance may nevertheless be granted in the presence of noted deficiencies at the discretion of the Departmental Representative.
- .5 Final completion will not be granted until system is in full operation, third party written tests submitted and verified by the Departmental Representative, all noted deficiencies have been cleared and all documentation deliverables have been received by the Departmental Representative in the quantities specified.

#### **3.2 GENERAL INSTALLATION PROVISIONS**

- .1 Inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- .2 Verify the accuracy of all dimensions, allowances, and clearances on site prior to commencing with any work that may be affected by those dimensions, allowances, and clearances.
- .3 Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.
- .4 Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- .5 Supervise construction activities to ensure that no part of the Work, completed or in progress is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- .6 Precautions shall be taken to guard against electrostatic and electromagnetic susceptibility and interference.
- .7 Provide adequate ventilation for all heat radiating equipment.
- .8 Install equipment so as to provide maximum safety to the operating and maintenance personnel.

#### **3.3 METHOD OF WORK**

- .1 Work to be performed by fully competent technicians in a thorough manner.

- .2 All workmanship to be of the highest quality and meet recognized standards of craftsmanship.
- .3 Areas of installation deemed not acceptable by the Departmental Representative to be reworked at the Contractor's expense, additional charges to the contract will not be accepted.

### **3.4 PROTECTION OF EXISTING PROPERTY**

- .1 Be responsible for protecting all existing property including floors, walls, ceilings, furniture, and furnishings from damage, dust and other construction related activities. Provide all necessary dust covers and protective pads required for performance of the Work.
- .2 Remove all debris and protective coverings at the end of each work period. Leave premises in condition found at start of work in each room or area of work.
- .3 Except for scheduled activities, do not inconvenience user due to construction operations.

### **3.5 INSTALLATION**

- .1 All material furnished shall be new and conform to the applicable requirements of the Underwriters Laboratories and the National Standards Institute.
- .2 Unless otherwise noted, all wiring is to be installed in conduit or wireways.
- .3 Do not exceed manufacturer's maximum cable pulling force specifications.
- .4 Maintain not less than minimum bending radius for fiber and copper conductors.
- .5 If more or larger conduit is required than exists or is indicated on the drawings, allow for such additional conduit in contract price.
- .6 All system equipment to be contained within equipment cabinets. If more or larger equipment cabinets are required than exist or are indicated on the drawings, allow for such additional equipment racks and cabinets in contract price.
- .7 All system equipment and field devices to be held securely in place. Fastenings and supports shall be selected to provide a safety factor of three.
- .8 All system equipment equipped with plug in power connectors to be connected to a dedicated receptacle. Do not use tap connectors for plugging in multiple plugs into a single receptacle.
- .9 All cable within equipment cabinets to be neatly bundled and properly secured.
- .10 Wires shall not be nicked, have strands removed, or have frayed strands when removing insulation or terminating. Nicked wires shall be replaced with new.
- .11 All field wiring to be terminated on rack mounted terminal blocks.
- .12 Factory manufactured interface cables to be provided for each field interface board.
- .13 Terminal blocks to be provided in cabinet with factory cable interface to field wiring.
- .14 Enclosures:
  - .1 Install at locations and heights indicated on the Contract Drawings
  - .2 Use green insulated #10 AWG bond conductors for bonding enclosures. Use green insulated #6 AWG bond conductors for bonding racks and cabinets. Use grounding bushing, solderless lug, clamp, or cup washer and screw



- .3 Protect bond conductors from mechanical injury
- .4 Install bond conductors such that neither bond conductors nor data cables interfere with one another in regards to future servicing of patch panel rear connections
- .5 Anchor or stabilize cabinets per code requirements and the local authority

### **3.6 IDENTIFICATION AND LABELLING**

- .1 Identification and labelling scheme for all cabling and all devices shall be provided to CSC and or the Departmental Representative for review and comment prior to proceeding with the Work. The CSC shall reserve the right to change the labelling scheme to suit any numbering deviation as a result of field or as installed conditions. Any additional work associated with these changes shall be included in the contract and shall not be considered as an additional cost to the contract.
- .2 Color identification of wiring:
  - .1 Identify wiring by continuous insulation color
  - .2 Where multi-conductor cables are used, use the same color-coding system for identification of wiring throughout
  - .3 Maintain uniform phasing and color-coding throughout system
  - .4 Colour indicated in the Identification section of the General Requirements
- .3 Name identification of wiring:
  - .1 Identify wiring at all equipment locations, pull boxes, junction boxes and outlet boxes
  - .2 Develop a uniform identification scheme for use throughout the system
  - .3 Record wire name identification on all applicable drawings and provide wiring tables within the operating and installation manuals
  - .4 Mechanically printed labels only
  - .5 Colour indicated in the identification section of the General Requirements
- .4 Use one of the following marking materials:
  - .1 Heat shrink sleeves
  - .2 Clear plastic tape wrap-on strips with designated labelling section
  - .3 Slip-on identification bead markers or sleeves

### **3.7 TESTING AND ADJUSTING**

- .1 Test system components in presence of the Departmental Representative's to ensure correct operation of system. On completion of tests, submit to the Departmental Representative a certificate listing components tested.
- .2 Except where otherwise specified, arrange and pay for testing & adjusting of the system.
- .3 If test results do not conform to applicable requirements, repair, replace, adjust, or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.
- .4 Log and tabulate test results on appropriate test report forms and as specified.
- .5 Submit forms to the Departmental Representative prior to use.

- .6 Submit copy of completed test report forms to the Departmental Representative immediately after tests are performed for review.
- .7 Insert a copy of completed test report forms in each copy of the Operating and Maintenance Manuals.

END OF SECTION

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**1 GENERAL**

**1.1 SCOPE**

- .1 Provide expanded television distribution system as indicated on the drawings and specified herein. Provide cable and equipment required to connect to CATV distribution network at existing institution. Provide cable from the main Communications Room to all outlets shown. Provide all necessary cabinets, conduit, amplifier / splitters and run individual cables to each T.V. outlet shown.
- .2 Television distribution system to include all required components to provide a complete operating system with signal levels at minimums that meet industry standards as described herein.

**1.2 SHOP DRAWINGS**

- .1 Refer to Section 26 05 00 – Common Work.

**1.3 APPROVALS**

- .1 Refer to Section 26 05 00 – Common Work.

**1.4 GENERAL REQUIREMENTS**

- .1 System to be complete with all necessary components to provide functions required whether or not each and every item is necessarily mentioned. All components to be production proven models. Custom designed units will only be considered for those items that are not currently available on commercial market. System to be supplied and installed by an established communications contracting firm that is approved by the Departmental Representative.
- .2 Selection of system to be made on the basis of quality and suitability of equipment, service facilities available, experience, capabilities, and past performance of the contracting firm.
- .3 Division 26 to be responsible for supply and installation of all backboards, cabinets, conduit and pullboxes, and installation of junction boxes, device boxes and terminal panels where required to provide a complete conduit system. Substantial corrosion resistant pullwires to be installed in all conduit runs.
- .4 If a particular contracting firm requires more or larger conduit, boxes or panels than that shown on the drawings, firm is to allow for such changes in tender price. No extras will be allowed for additional conduit or increased conduit, boxes or panel size required to accommodate any particular make of system.
- .5 Under no circumstances will Division 26 be allowed to reduce conduit and panel sizes.
- .6 All wiring for systems to be installed in conduit.

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## **1.5 TESTS AND ADJUSTMENTS**

- .1 Upon completion of system installation, tests to be conducted by the system installer to determine system conformity to the requirements of the specification. Tests to be conducted in presence of Departmental Representative and/or his representative who may suspend or discontinue tests at any time performance is considered unsatisfactory. Resumption of testing to cover the previously untested elements and any completed elements at the discretion of the Departmental Representative.
- .2 All equipment or wiring provided by system installer which tests prove to be defective or operating improperly to be corrected or replaced promptly at no additional cost to the owner.
- .3 Contractor to furnish all equipment and personnel required for test as follows:
  - .1 Use field strength meter and measure signal level at any tap-off in the system at random. Signal on each channel to read not less than 8 dbmV or more than 15dbmV with minimum of 33 db signal to noise ratio 98per cent of the time. Connect a television set to outlet in the system at random. Picture and audio quality must be equal or superior to reception normally available in the area.
  - .2 Signal to noise test to employ Jerrold 704B field strength meter or equivalent. Measurements to be made at the output of last amplifier in system. With normal levels in system, the field strength meter to be tuned to picture carrier of each channel in turn and readings obtained on the meter noted. Signal to then be removed and the input of headend amplifier to be terminated in 70 ohms, and field strength meter again read in absence of signal. Difference between two readings will give system signal to noise ratio and shall not be less than 50 db.
  - .3 Signal level at the receivers will be well balanced throughout the system. System levels will be termed balanced when the difference between any two adjacent low bank VHF channels (2 to 6) does not exceed 2 db, and the difference across the entire low band VHF channels or frequency range does not exceed 6 db, and the difference between any high band VHF channel does not exceed 2 db. Maximum difference across the entire high band VHF frequency range not to exceed 4 db.

## **1.6 SYSTEM REQUIREMENTS**

- .1 Prior to system takeover Division 26 to conduct an operating test for approval. System to be demonstrated to operate in accordance with requirements of these specifications.
- .2 System to allow for future provisioning of outlets.
- .3 System to include 120 volt AC power service to each RFTV cabinet.
- .4 Minimum signal available at output of any receptacle making use of specific normally viewed open circuit channels will be 8 dbmV.
- .5 Maximum signal available at any receptacle making use of normally viewed open circuit television channels will not exceed 15 dbm.

- .6 Signal on a specific channel measured at any television receptacle in the system will be within 6 db of the same signal measured at any other receptacle in the system.
- .7 There shall be a minimum RF isolation between the receivers attached to the system of 18 db.
- .8 System as installed to be capable of distributing future VHF channels.

## **2 PRODUCTS**

### **2.1 CABLE**

- .1 All cable used to be coaxial 75 ohm, with 100% foil shield and minimum 60% braid. Centre conductor to be 18 gauge solid. Cable from existing headend to new distribution to be sized as required for minimum signal loss.
- .2 Incoming service cable shall be 625 coaxial, outside plant.
- .3 Cable selection to be on basis of maximum permissible tilt incurred when providing a riser with individual distribution terminal points with an operating signal level of +10 dbmV  $\pm 2$  db over frequency range of 40 to 1000 MHz at each outlet location. Distribution system to be set up for 2 db forward output tilt at the input to each distribution riser between 40 and 1000 MHz and the cable type and lengths to be selected to comply with the above. Minimum cable size to be RG-6.
- .4 Horizontal cabling run length criteria:
  - .1 RG11 trunk cable 45m to 60m
  - .2 RG 6 drop cable 10m to 45m

### **2.2 PASSIVE COMPONENTS**

- .1 All passive components, i.e. splitters, directional couplers, matching networks, matching transformers, etc. to be of the 75 ohm back matched variety with band pass capability of 5 to 1000 MHz with flatness of 1 dB or better over the entire frequency range of each unit measured. Input and output return loss to be 20 dB or greater for each component over the complete frequency range.

### **2.3 ACTIVE COMPONENTS**

- .1 Distribution amplifiers to be broadband with +34 dB of operational gain for 54 MHz to 1000 MHz, with variable gain control of  $\pm 15$  dB complete with power supply. Amplifiers to have a channel loading of 135 channels, impedance of 75 ohms per port, push-pull discrete amplifier stages and flatness of 1 dB.
- .2 Acceptable products: Holland HAD-1000 or approved equal.

### **2.4 WALL PLATES**

- .1 Only "back matched", "flat loss" 75 ohm directional coupler wall plates to be used in distribution system and these to meet following technical specifications:

- .1 Minimum frequency band pass capability of 5 to 1000 MHz with output flatness of 1 dB or better for each unit over the entire frequency range.
- .2 Each unit to have 20 dB return loss or greater over entire frequency range.
- .3 Each unit to have 32 dB output to tap isolation or greater over entire frequency range.
- .4 Each unit to have 20 dB directivity or greater over entire frequency range.
- .5 Wall plates to be stainless steel complete with TORX screws.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 All terminal cabinets shown on the drawings and as required shall be ventilated and lockable. Cabinets shall be provided by the system installer and are to suit their individual distribution requirements.
- .2 All outlets to have separate home run to amplifier/splitter cabinet located in communications room. Location of splitters and amplifiers in areas other than communication room is not permitted.
- .3 Make all connections, terminations, tests and put system into operation.
- .4 All cabling and outlets to be labelled with room number and outlet number at both ends.

END OF SECTION

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**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 – Common Work
- .3 Section 26 05 31 - Splitters, Junction Boxes, Pull Boxes, and Cabinets

**1.2 REFERENCES**

- .1 C22.1-09 – Canadian Electrical Code, Part 1

**1.3 SCOPE OF WORK**

- .1 Contractor shall be responsible for the following:
  - .1 Supply, install, terminate and test the dedicated fibre from the existing security system located in the Building A CER Room to the Communication Room
  - .2 Provide conduit, junction boxes, back boxes and wire from the security control panel in the Communications Room to the door position switches.
  - .3 Terminate wires in the security control panel.
  - .4 Terminate wires to the field devices.
  - .5 Update existing database and map to incorporate new building addition.
- .2 Corresponding door frame junction boxes shall be provided by the door manufacturer. Coordinate door rough-in requirements with door manufacturer/door installer on site.

**1.4 SYSTEM DESCRIPTION**

- .1 The alarm annunciation, control and communication system shall operate as a windows based, PC compatible platform capable of sensor monitoring.
- .2 Alarm processing operations shall be performed using a keyboard, mouse, trackball and/or touch screen monitor. All system events, operator actions and maintenance information shall be stored on the computer hard disk to maintain a permanent record of system activity.
- .3 The system shall provide the capability of creating site specific maps and databases. The system shall be programmable for the unique alarm response requirements. Site information and alarm data shall be displayed on color maps.
- .4 The alarm signal communications network shall be designed specifically for security monitoring applications. The network shall provide communications between a centralized control facility and the remote security devices.
- .5 Provide a complete data network that will connect the system, monitoring station, I/O modules and devices in accordance with Division 27.

**1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Division 01.

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**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Division 01.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Division 01.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten, and place in designated area for recycling.

**2 PRODUCTS**

**2.1 MANUFACTURER**

- .1 Senstar; Contact: Tom Coxford, Phone: 1-800-390-5796, Email: [tcoxford@senstar.com](mailto:tcoxford@senstar.com)

**2.2 NETWORK DEVICE**

- .1 Transponder Unit:
  - .1 16 programmable inputs; connects to network controller via redundant RS-485 multi-drop data lines.
  - .2 16 VAC output, 120 VAC input, 60 Hz
  - .3 Lockable enclosure complete with tamper switch and mounting rails for media converter

**2.3 DOOR POSITION SWITCHES**

- .1 Door position switches and magnets suitable for flush mounting on doors in high security locations, non-biased, Form C, 25 mm diameter, 25 mm gap.
- .2 Acceptable products: General Electric Magnetic Steel Door Contact, Model No.: 1076W.

**2.4 CABLING**

- .1 4 conductor, #18 AWG twisted, PVC jacket.

**3 EXECUTION**

**3.1 TESTING AND COMMISSIONING**

- .1 Provide a detailed Acceptance Test Procedure (ATP) to the Departmental Representative for approval at least two weeks prior to the start of the installation of the Door Supervision System.



- .2 Complete all the tests outlined in the ATP prior to the ATP testing being carried out by the Departmental Representative.
- .3 The equipment warranty will commence on the date the ATP test is carried out by the Departmental Representative.

END OF SECTION

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**1 GENERAL**

**1.1 REFERENCES**

- .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems
- .2 CAN/ULC-S525, Audible Signal Device for Fire Alarm Systems
- .3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems
- .4 CAN/ULC-S527, Control Units for Fire Alarm Systems
- .5 CAN/ULC-S528, Manual Pull Station for Fire Alarm Systems
- .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems
- .7 CAN/ULC-S530, Heat Detectors for Fire Alarm Systems
- .8 CAN/ULC-S531, Standard for Smoke Alarms
- .9 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems
- .10 CAN/ULC-S537, Verification of Fire Alarm Systems
- .11 CSA B44-10, Safety Code for Elevators and Escalators
- .11 NBCC- National Building Code of Canada
- .12 NFCC- National Fire Code of Canada
- .13 Canadian Electrical Code
- .13 TB OSH – Treasury Board of Canada, Occupational Safety and Health Manual – Chapter 3-03, Standard for Fire Protection Electronic Data Processing Equipment.
- .14 TB OSH – Treasury Board of Canada, Occupational Safety and Health Manual – Chapter 3-04, Standard for Fire Alarm Systems.
- .15 All references to the latest edition of these standards.
- .16 Where the standards listed above reference other standards, those requirements shall also apply.

**1.2 SYSTEM DESCRIPTION**

- .1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital and multiplexing techniques for data transmission.
- .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating two-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to a ULC approved monitoring agency.
- .3 Zoned, coded, two stage.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:
  - .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
  - .2 Reprogramming of existing fire alarm system.
  - .3 Updating existing fire alarm annunciator graphic(s).
  - .4 All panel modules and add-on cards, connections, software and programming as required. Provide 25% spare capacity in control panel cabinet for future cards/modules.
  - .5 Power supplies.

- .6 Initiating/input circuits.
- .7 Output circuits.
- .8 Auxiliary circuits.
- .9 Wiring.
- .10 Manual and automatic initiating devices.
- .11 Ancillary devices.
- .12 Relay outputs to initiate device shutdown on alarm.
- .13 Audible and visual signalling devices.
- .14 End-of-line devices.
- .15 Printer or Event log memory chip.
- .16 Historic event recorder.

- .7 New fire alarm system to be integrated to the existing site wide Simplex 4100U System. Provide required software and hardware at the new building as well as in the Administration Building.

### **1.3 REQUIREMENTS OF REGULATORY AGENCIES**

- .1 System:
  - .1 To TB OSH Chapter 3-04.
  - .2 Subject to Fire Commissioner of Canada (FC) approval.
  - .3 Subject to FC inspection for final acceptance.
- .2 System components: listed by ULC and comply with applicable provisions of National Building Code, and meet requirements of local authority having jurisdiction.

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with the requirements of this section, Section 26 05 00 – Common Work.
- .2 Include:
  - .1 Overall system riser identifying control equipment, initiating zones, signaling circuits; devices and end-of-line devices (as applicable).
  - .2 Details for all products and devices used to produce a working system. Include all initiating and annunciating devices, end-of-line devices, panels, ancillary devices, and other devices required to produce a complete working fire alarm system.
    - .1 Identify all options and features that will be present with equipment as installed, including but not limited to: operating ranges, colors, voltage, phase, dimensions, enclosure ratings, materials or protective features.
  - .3 Step-by-step operating sequence, (cross-referenced to logic flow diagram if required for clarification).

### **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Division 01.
- .2 Include:
  - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.
  - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

- .4 List of recommended spare parts for system.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to ULC-S525.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.
- .9 Smoke alarms: to CAN/ULC-S531.

### **2.2 ACCEPTABLE MANUFACTURERS**

- .1 All components shall be Simplex 4100U.

### **2.3 SYSTEM OPERATION: TWO STAGE - SIGNALS ONLY**

- .1 Actuation of any alarm initiating device on first stage to:
  - .1 Cause electronic latch to lock-in alarm state at central control unit (and data gathering panels/transponders where installed).
  - .2 Indicate zone of alarm at central control unit and at remote annunciator(s).
  - .3 Cause audible devices throughout building to sound depending on the location of alarm:
    - .1 For inmate living areas, a stage 1 alarm will not be audible. Stage 1 alarms will be received and managed by supervising staff.
    - .2 For administrative (non-living) areas, a stage 1 alarm will be audible.
- .2 Actuation of any alarm initiating device on second stage to:
  - .1 Cause audible signalling devices to sound in the entire building.
  - .2 Cause fire doors and smoke control doors, if normally held open, to close automatically.
  - .3 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
  - .4 Cause elevators to return to floor of egress, or to alternate floor, as required.
  - .5 Where alert and alarm signals are present, lighting relays for those areas shall be forced 'on'.
  - .6 Cause additional ancillary device shutdowns to occur.
- .3 Signals shall be capable of being silenced in staff supervisory stations and control rooms.
- .4 If first stage alarm is not acknowledged within 5 min, system to automatically go into second stage.
- .5 Acknowledging alarm: indicated at central control unit.
- .6 Possible to silence signals by "alarm silence" switch at central control unit, after 60s period of operation.
- .7 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

- .8 Actuation of any supervisory device to:
- .9 Cause electronic latch to lock-in supervisory state at central control unit (and data gathering panels/transponders where installed).
- .10 Indicate respective supervisory zone at central control unit and remote annunciator panels.
- .11 Cause audible signal at central control unit to sound.
- .12 Activate common supervisory sequence.
- .13 Resetting alarm or supervisory device will not return system indications/functions back to normal until control unit is reset.
- .14 Trouble on system to:
  - .1 Indicate circuit in trouble at central control unit.
  - .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; visual indication to remain until trouble is cleared and system is back to normal.
  - .3 Troubles on system: suppressed during course of alarm.
  - .4 Trouble condition on any circuit in system not to initiate alarm conditions.

## 2.4 CONTROL PANEL

- .1 Central control unit (CCU).
  - .1 Suitable for DCLA communication style: to CAN/ULC-S524.
  - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
  - .3 Minimum capacity of 500 addressable monitoring and 500 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.
  - .4 Maintain 25% spare device capacity in each SLC loop.
  - .5 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.
  - .6 Integral power supply, battery charger and standby batteries.
  - .7 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (e.g. zone labels, priorities) and changing of system operation software.
  - .8 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

- .9 Communication between CCU and remote DGP's/TPR's to be supervised, DCLA. Should communications fail between CCU and remote units, audible and visual trouble to be indicated at CCU. Data communication to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel: capable of communicating up to distance of 3,000 m.
  - .1 Communication between nodes in networked system to be supervised, DCLA. Should communications fail between any 2 nodes, other nodes on loop to continue to communicate with each other and programmed functions on communicating nodes to continue operating.
- .10 Support up to 2 RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
- .11 Equipped with software routines to provide Event-Initiated-Programs (EIP); change in status of one or more monitor points, may be programmed to operate any or all of system's control points.
- .12 Software and hardware to maintain time of day, day of week, day of month, month and year.

## **2.5 POWER SUPPLIES**

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Panel load calculation to be submitted with shop drawing submittal.
- .5 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .6 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .7 Standby batteries: sealed, maintenance free. Minimum expected lifespan of 4 years. Sized in accordance with NBC.
- .8 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

## **2.6 INITIATING/ INPUT CIRCUITS**

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA/DCLC configuration to central control unit.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.

- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

## **2.7 ALARM OUTPUT CIRCUITS**

- .1 Alarm output circuit: connected to signals, wired in Class A configuration to central control unit.
  - .1 Signal circuits' operation to follow system programming; capable of sounding horns continuously in a temporal pattern. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.

## **2.8 AUXILIARY CIRCUITS**

- .1 Auxiliary contacts for control functions.
- .2 Alarm and supervisory, trouble on system to cause operation of programmed auxiliary output circuits where shown or specified.
- .3 Two sets of separate contacts for elevator capture (to main floor of egress and to alternate floor of egress).
- .4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .5 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

## **2.9 WIRING**

- .1 Twisted copper conductors installed in conduit.
- .2 Minimum wire gauges:
  - .1 120 VAC wiring, #12 AWG minimum, installed in conduit.
  - .2 To initiating circuits: #18 AWG minimum, ULC listed, and in accordance with manufacturer's requirements.
  - .3 To signal circuits: #16 AWG minimum for horn/strobe circuits, ULC listed, #14 AWG for bell circuits, and in accordance with manufacturer's requirements.
  - .4 To control circuits: #14 AWG minimum, ULC listed, and in accordance with manufacturer's requirements.
- .3 Size all signalling and control circuits for maximum 5% voltage drop at last signalling/control device on each circuit.
- .4 Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back-boxes, except where conduit entry is specified by the manufacturer.
- .5 One 4 strand, multi-mode, 50/125, OM3, OSP fiber optic cables from the new fire alarm panel to the existing site wide central control panel in new and existing conduits and ducts.

## **2.10 MANUAL ALARM STATIONS**

- .1 Addressable manual pull station: Bilingual, pull lever, semi-flush wall mounted type, single action, two stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be labelled on station in field.

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## **2.11 AUTOMATIC ALARM INITIATING DEVICES**

- .1 Addressable MULTISENSOR detector.
  - .1 Combination type, Ionization, Photoelectric, and rate of rise heat detection unit type standard (Ionization where shown).
  - .2 POD Beds, POD Mechanical/Electrical Room and POD Laundry detectors shall be equipped with a sounder base. Activation of any of these detectors will initiate an audible output in all the local POD detectors equipped with sounder bases and the local POD horns and strobes.
- .2 Addressable thermal fire detector.
  - .1 Combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 88EC (or as shown otherwise), rate of rise 8.3 degrees C per minute.
- .3 Addressable carbon monoxide detector:
  - .1 Detector shall be a ULC-S529 and CSA-6.19 listed device.
  - .2 Detectors to be equipped with sounder bases. Activation of the POD Mechanical Room detectors will initiate and audible output in all the POD detectors equipped with sounder bases.
- .4 Electronics to communicate detector's status to addressable module/transponder.
- .5 Plug in type with fixed base.
- .6 Wire-in base assembly with integral red alarm LED.
- .7 Detector address to be labelled on detector in field.

## **2.12 AUDIBLE AND VISUAL SIGNAL DEVICES**

- .1 Horn/strobe combination units shall be 24 V DC, red in colour with individual device volume and strobe output control.
- .2 Devices shall be synchronized

## **2.13 END-OF-LINE DEVICES**

- .1 Required for Class B (non-coded) fire alarm circuits.
- .2 End-of-line devices to control supervisory current in alarm circuits and/or signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.
- .3 Install EOL devices in separate box with labels indicating zone. Where coded devices (addressable) are installed with a single device per zone, the EOL may be installed in the initiating device box.

## **2.14 REMOTE ANNUNCIATORS**

- .1 Alphanumeric type, with designation cards to indicate zones.
- .2 Display:
  - .1 Alarms and troubles for alarm initiating circuits.
  - .2 Supervisory alarms and troubles for supervisory initiating circuits.
  - .3 Common system trouble.
- .3 Trouble buzzer.



- .4 Acknowledging trouble at main panel to silence trouble buzzers in system.
- .5 Supervised, with LED test button and stage 1 and stage 2 alarms acknowledge button.

## **2.15 CONTROL RELAY MODULES**

- .1 Control relay modules shall be equipped with a 'Form C' dry relay contact to control external appliances such as door closers, door hold opens, fans, dampers, ranges, etc.
- .2 Contact rating of 2 A, 24VDC or 0.5 A, 120/240VAC. Provide interposing relays as required.

## **3 EXECUTION**

### **3.1 GENERAL**

- .1 All construction waste to be handled in accordance with requirements of
- .2 All materials delivered and stored on site shall be protected from theft, mechanical and environmental damage (temperature, moisture, dust and other contaminants).

### **3.2 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install central control unit and connect to ac power supply, dc standby power.
- .3 Install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .5 Connect alarm circuits to main control panel.
- .6 Install bells and visual signal devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install end-of-line devices at end of alarm and signalling circuits (as required).
- .9 Install remote annunciator panels and connect to annunciator circuit wiring.
- .10 Install door releasing devices.
- .11 Install remote relay units to control fan shut down.
- .12 Install remote control relay modules to control external appliances.
- .13 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .14 Room detection system.
- .15 Install detectors. Make necessary connections between room detection panel and main fire alarm panel.
- .16 Locate and install audible signals and visual alarms.
- .17 Locate and install detectors under raised floor. Fasten to steel brackets approximately 300 mm above sub-floor level to clear cables and conduits.

- .18 Connect fire suppression systems to control panel.
- .19 Splices are not permitted.
- .20 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .21 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .22 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

### 3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work and CAN/ULC-S537.
- .2 Fire alarm system:
  - .1 Test all zones, signal, alarm, ancillary and annunciation devices which have been installed.
  - .2 Test such device and alarm circuit to ensure manual stations, thermal and smoke detectors, and sprinkler system devices transmit alarm to control panel and actuate alarm states and operate ancillary devices.
  - .3 Test each signal device and each signal circuit; including auxiliary inputs and trouble signals.
  - .4 When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
  - .5 Check annunciator panels to ensure zones are shown and actuated correctly. Ensure that each smoke detector and zone is properly annunciated.
  - .6 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
  - .7 Tests to be carried out by the contractor or contractors agent.
  - .8 Tests to include witness of fan shutdown, activation of lighting circuits on alarm, magnetic door holder operation, preaction/clean agent system operation and all other ancillary devices.
  - .9 Tabulated, contractor stamped, signed and dated test results are to be submitted to the Departmental Representative for review and approval, and included in the O&M manual.
  - .10 Addressable circuits system style DCLA:
    - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .3 Provide final EPROM program for system incorporating program changes made during construction.

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### **3.4 VERIFICATION**

- .1 Verify all zones, signal, and alarm, which have been installed or modified in any fashion. Verification to CAN/ULC S537. Include verification costs in tender price.
- .2 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate first stage alarm, general alarm and ancillary devices.
- .3 Test each signal device and each signal circuit.
- .4 Check the fire alarm panel display to ensure zones are shown and actuated correctly. Ensure that each smoke detector is properly annunciated.
- .5 Simulate grounds and breaks on alarm and signalling devices and circuits to ensure proper operation of trouble signals.
- .6 Test to be carried out in the presence of a Departmental Representative from the engineering office where applicable.
- .7 Verification to include the operation at the existing central station connections.
- .8 Verification to include a witness of the ventilation system (and other ancillary shutdowns) shutdown on fire alarm.
- .9 The contractor will be responsible for corrective deficiencies in the contractor's work that are reported by the verification agent.
- .10 Fire alarm verifier to certify one plan drawing. Certification to be included on fire alarm verification report.
- .11 Contractor to carry the cost of the verification in the bid price.

### **3.5 DEMONSTRATION AND TRAINING**

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.
- .2 Allow for three (3) separate training sessions, three (3) hours for each.

### **3.6 AS-BUILT DRAWINGS**

- .1 Record all wiring, terminations/splicing, pipe runs and junction box locations on the asbuilt drawings. Include wire gauge, conduit size and junction box size.
- .2 As-Built drawings to show ladder diagram of operation detailing input signals to programmed output function for programmed systems.
- .3 As-Built drawings to show fire alarm zoning, device addresses and the location of each field device of the fire alarm system including fault isolation modules, ancillary devices and control panels.
- .4 Include room and corridor numbers
- .5 Show all line voltage branched circuit connections including ancillary connections. Include panel identification, circuit number and over-current protection.
- .6 Identify each drawing in lower right hand corner in letters at least 12mm high as follows: "ASBUILT DRAWINGS: THIS DRAWINGS HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" complete with electricians signature and date.

- .7 Submit completed record drawing with Operating & Maintenance Manuals to the Departmental Representative for approval and make corrections as directed.

END OF SECTION

**Part 1 General****1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C88, Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
  - .2 ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregate.
  - .3 ASTM C117, Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .4 ASTM D1557, Specification for Test Methods for Aggregate Mixtures using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop.
  - .5 ASTM D698, Standard Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures using 2.49 kg Rammer and 304.8 mm Drop.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction.
3. The Contractor is to examine and comply with project geotechnical assessment documents prepared by Stantec (of Stantec Project No.: 1233-10756) as follows:
  1. December 1, 2011, report titled “Proposed 20 Men Inmate Living Building – Geotechnical Assessment – Final”;
  2. August 9, 2012 letter to Public Works and Government Services Canada titled “Parking Lot Pavement Design: 20 Men Living at the Matsqui Institution, Abbotsford, BC”

In the case of any conflict between the requirements of the specification sections and the project geotechnical assessment documents prepared by Stantec, comply with the more stringent requirement.

**1.2 SCOPE OF WORK**

- .1 General site clearing, grubbing and topsoil stripping.
- .2 Civil Engineering cut, fill, trenching and grading work exceeding 1m beyond the building footprint inclusive of:
  - .1 Excavating, trenching and backfill for utility services and buried installations.
  - .2 General site grading
  - .3 Topsoil restoration in re-graded landscaped areas
  - .4 Sub-grading below paved areas

- .3 Exclusions to scope of this specification:
  - .1 Earthworks inside a perimeter drawn 1m beyond the building footprint.

### 1.3 REGULATIONS

- .1 Shore and brace excavations, protect slopes and banks and perform all work in accordance with Provincial and Municipal regulations whichever is more stringent.
- .2 Not later than one week before backfilling or filling, provide to designated testing agency, 23 kg sample of bedding and surround, backfill or fill materials proposed for use.
- .3 Do not begin backfilling or filling operations until material has been approved for use by the Departmental Representative.
- .4 Not later than 48 hours before backfilling or filling with approved material, notify the Departmental Representative so that compaction tests can be carried out by designated testing agency.
- .5 Before commencing work, conduct, with the Departmental Representative, condition survey of existing structures, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

### 1.4 TESTS AND INSPECTIONS

- .1 The contractor shall retain, at his own cost, the services of an independent and certified testing agency to undertake soil and granular material tests at the following minimum frequencies / intervals:
  - .1 Sieve Analysis prior to commencing and 1 every 200 tonnes on:
    - .1 All materials referred to in item 2.1 of this Section 31 00 99 (Earthworks for Minor works)
    - .2 Base and sub-base materials referred to in Section 2.1.1 of Section 32 12 16.02 (Asphalt Paving for Building Sites).
  - .2 Modified Proctor Analysis on all materials for which density tests are specified below, prior to commencing and 1 every 200 tonnes.
  - .3 Density Tests on placed and compacted soils and granular materials, for which the results are to be expressed as a percentage of Modified Proctor Density, as follows:
    - 1. Stripped and compacted subgrade: Density tests at 1 per 500 m<sup>2</sup>
    - 2. Compacted fill below paved areas and sidewalk: Density tests at 1 per 500 m<sup>2</sup>
    - 3. Base and Sub-base granular: Density tests at 1 per 500 m<sup>2</sup>  
Note: For all other specification details for base and sub-base granular material please refer to Section 32 12 16.02 - Asphalt Paving for Building Sites.

4. Compacted trench backfill (trenches up to 1.5m depth): Density tests at 1 per 30 lin.m; just below road subgrade.
5. Compacted trench backfill (trenches exceeding 1.5m depth): Density tests at 2 per 30 lin.m; one at half height and one just below road subgrade.
4. The Contractor shall cooperate with the Departmental Representative in the selection of test samples. Copies of the test results shall be forwarded to Departmental Representative.
5. The Contractor is responsible for ensuring all materials meet specifications. Where initial tests fail and subsequent testing is deemed necessary by the Departmental Representative, the cost of the subsequent testing will be the responsibility of the Contractor.
6. In addition to sample testing, the Contractor will undertake proof rolling of subgrade, subbase and base granular surfaces as required and in the presence of the Departmental Representative and / or the Geotechnical Consultant, for which a minimum of 48 hours notice shall be provided by the Contractor.

## **1.5 BURIED SERVICES**

- .1 Before commencing work verify the location of all buried services on and adjacent to the 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 2 m of foundations. Cap cut-offs.

## **1.6 PROTECTION**

- .1 Protect excavations from freezing.
- .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 the Departmental Representative's approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect all active buried services. Assume all services to be active unless:
  - .1 Stated otherwise in contract documents;
  - .2 Confirmed otherwise by contractor's own investigations in consultation with Departmental Representative.
- .6 Repair at contractor's own cost damage to existing structures or services resulting from the contractor's failure to locate and protect.
- .7 Avoid mixing excavated materials. Protect the condition and suitability of native soil and topsoil materials stockpiled for re-use.

**Part 2 Products****2.1 MATERIALS**

- .1 Imported granular material to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over a five year period for particular source of material, soundness to be tested according to ASTM test procedure C-88 or latest revised issue. Maximum weight average losses for coarse and fine aggregates to be 30% when magnesium sulphate is used after five cycles.
- .2 Imported crushed granular material when tested according to ASTM C-136 and ASTM C-117, or latest revised issue, to have a generally uniform gradation, conform to following sieve grading and have one or more fractured faces. Determination of the Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method "A", which determines fractured faces by count. The Plasticity Index for crushed gravel to not exceed 6.0.
- .3 Native material to be any workable soil free of organic or foreign matter; any material obtained within limits of Contract may be deemed native material for purposes of payment if it is approved by the Departmental Representative. Native material is not acceptable if it is impracticable to control its water content or compact to specified density.
- .4 Granular Pipe Bedding and Surround Material  
Crushed or graded gravels: to conform to following gradation:

Sieve Designation	Percent Passing	
	Type 1*	Type*2
25.0mm	100	100
19.0mm	90 - 100	90 - 100
12.5mm	65 - 85	70 - 100
09.5mm	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 Departmental Representative's prior approval.

- .5 Below paved areas trench backfill and general fill should consist of imported 75 mm minus sand or gravel with less than five percent fines (particles passing the 75 µm diameter sieve), be substantially free of clay lumps, free of organic matter and other extraneous material and meet the gradation requirements below.



Sieve Designation	Percent Passing	
	Pit run gravel	Pit run sand
300mm dia	(100)	
200mm dia	---	(100)
100mm dia	---	(100)
75.0mm	---	100
50.0mm	70 -	100
25.0mm	50 -	100
12.5mm	-----	100
4.75mm	22 -	100
2.36mm	10 -	85
1.18mm	-----	13 -
0.600mm	-----	8 -
0.300mm	-----	5 -
0.150mm	-----	2 -
0.075mm	2 -	8

- .6 Approved native material used as trench backfill below unpaved areas is to be free of organic and foreign matter. Native material is not acceptable if it is impracticable to control its water content or compact to the specified density.

### Part 3 Execution

#### 3.1 SITE PREPARATION

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

#### 3.2 CLEARING AND GRUBBING

- .1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas to be excavated, covered with new construction or re-graded.
- .2 Remove stumps and tree roots below footings, slabs, and paving, and to not less than 200 mm below finished grade elsewhere.
- .3 Dispose of cleared and grubbed material off site daily to disposal areas acceptable to authority having jurisdiction.

#### 3.3 EXCAVATION

- .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 Strip topsoil over areas to be excavated, areas to be covered by new construction, areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil.

- .3 Topsoil to be stored for re-use in stockpiles not exceeding 1.5m high in location designated by the Departmental Representative.
- .4 Should insufficient quantity of native topsoil be available for restoring landscaped areas, due to inappropriate handling or storage of topsoil by contractor, the contractor shall import the required balance at his own cost, ensuring imported material is equal or better than native material.
- .5 Avoid mixing topsoil with subsoil.
- .2 Excavate as required to carry out work, in all materials met. Do not disturb soil or rock below bearing surfaces. Notify the Departmental Representative when excavations are complete and obtain Departmental Representative's approval before proceeding further. If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work. Excavation taken below depths shown without Departmental Representative's written authorization to be filled with concrete of same strength as for footings at Contractor's expense.
- .3 Temporary excavations for service trenches and building areas deeper than 1.2m requiring worker entry should be sloped/shored in accordance with Workers' Compensation Board regulations, or as directed on site by a qualified professional engineer. Flatter cut slope inclinations may be required if heavy groundwater seepage is encountered or if the temporary excavations will be open during periods of high precipitation.
- .4 Dewatering may be required, especially if the excavation is carried out during wet weather. The contractor should protect open excavations against flooding and damage from surface runoff. Select dewatering methods based on site conditions and construction techniques, disposing of water in accordance with Environmental procedures via flocculation tanks, settling basins or other treatment facilities to remove suspended solids or other contaminants before discharging to storm sewers. Avoid discharge to the soakaways being constructed as part of these works.
- .5 Excavate trenches to provide uniform continuous bearing and support for 100 mm thickness of pipe bedding material on solid and undisturbed ground. Trench widths below point 300 mm above pipe not to exceed diameter of pipe plus 600 mm.
- .6 Excavate for slabs and paving to subgrade levels. In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.
- .7 For trench excavation, unless otherwise authorized by the Departmental Representative in writing, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 15m at the end of the day's operation.
- .8 Keep excavated and stockpiled materials a safe distance away from edge of trench. Restrict vehicle operations directly adjacent to open trenches.
- .9 Avoid mixing different excavated subsoils.

### 3.4 BACKFILLING / FILLING

- .1 Inspection: do not commence backfilling until fill material and spaces to be filled have been inspected and approved by the Departmental Representative.
- .2 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.

**Abbotsford, BC – Fraser Valley Institution  
New 20-Person Living Unit**

Page 7

- .3 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.
- .4 Compaction: place backfill / fill in uniform lifts not exceeding 150mm and compact to following Modified Proctor densities in compliance with ASTM D1557. (All densities in compliance with ASTM D1557).
  - .1 Below boulevards, easements and landscaped areas to minimum 90%
  - .2 Below and within 1:1 sloping zone of influence of roads, driveways, shoulders, re-shaped ditches, parking areas, patios, paved areas and sidewalks to minimum 95%.
  - .3 Use caution in pipe zone to ensure no damage to pipe.
- .5 Under areas to be top-soiled: use compliant native material up to bottom of topsoil.
- .6 Blown rock material, not capable of fine grading, is not acceptable, imported material must be placed on this type of material.
- .7 Do not proceed with backfilling operations until Departmental Representative has inspected and approved installations.
- .8 During backfilling / filling and compaction, compact each layer before placing succeeding layer.
- .9 Backfilling around installations:
  - .1 Place bedding and surround material as specified elsewhere.
  - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing concrete.
  - .3 Place layers simultaneously on both / all sides of installed work to equalize loading.

**3.5 CONTAMINATED MATERIALS**

- .1 If contaminated materials are detected during excavation operations, immediately notify the Departmental Representative. Any contaminated materials to be disposed of using methods approved by the Departmental Representative.

**3.6 GRADING**

- .1 Following clearing and topsoil stripping excavate to rough grade any areas requiring cut.
- .2 Proof roll exposed sub-grade. Excavate soft spots encountered and backfill with permitted materials in maximum 150mm lifts with compaction to specified density.
- .3 Before placing fill in areas requiring fill, scarify surface to depth of 150mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .4 In areas requiring fill, raise elevations in permitted materials in maximum 150mm lifts with compaction to specified density.
- .5 Employ the preceding operations to achieve rough grading to design elevations allowing for depth of pavement structure, topsoil or other surface treatment as indicated. Grade slopes to be consistent and smooth between finished spot elevations shown on drawings. Tolerance on sub-grade elevations is within 30mm of design elevations but not uniformly high or low.

- .6 Slope rough grade away from building at 2% minimum (unless indicated otherwise).
- .7 Do not disturb soil within branch spread of trees and shrubs to remain.

### **3.7 RESTORATION – TOPSOILED AREAS**

- .1 Prepare subgrade as detailed above and verify that all grades are correct.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 remove debris, roots, branches, stones in excess of 50mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75mm above surface. Dispose of removed material to appropriately licensed off-site disposal area.
- .4 Coarse cultivate entire area which is to receive topsoil to a minimum depth of 150mm immediately before placing topsoil. Cross cultivate areas where equipment used for hauling and spreading has compacted soil.
- .5 When sub-grade accepted by Departmental Representative, commence placing topsoil.
- .6 Place topsoil over prepared subgrade and allow to settle or compact by light rolling such that it is firm against deep footprints. Do not compact topsoil more than is necessary to meet this requirement.
- .7 Ensure topsoil is moist (25% to 75% of field capacity) but not wet when placed, and do not handle if frozen or so wet that its structure will be altered.
- .8 Manually spread topsoil around trees, shrubs and obstacles.
- .9 Fine grade topsoil after placing to specified elevations and contours. Re-grade rough spots and low areas to ensure positive surface drainage.
- .10 Finish surface smooth, uniform, firm against deep footprinting with a fine loose surface texture.

### **3.8 RESTORATION - GENERAL**

- .1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by the Departmental Representative.
- .2 Reinstate pavement, sidewalks and grass-block areas in layers, materials, densities and to lines and elevations which existed before excavation, in all cases providing smooth transition to adjacent paved areas.
- .3 Clean all affected surfaces.
- .4 Scarify and loosen topsoil in areas used for storage, haulage, machinery and the like.

### **3.9 SHORTAGE AND SURPLUS**

- .1 Supply all necessary fill to meet backfilling and grading requirements.
- .2 Dispose of surplus material off site.

**END OF SECTION**

**1 General**

**1.1 RELATED WORK**

- .1 Section 01 01 50 - General Instructions.
- .2 Section 31 00 99 - Earthwork for Minor Works

**1.2 WORK SUMMARY**

- .1 Excavation, trenching and backfilling within building footprint plus 1 meter outside building.

**1.3 REFERENCES**

- .1 ASTM D698-12 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .2 ASTM C136-06 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM C117-04 Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

**1.4 SITE CONDITIONS**

- .1 One (1) geotechnical investigation soils report, created by Stantec; File:1233-10756 dated Dec 1, 2011 is bound with the specification following this section.
- .2 The geotechnical report is for information only, and does not comprise part of the Contract Documents.
- .3 Establish elevation of all affected utilities prior to commencing work.

**1.5 SAMPLES**

- .1 Submit samples in accordance with Section 01 01 50.
- .2 Submit to Testing Laboratory approved by Departmental Representative, samples of Type 1 fill specified in Clause 2.1, for sieve analysis by testing laboratory. Pay for this service.

**1.6 PROTECTION**

- .1 Protect bottoms of footing excavations from softening. Should softening occur, remove softened soil and replace with Type 1 fill and compact in accordance with para. 3.5.1.
  - .2 Protect bottoms of excavations from freezing. Protect excavated bearing surfaces with Type 1 gravel fill.
  - .3 Construct banks of trench excavation in accordance with WCB and local bylaws. Maintain minimum 1.5H:1V side slope. Comply with Workers' Compensation Board (WCB) of B.C. Industrial Health and Safety Regulations for excavations and shoring requirements and applicable regulations.
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- .4 Effect approved measures to minimize dust as result of this work. Refer to Section 01 01 50.
- .5 Do not stockpile excavated material to interfere with site operation or drainage.

## 2 Products

### 2.1 MATERIALS

- .1 Type 1 fill: clean, hard, durable sand, gravel, free from shale, clay, friable materials, organic matter and other deleterious substances when tested to ASTM C136 and ASTM C117 and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart:

<u>ASTM Sieve Designation</u>	<u>% passing</u>
25 mm	100
19 mm	90 - 100
12.5 mm	65 - 85
9.5 mm	50 - 75
4.75 mm	25 - 50
2.36 mm	10 - 35
1.18 mm	6 - 26
0.6 mm	3 - 17
0.075 mm	0 - 5

- .2 Type 2 fill: clean, hard, durable crushed gravel or stone, free from shale clay, friable materials, organic matter and other deleterious substances and graded within the following limits when tested to ASTM C136 and ASTM C117 and giving a smooth curve without sharp breaks when plotted on a semi-log chart:

<u>ASTM Sieve Designation</u>	<u>% Passing</u>
75 mm	100
50 mm	70 - 100
25 mm	50 - 100
4.75 mm	22 - 100
2.36 mm	10 - 85
0.075 mm	2 - 8

- .3 Type 3 fill: selected granular material from within the building area excavation, approved by Departmental Representative for use intended, free of; rocks larger than 75 mm, frozen material, construction rubble, cinders, ashes, wood-waste and organic matter, sods, refuse or other deleterious materials.

- .4 Type 4 fill: clean coarse, washed sand, free from clay, shale and organic matter and other deleterious substances and graded within the following limits when tested to ASTM C136 and ASTM C117 and giving a smooth curve without sharp breaks when plotted on a semi-log chart:

<u>ASTM Sieve Designation</u>	<u>% Passing</u>
4.75 mm	35 - 100
2.36 mm	20 - 70
0.075 mm	0 - 6

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**3 Execution**

**3.1 STOCKPILING**

- .1 Stockpile fill materials in areas designated by Departmental Representative. Stockpile granular materials in manner to prevent segregation. Protect fill materials from contamination.

**3.2 SHORING AND BRACING**

- .1 Construct temporary works to depths, heights and locations in accordance with WCB requirements.

**3.3 DEWATERING**

- .1 Keep excavations free of water while work is in progress.
- .2 Protect open excavations from flooding and damage due to surface run-off.
- .3 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction. Dispose of silt laden water into settlement pond and control runoff with silt fences.

**3.4 EXCAVATION**

- .1 Excavate to lines, grades, elevations and dimensions indicated or as directed by Departmental Representative.
- .2 Excavate to 1000 mm below the existing grade and proof roll with a 10-tonne vibratory roller or a large backhoe mounted vibratory compactor (Hoepac) with an impulse force greater than 70 kN. Excavate any soft or otherwise unsuitable soils and replace with compacted Type 2 granular fill as follows:
  - .1 Compact the upper 300 mm of the excavated subbase in place to a minimum dry density of 100% standard Proctor corrected maximum dry density (ASTM D698). If the existing material exposed in the base of the excavation does not consist of clean granular material or very stiff to hard silt (till), but contains silt lenses for example, excavate and replace with compacted clean granular Type 2 fill. Place the fill in maximum 300 mm thick layers and compact to a minimum dry density of 100% standard Proctor corrected maximum dry density.
  - .2 Any additional excavation required to remove unsuitable soil below 1000 mm deep excavated subgrade during proof rolling operations, as indicated in previous paragraphs, will be determined by Departmental Representative on site. Replace over excavated areas with compacted Type 2 fill as directed by the Departmental Representative. Cost for over excavation and removal from site area, replacement fills and compaction will be paid as extra to contract price, as directed by the Departmental Representative, in accordance with General Conditions.
  - .3 Excavate to 2000 mm below existing grade at elevator pit.
- .3 Excavate subgrade to depth indicated and as follows:
  - .1 Extend excavated subgrade of footing excavation 1000 mm laterally beyond foundation wall plus account for 1:1 slope ratio from edge of footing.

- .4 Refer to drawings for footing layout and depth requirements.
- .5 Protect exposed subgrade from disturbance by construction operations as directed by the Departmental Representative.
- .6 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing as noted in paragraph 3.4.3.1.
- .7 Dispose of surplus and unsuitable excavated material on site and place as directed by the Departmental Representative.
- .8 Where required due to unauthorized or directed over-excavation, correct as follows:
  - .1 Fill under bearing surfaces with Type 2 fill compacted to minimum of 100% Standard Proctor Maximum Dry Density to ASTM D698, method C.
- .9 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

### **3.5 FILL TYPES AND COMPACTION**

- .1 Use fill of types as indicated or specified below. Unless otherwise specified, compact all placed fills to the following densities:
    - .1 Type 1: 100% Standard Proctor Maximum Dry Density, to ASTM D698, Method C.
    - .2 Type 2: 98% (except as noted) Standard Proctor Maximum Dry Density, to ASTM D698, Method C.
    - .3 Type 3 (in non-loadbearing areas): 85%, Standard Proctor Maximum Dry Density to ASTM D698, Method C.
    - .4 Type 4: 95% Standard Proctor Maximum Dry Density, to ASTM D698, Method C. (98% under paving areas, 100% inside building structure areas.)
  - .2 Exterior side of perimeter walls: above drain rock drains use Type 2 fill in paved areas and selected Type 3 granular fill in landscape areas to subgrade level.
  - .3 Within building area under concrete floors:
    - .1 Spread base material to levels indicated and compact sub-base. Place Type 2 fill to bring grade to base course level followed by minimum 150 mm of Type 1 fill directly under floor slabs, uniformly compacted to paragraph 3.5.1.
  - .4 Under concrete sidewalk slabs:
    - .1 Place and compact Type 2 fill to bring grade to base course level, followed by 150 mm minimum of Type 1 fill.
  - .5 Underground services: (Except as specified in other sections)
    - .1 Pipe bedding and immediate protective cover: place minimum 150 mm thickness of Type 4 Fill over excavated trench bottom, grade to pipe inverts and compact. Cradle half diameter of pipe in haunch zone using type 4 fill. After pipe or conduit is in place, cover with minimum 300 mm depth of type 4 fill.
    - .2 Cable and cable ducts bedding and immediate protective cover: cover bottom of trench with minimum 150 mm of type 4 fill. After cables and ducts are in place, side fill with sand up to top of ducts. Tamp around ducts with hand tampers and cover to level of warning tape with 150 mm of same material.
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- .3 Fill above protective cover: in areas within buildings and where paving and walks occur, fill remainder of trench with Type 2 fill to underside of Type 1 base course. In landscape areas, fill to subgrade (rough grade) level using type 3 fill.
- .4 Compaction: compact bedding and immediate protective cover to 95% density. In areas within buildings and where paving and walks occur, compact remainder of fill to 100% density. In landscape areas compact remainder of fill to 85% density.
- .5 Notify Departmental Representative five (5) days prior to backfilling of trenches for mechanical and electrical services.

### **3.6 BACKFILLING**

- .1 Do not proceed with backfilling operations until Departmental Representative has inspected and approved installations.
- .2 Backfilled areas to be free from debris, snow, ice, water or 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 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

### **3.7 GRADING**

- .1 Rough grade around perimeter of building (within 1000 mm of foundation wall) sloped minimum 1:50 from building foundation to adjoining grades.
- .2 Rough grading areas 1000 mm beyond the building perimeter is specified in Section 31 00 99.
- .3 Grade disturbed areas using approved excavated granular Type 3 fill and Type 2 as noted in clause 3.8.

### **3.8 TESTING**

- .1 Inspection and testing of soil compaction will be carried out by testing laboratory approved by the Departmental Representative.
- .2 Pay costs for testing. Refer to Section 01 01 50.
- .3 Contact soils testing firm to perform tests on site during:
  - .1 Field density tests at new compacted subbase and base course as specified in Section 31 00 99 Earthwork for Minor Works.

**END OF SECTION**

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**Part 1 General****1.1 SECTION INCLUDES**

- .1 Materials and installation for asphalt concrete pavement for car park areas, driveways to buildings, bikeways and walks or play areas.

**1.2 RELATED SECTIONS**

- .1 Section 31 00 99 – Earthwork for Minor Works.
- .2 Section 32 16 15 – Concrete Walks, Curbs and Gutters.
- .3 Section 32 17 23 – Pavement Markings.

**1.3 MEASUREMENT PROCEDURES**

- .1 Asphalt concrete pavement including granular base and sub-base will be measured in square metres of asphalt surface in place.

**1.4 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM C88-99a, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
  - .2 ASTM C117-95, Standard Test Method for Material Finer Than 0.075 (No. 200) mm Sieve in Mineral Aggregates by Washing.
  - .3 ASTM C123-98, Standard Test Method for Lightweight Particles in Aggregate.
  - .4 ASTM C127-01, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
  - .5 ASTM C128-01, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
  - .6 ASTM C131-01, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .7 ASTM C136-01, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .8 ASTM D698-00a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>).
  - .9 ASTM D995-95b(2002), Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
  - .10 ASTM D1557-00, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>) (2,700 kN-m/m<sup>3</sup>).
  - .11 ASTM D1559-89, Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus, was withdrawn in 1998 with no replacement.

- .12 ASTM D2419-02, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- .13 ASTM D3203-94(2000), Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .14 ASTM D4318-00, Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .15 ASTM D4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 Asphalt Institute (AI)
  - .1 AI MS-2-1993 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
  - .3 CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes.
  - .4 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.
  - .5 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.

**1.5 SUBMITTALS**

- .1 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review, at least one week before commencing work.
- .2 Materials to be tested by accredited by an independent testing laboratory including Marshall tests at a minimum rate of 1 per day and depth / density test cores at a rate of 1 per 300m<sup>2</sup> or part thereof.
- .3 Submit test certificates showing suitability of materials at least 4 weeks prior to commencing work, certifying that asphalt cement meets the requirements of this section.
- .4 Inform Engineer of proposed source of aggregates and provide access for sampling, if required, at least 4 weeks prior to commencing work.
- .5 Testing and compliance records for granular base and sub-base materials as identified in item 1.4 of Section 31 00 99 - Earthworks for Minor Works.

**Part 2 Products****2.1 MATERIALS**

- .1 Granular base and sub-base material meeting the following requirements:
  - .1 Well graded crushed or screened stone, gravel or sand.
  - .2 Gradations: within limits specified when tested to ASTM C136 and ASTM C117. Table:

Sieve Designation	Granular Base (% passing)	Granular Sub-Base (% passing)
		Select      Crushed

Sieve Designation	Granular Base (% passing)	Granular Sub-Base (% passing)	
		Select	Crushed
75 mm	-	100	100
50 mm	-	-	-
38 mm	-	-	60-100
25 mm	-	50-85	-
19 mm	100	-	35-80
12.5 mm	75-100	-	-
9.5 mm	60-90	-	26-60
4.75 mm	40-70	-	20-40
2.36 mm	27-55	-	15-30
1.18mm	16-42	-	10-20
0.600 mm	8-30	-	5-15
0.300 mm	5-20	-	3-10
0.150mm	-	0-15	-
0.075 mm	2-8	0-8	0-5

## .3 Granular base aggregates:

- .1 Crushed particles: at least 60 % of particles by mass retained on 4.75 mm sieve to have at least 1 freshly fractured face.
- .2 Liquid limit: to ASTM D4318, maximum 25.
- .3 Plasticity index: to ASTM D4318, maximum 6.

## .2 Asphalt concrete aggregates:

- .1 Coarse aggregate is aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C117.
- .2 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.
- .3 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .4 Aggregate: material to following requirements:
  - .1 Well graded crushed stone or gravel, consisting of hard, durable , angular particles free from clay lumps, cementation, organic material, frozen material and deleterious materials.
  - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117.

## .3 Table:

Sieve Designation	Asphalt Concrete Lower Course (% Passing)	Asphalt Concrete Upper Course (% Passing)
19.0 mm	100	-
12.5mm	84-99	100
9.5 mm	73-88	-

Sieve Designation	Asphalt Concrete Lower Course (% Passing)	Asphalt Concrete Upper Course (% Passing)
4.75 mm	50-68	55-75
2.36 mm	35-55	38-58
1.18 mm	27-46	28-47
0.600 mm	18-36	20-36
0.300 mm	10-26	10-26
0.150 mm	4-17	4-17
0.075 mm	3-8	3-8

- .4 Sand equivalent: to ASTM D2419, Minimum 40.
- .5 Magnesium Sulphate soundness: to ASTM C88. Max % loss by weight: coarse aggregate 15, fine aggregate 18.
- .6 Los Angeles Degradation: to ASTM C131. Max % loss by weight: coarse aggregate upper course 25, coarse aggregate lower course 35.
- .7 Absorption: to ASTM C127. Max % by weight: coarse aggregate, 1.75.
- .8 Loss by washing: to ASTM C117; Max % passing 0.075mm sieve: Coarse Aggregate 1.5.
- .9 Lightweight particles: to ASTM C123. Max % by mass, with less than 1.95. Relative density (formally Specific Gravity): 1.5.
- .10 Flat and elongated particles: to ASTM D4791, (with length to thickness ratio greater than 3): Max % by weight: coarse aggregate, 10.
- .11 Crushed particles: at least 60 % of particles by mass within each of following sieve designation ranges to have at least 2 freshly fractured faces. Material to be divided into ranges using methods of ASTM C136 and ASTM C117.

Passing		Retained on
25 mm	to	12.5 mm
12.5 mm	to	4.75 mm

- .12 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .3 Mineral filler for asphalt concrete:
  - .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 by Engineer to improve mix properties.
- .4 Asphalt cement: to CAN/CGSB-16.3, 80 - 100.
- .5 Asphalt prime: to CAN/CGSB-16.1, grade MC-70.
- .6 Sand blotter: clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.
- .7 Asphalt tack coat: to CAN/CGSB-16.2, grade SS-1.

**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 rollers of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers for parking lots and driveways:
  - .1 Minimum drum diameter: 750 mm.
  - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.
- .4 Haul trucks: of 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.
- .5 Suitable hand tools.

**2.3 MIX DESIGN**

- .1 Mix design to AI MS-2.
- .2 Design of mix: by Marshall method to requirements below:
  - .1 Compaction blows on each face of test specimens: 75.
  - .2 Mix physical requirements:

Property	Lower Course	Upper Course
Marshall Stability at 60 degrees C, kN minimum.	6.4	5.5
Flow Value, mm.	2-4	2-4
Air Voids in Mixture, %	3-6	3-5
Voids in Mineral Aggregate, % minimum	14	15
Index of Retained Stability, % minimum	75	75

- .3 Measure physical requirements as follows:
  - .1 Marshall load and flow value: to ASTM D1559.
  - .2 Compute void properties on basis of bulk specific gravity of aggregate to ASTM C127 and ASTM C128. Make allowance for volume of asphalt absorbed into pores of aggregate.
  - .3 Air voids: to ASTM D3203.
  - .4 Voids in mineral aggregate: to AI MS-2, chapter 4.
  - .5 Index of Retained Stability: measure in accordance with Marshall Immersion Test for Bitumen, ASTM D 1559.
- .4 Do not change job-mix without prior approval of Engineer. When change in material source proposed, new job-mix formula to be approved by Engineer.

**Part 3 Execution****3.1 SUBGRADE PREPARATION AND INSPECTION**

- .1 Verify grades of subgrade and items set in paving area for conformity with elevations and sections before placing granular base and sub-base material.
- .2 Obtain approval of subgrade by Geotechnical Engineer before placing granular sub-base and base.

**3.2 GRANULAR SUB-BASE AND GRANULAR BASE**

- .1 Place granular base and sub-base material on clean unfrozen surface, free from snow and ice.
- .2 Place granular base and sub-base to compacted thicknesses as indicated. Do not place frozen material.
- .3 Place in layers not exceeding 150 mm compacted thickness. Compact to density not less than 95 % Modified Proctor Density in accordance with ASTM D1557.
- .4 Finished base surface to be within 10 mm of specified grade, but not uniformly high or low.

**3.3 ASPHALT PRIME**

- .1 Cutback asphalt:
  - .1 Heat asphalt prime for pumping and spraying in accordance with CAN/CGSB-16.1.
  - .2 Apply cutback asphalt prime to granular base, at rate not exceeding 2 L/m<sup>2</sup>.
  - .3 Apply on damp surface, unless otherwise directed by Engineer.
- .2 Emulsified asphalt:
  - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application. Mix thoroughly by pumping or other method approved.
  - .2 Apply diluted asphalt emulsion not exceeding 5 L/m<sup>2</sup>.
  - .3 Apply on damp surface unless otherwise directed.
- .3 Do not apply prime when air temperature is less than 5 degrees C or when rain is forecast within 2 hours.
- .4 If asphalt prime fails to set within 24 hours, spread sand blotter material in amounts required to absorb excess material. Sweep and remove excess blotter material.

**3.4 ASPHALT TACK COAT**

- .1 Apply asphalt tack coat only on approved clean, dry surfaces.
- .2 Dilute asphalt emulsion with water at 1:1 ratio for application. Mix thoroughly by pumping.
- .3 Apply tack coat evenly to pavement surface not exceeding 0.7L/m<sup>2</sup>, when diluted.

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- .4 Paint contact surfaces of curbs, edges, headers, gutters, manholes and like structures with thin uniform coat of asphalt tack coat material.
- .5 Do not apply tack coat at air temperature below 5 degrees C or when rain forecast within 2 hours of application.
- .6 Apply tack coat only to surfaces that are to be overlaid same day.
- .7 Evenly distribute localized excessive deposits of tack coat by brooming.
- .8 Where traffic is to be maintained treat no more than one half the width of the surface in one application.
- .9 Keep traffic off tacked areas until asphalt tack coat has set.

**3.5 PLANT AND MIXING REQUIREMENTS**

- .1 In accordance with ASTM D995.

**3.6 ASPHALT CONCRETE PAVING**

- .1 Obtain approval of base, tack coated and primed areas before placing asphalt mix.
- .2 Place asphalt mix only when base or previous course is dry and air temperature is above 5 degrees C. Place overlay pavement only when air temperature is above 10 degrees C.
- .3 Place asphalt concrete in compacted layers not exceeding 50 mm per lift and not less than 35mm per lift.
- .4 Minimum 135 degrees C mix temperature required when spreading.
- .5 Maximum 160 degrees C mix temperature permitted at any time.
- .6 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.
- .7 Compact parking lot and driveway asphalt concrete to density not less than 97 % of density obtained with Marshall specimens prepared in accordance with ASTM D1559 from samples of mix being used. Roll until roller marks are eliminated.
- .8 Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.
- .9 Moisten roller wheels with water to prevent pick up of material.
- .10 Compact mix with hot tampers or other approved equipment, in areas inaccessible to roller.
- .11 Finished surface is to be within 6 mm of design elevations and not uniformly high or low. Surface irregularities are not to exceed 6 mm when checked with a 3m straight edge in any direction. Water ponding on the finished surface is not permitted.
- .12 Repair areas showing checking, rippling, segregation or which are otherwise out of compliance with specified criteria.

**3.7 JOINTS**

- .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.



- .2 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .3 For cold joints, cut back to full depth vertical face and tack face with hot asphalt.
- .4 For longitudinal joints, overlap previously laid strip with spreader by 25 to 50 mm.

**3.8 ASPHALTIC CURBS (NOT REQUIRED FOR THIS CONTRACT)**

- .1 Form asphalt curbs by machine to profiles as indicated. Curve curbs uniformly.

**3.9 SPEED BUMPS (NOT REQUIRED FOR THIS CONTRACT)**

- .1 Form speed-limiting bumps as indicated. Stop bumps [300] mm short of [curb] [edge of driveway].

**3.10 PROTECTIVE COATING**

- .1 Apply 2 coats of protective coating to completed paved areas and asphalt curbs in accordance with manufacturer's instructions.

**3.11 PROTECTION**

- .1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38 degrees C. Do not permit stationary loads on pavement until 24 hours after placement.
- .2 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

**END OF SECTION**

**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 03 30 00 – Cast-in-place Concrete.
- .2 Section 31 00 99 – Earthworks for Minor Works.
- .3 Section 32 12 16.02 – Asphalt for Building Sites.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C117-04, Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D260-86(2001), Standard Specification for Boiled Linseed Oil.
  - .4 ASTM D698-00ae1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-3.3-99(March 2004), Kerosene, Amend. No. 1, National Standard of Canada.
  - .2 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

**Part 2 Products****2.1 MATERIALS**

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete with the following criteria specific to this section:
  - .1 Hand-formed and hand placed concrete:
    - .1 Slump: 80mm
    - .2 Air Entrainment: 5 to 8%
    - .3 Maximum aggregate size: 20mm
    - .4 Minimum cement content: 335kg/m<sup>3</sup>
    - .5 Minimum 28 day compressive strength: 32 MPa
  - .2 Extruded concrete:
    - .1 Slump: 0-25mm
    - .2 Air Entrainment: 6 to 9%
    - .3 Maximum aggregate size: 10mm
    - .4 Fineness modulus: 2.1 to 2.4

- .5 Minimum cement content: 335kg/m<sup>3</sup>
- .6 Minimum 28 day compressive strength: 32 MPa
- .2 Joint filler in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .3 Granular base: material to item 2.1.1 of Section 32 12 16.02 – Asphalt for Building Sites.
- .4 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.
- .5 Fill material: to item 2.1.5 of Section 31 00 99 – Earthwork for Minor Works.
- .6 Boiled linseed oil: to ASTM D260.
- .7 Kerosene: to CAN/CGSB-3.3.

**Part 3 Execution****3.1 GRADE PREPARATION**

- .1 Do grade preparation work in accordance with Section 31 00 99 – Earthwork for Minor Works.
- .2 In preparing grade allow for width of gravel base including shoulders as detailed, beyond edges of concrete.
- .3 Place fill in maximum 150 mm layers and compact to at least 95% Modified Proctor Density to ASTM D1557.

**3.2 GRANULAR BASE**

- .1 Obtain Geotechnical Engineer's approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Compact granular base in maximum 150 mm layers to at least 95% Modified Proctor Density to ASTM D1557, and to within 10mm of specified grade, but not uniformly high or low.

**3.3 FORMWORK**

- .1 Ensure steel forms of approved design and free from twists and warp.
- .2 Ensure wood forms of select dressed lumber, straight and free from defects and thoroughly cleaned.
- .3 Use flexible forms for all curves less than 60m radius.
- .4 After obtaining Departmental Representative's approval of compacted base, set forms to line and grade as shown on Contract Drawings. Free from waves or irregularities in line or grade.
- .5 Set special isolation forms as required around catchbasin, manholes, poles or other objects as shown or as required for implementing other items of the Works.
- .6 Forms to be to shape, lines and full dimensions or the work being formed.
- .7 Adequately brace forms to maintain specified tolerances after concrete is placed.

- .8 Treat forms lightly with approved release agent and remove surplus agent.

### 3.4 CONCRETE PLACEMENT

- .1 Obtain Geotechnical Engineer's approval of granular base prior to placing concrete.
- .2 In conjunction with execution of formwork and with reference to the contract drawing showing sidewalk joint spacing dimensions, layout proposed expansion, control and dummy joints and agree same with Departmental Representative.
- .3 Do concrete work in accordance with Section 03 30 00 – Cast-in-Place Concrete.
- .4 Do not place during rain or on ponded water or frozen base.
- .5 Do not place concrete when air temperature appears likely to fall below 5 degrees C within 24 hours unless specified precautions are taken and approved by Departmental Representative.
- .6 Schedule concrete placement to ensure sufficient daylight hours available to permit edging and finishing or provide adequate illumination.
- .7 Moisten granular base immediately prior to placing concrete.
- .8 Place concrete within 1.5 hours of batching time.
- .9 Place concrete in forms, ensuring no segregation of aggregate and consolidate with approved mechanical vibrator or power screed.
- .10 Place concrete in continuous operation until entire panel or section completed. Do not place fresh concrete on concrete which has achieved partial set.
- .11 Incorporate all castings into concrete at time of placement.
- .12 Discontinue placement at expansion, construction or isolation joints only.
- .13 Remove face forms as soon as practical to permit face finishing. Do not leave face forms in place overnight.

### 3.5 EXTRUDED SECTIONS

- .1 Extruding machine to be fitted with approved template consistent with sections shown on Standard Details.
- .2 Extruded sections to be true to line, grade and cross-section.
- .3 Finished appearance, quality and workmanship to comply with Contract Drawings, this specification and Standard Details.
- .4 Where finished product does not conform to specifications, remove defective product and replace.

### 3.6 TOLERANCES

- .1 Maximum horizontal or vertical deviation = 6mm. Maximum irregularity from finished horizontal or vertical alignment to be 6mm in 3 m.

**3.7 EXPANSION AND CONTRACTION JOINTS**

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals not exceeding those indicated on contract details.
- .2 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.
- .3 Extend through full depth of concrete.
- .4 Fill with 13mm approved expansion joint material.
- .5 Bond break compound may be used in lieu of expansion joint between sidewalk and back of abutting curb and gutter or where applicable between sidewalk and back of abutting utility strip or sidewalk infill.

**3.8 CONTROL JOINTS**

- .1 In sidewalks, infill, curbs or curb and gutter construct control joints at maximum 3m intervals. Where sidewalks, infill, curbs or curb and gutter are adjacent, make joints in each coincide.
- .2 Cut such that uncut depth does not exceed 75mm.
- .3 Use proper tool to make cut while concrete is still green or sawcut after concrete has hardened.

**3.9 ISOLATION JOINTS**

- .1 Form isolation joints around all poles, hydrants, manholes, and all structures or fixed objects located within concrete section by using specified joint filling material.

**3.10 FINISHING**

- .1 Finish surface of concrete sidewalks and utility strips to smooth surface with magnesium or wood float and then immediately brush or broom to provide uniform non-skid surface complete with regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
- .2 Broom or brush crossways or as otherwise directed if / as necessary to match adjacent finish.
- .3 Grooves or scoring (dummy joints) used for aesthetic purposes to be marked with proper tools and set 15mm deep.
- .4 Round edges of panels between each expansion, control and/or dummy joint with steel edging tool to a width of between 30 and 50mm (but not varying) around perimeter of each panel.
- .5 Ensure surface of hand-formed curb and gutter is smooth magnesium or wood float finish. Ensure extruded curb and gutter is smooth finished and hand floated as required to correct irregularities.
- .6 Under no circumstances is concrete to be overworked by trowelling, dusted with dry cement or finished with a mortar coat.

**3.11 PROTECTION**

- .1 Protect freshly finished concrete from dust, rain or frost by using appropriate coverings, kept clear of finished surface.
- .2 Protect finished concrete from equipment, vehicles, pedestrians and all other potential damage.

**3.12 CURING**

- .1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 7 days after placing, or sealing moisture in by curing compound to all exposed concrete surfaces at rate recommended by manufacturer.
- .2 When temperature is below 5 degrees C, maintain all concrete at temperature not less than 10 degrees C for at least 72 hours and protect from freezing for at least another 72 hours or such time as required to ensure proper curing of concrete. Admixtures are not to be used for prevention of freezing.

**3.13 BACKFILL**

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material per Section 31 00 99 – Earthwork for Minor Works.
- .3 Compact and shape to required contours or and / or spot elevations as indicated.

**3.14 LINSEED OIL TREATMENT**

- .1 Apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters, after concrete has cured for specified curing time and when surface of concrete is clean and dry.
- .2 Linseed oil mixture to consist of 50% boiled linseed oil and 50% mineral spirits by volume.
- .3 Apply treatment when air temperature above 10 degrees C.
- .4 Apply first coat at 135 mL/m<sup>2</sup>.
- .5 Apply second coat at 90 mL/m<sup>2</sup> when first coat has dried.

**3.15 CLEANING**

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1 General****1.1 RELATED REQUIREMENTS**

- .1 Section 32 12 16.02 – Asphalt for Building Sites.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.5-99, Low Flash Petroleum Spirits Thinner.
  - .2 CAN/CGSB 1.74-01, Alkyde Traffic Paint.
- .2 Green Seal Environmental Standards (GS)
  - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature and data sheets for pavement markings and include product characteristics, performance criteria, physical size, finish and limitations.

**Part 2 Products****2.1 MATERIALS**

- .1 Paint:
  - .1 To MPI -EXT 2.1B, Alkyd zone/traffic marking.
  - .2 Paints: in accordance with MPI recommendation for surface conditions.
    - .1 Paints: maximum VOC limit 100 g/L to SCAQMD Rule 1113 to GS-11.
  - .3 Colour: to MPI listed, white.
- .2 Thinner: to MPI listed manufacturer.
- .3 Glass reflective beads: type suitable for application to wet paint surface for light reflectance. **(NOT REQUIRED FOR THIS CONTRACT)**



**Part 3 Execution****3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive pavement markings previously installed under other Sections or Contracts are acceptable for product installation in accordance with MPI instructions prior to pavement markings installation.
  - .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Pavement surface: dry, free from water, frost, ice, dust, oil, grease and other deleterious materials.
- .3 Proceed with Work only after unacceptable conditions have been rectified.

**3.2 EQUIPMENT REQUIREMENTS**

- .1 Paint applicator: approved pressure type mobile with positive shut-off distributor capable of applying paint in single, double and dashed lines and capable of applying marking components uniformly, at rates specified, and to dimensions as indicated.
- .2 Distributor: capable of applying reflective glass beads as overlay on freshly applied paint. **(NOT REQUIRED FOR THIS CONTRACT)**

**3.3 APPLICATION**

- .1 Pavement markings: Contractor to lay out pavement markings and obtain approval.
- .2 Unless otherwise approved by Departmental Representative, apply paint only when air temperature is above 10 degrees C, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.
- .3 Apply traffic paint evenly at rate of 3 m<sup>2</sup>/L.
- .4 Do not thin paint unless approved.
- .5 Symbols and letters to dimensions indicated.
- .6 Paint lines: of uniform colour and density with sharp edges.
- .7 Thoroughly clean distributor tank before refilling with paint of different colour.
- .8 Apply glass beads at rate of [0.5] kg/l of painted area immediately after application of paint. **(NOT REQUIRED FOR THIS CONTRACT)**

**3.4 TOLERANCE**

- .1 Paint markings: within plus or minus 10 mm of dimensions indicated.
- .2 Remove incorrect markings to satisfaction of the Departmental Representative.

**3.5 PROTECTION OF COMPLETED WORK**

- .1 Protect pavement markings until dry.

**END OF SECTION**

**1 General**

**1.1 RELATED WORK**

- .1 Section 01 01 50 - General Instructions.
- .2 Section 31 00 99 - Earthwork for Minor Works

**1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International):
  - .1 CAN/CSA A3001-2009 - Cementitious materials for use in concrete.
  - .2 CAN/CSA-A23.1/A23.2-M2009, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete
  - .3 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .2 Canadian Gheneral Standards Board (CGSB)
  - .1 CAN/CGSB-138.1-96, Fence, Chain Link, Fabric.
  - .2 CAN/CGSB-138.2-96, Fence, Chain Link, Framework, Zinc-Coated, Steel.
  - .3 CAN/CGSB-138.3-96, Fence, Chain Link - Installation.
  - .4 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 ASTM International (ASTM):
  - .1 ASTM A53/A53M-10, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A90/A90M-09 - Standard Test Method for Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  - .3 ASTM A123 / A123M - 09 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .4 ASTM A 121-07 - Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
  - .5 ASTM A392- 07 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
  - .6 ASTM F1043-10 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
  - .7 ASTM F1379 - 95(2008) Standard Terminology Relating to Barbed Tape.

**1.3 SUBMITTALS**

- .1 Submit shop drawings or product data in accordance with Section 01 01 50.
- .2 Product data to indicate: overhang arms construction details, manufacturer's standard and custom hardware.

**2 Products**

**2.1 MATERIALS**

- .1 Concrete mix designed to produce 20 MPa minimum compressive strength at 28 days and containing 20 mm maximum size, 5 mm minimum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1 Table 7 for Class F-2 exposure and 60 mm slump at time and point of deposit. Air entrainment to CAN/CSA-A23.1, Table 8.

- .2 Chain-link fence fabric: to CAN/CGSB-138.1:
  - .1 Equipment Compound fence fabric:
    - .1 Interwoven steel wire fabric, 50 mm x 50 mm, 3.75 mm  $\phi$  (9 Ga), with minimum 366 gm/m<sup>2</sup> galvanized coating.
    - .2 Height of wire mesh: 2440 mm.
    - .3 Knuckled selvedge at top and bottom.
- .3 Posts and rails: to CAN/CGSB-138.2, ASTM F1043, Schedule 40 electro-galvanized steel pipe (550 g/m<sup>2</sup>) in the following sizes, except as noted otherwise:
  - .1 Gate, Corner and Terminal posts: 73 mm O.D, 8.6 kg/m. .
  - .2 Top and bottom rails 42 mm O.D, 3.4 kg/m.
- .4 Tie wire fasteners: single strand, galvanized steel wire conforming to requirements of fence fabric, 3.76 mm diameter (9 ga).
- .5 Tension bar: 4.76 x 20 mm minimum galvanized steel.
- .6 Tension bar bands: 3.2 x 25 mm minimum galvanized steel.
- .7 Zinc pigmented paint: to CGSB 1.181.
- .8 Fittings and hardware: cast aluminum alloy, galvanized steel or malleable or ductile cast iron.

## **2.2 FINISHES**

- .1 Galvanizing:
  - .1 For chain link fabric: 366 g/m<sup>2</sup> to CAN/CGSB-138.1, ASTM A392.
  - .2 For posts, rails: 550 g/m<sup>2</sup> minimum to ASTM A90.
  - .3 For other fittings: to CSA G164, ASTM A123.

## **3 Execution**

### **3.1 ERECTION OF FENCE**

- .1 Provide all new chain link fence fabric, posts, framing and components for equipment compound fence.
  - .2 Erect fence along lines as indicated and in accordance with CAN/CGSB 138.3 .
  - .3 Excavate post footing holes at each fence post, by methods approved by Departmental Representative. Concrete post footing diameter four (4) x steel post outside diameter except no less than 300 mm diameter, whichever is greater.
    - .1 Concrete footing depth for fence: 1000 mm.
  - .4 Install posts gate, corners and termination at building except as indicated otherwise.
  - .5 Place concrete in post holes then embed posts into concrete to maximum concrete post depth. Extend concrete 50mm above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
-

- .6 Do not install fence fabric until concrete has cured a minimum of 5 days.
- .7 Install top rail between posts and through post tops.
- .8 Install bottom rail between posts of security fence and fasten securely to posts with fence post brackets.
- .9 Lay out fence fabric onto fences, stretch tightly to tension recommended by manufacturer and fasten to terminal, corner and straining posts with tension bar secured to post with tension bar bands spaced at 300mm intervals. Join end rolls of fabric by weaving a single strand of fabric into the ends of the rolls to form a continuous mesh. Same procedure for tying into existing fence. Join overlapped fabric with tie wires at 300 mm intervals along each exposed edge and stagger upper and lower ties 150 mm. Tighten fence fabric to CAN/CGSB-138.3.
- .10 Secure mesh fabric to posts and to top and bottom rails with 3.27 mm  $\phi$  tie wires at 300 mm intervals on secure side of fence. Install wire ties with minimum two complete revolutions. Orientate wire tie twists parallel to and on secure side of fence fabric.

### **3.2 TOUCH UP**

- .1 Repair damaged galvanized surfaces. Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of approved zinc pigmented (Galvacon) paint to damaged areas where zinc coating is removed.

### **3.3 CLEANING**

- .1 Clean areas disturbed by operations. Dispose of surplus material and repair damaged surfaces as directed by Departmental Representative.
- .2 Dispose of all materials off Institution grounds, including ties. Ensure all metal objects are removed from grounds.

**END OF SECTION**

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**Part 1 General****1.1 SECTION INCLUDES**

- .1 Materials and installation for wood post and dowel rail fences and gates.

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 31 00 99 – Earthworks for Minor Works.

**1.3 SUBMITTALS**

- .1 Shop drawings for double wood gates designed to coordinate with fence. Drawings to include all fabrication details including:
  - .1 Wood gate frame, bracing, rails or boards
  - .2 Hinges
  - .3 Latch and latch catch (with provision for padlock to be installed by client if required)
  - .4 Drop bolts on both gates and concrete surrounded ground recess tubes to accept drop bolts in the open and closed gate positions.
  - .5 Gate stops (not to be located in pedestrian walk) at 90 degree open position.
  - .6 All metalwork to be galvanized or stainless steel.

**Part 2 Products****2.1 MATERIALS**

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Wood post and three (3) dowel rail fence to alignment indicated on drawings. Western red cedar or equivalent approved, pressure treated for ground contact and outdoor exposure.
- .3 Fence posts to be of 1.8m height (including 0.6m buried depth). Domed tops to shed water. Drilled holes to accept three (3) dowel rails at 0.4m vertical spacing; top drilled hole to be 0.15m from top of post. 6" Diameter straight posts for line, end and corner locations.
- .4 Gate posts to be 8" diameter or 8" square to suit shop design of gates.
- .5 Rails to be 4" diameter, straight and 2.4m long including doweled ends.
- .6 Furnish gates with galvanized malleable iron or stainless steel hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.
- .7 Furnish double gates centre rest with drop bolts for open and closed positions.

**2.2 FINISHES**

- .1 Galvanizing: To CAN/CSA-G164, ASTM A123.

**Part 3 Execution****3.1 GRADING**

Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Generally maintain elevations, slopes and swales indicated on contract information. Provide clearance between centre of lowest rail and ground surface of 250 mm typically.

**3.2 ERECTION OF FENCE**

- .1 Erect fence along lines as indicated and in accordance with fencing supplier's recommendations and details below.
- .2 Excavate post holes to exceed post buried depth by 150mm minimum. Concrete post footing diameter three (3) x wood post outside diameter except no less than 400 mm diameter, whichever is greater.
- .3 Posts: Space line posts uniformly at a spacing to accept rails set parallel to the ground surface.
- .4 Install corner post where change in alignment exceeds 10 degrees. Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.
- .5 Place concrete in post holes then embed posts into concrete. Buried depth of post below ground design elevation to be 600 mm. Top of concrete to be finished 100 mm below ground design elevation. Mount dowelled rails between posts and brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .6 Restoration of topsoil around posts per Section 31-00-99, Earthworks for Minor Works.

**3.3 INSTALLATION OF GATES**

- .1 Install double gates at fence openings.
- .2 Allow for design grade slopes between gate posts and set top of both gate frames horizontal, with the bottoms clearing all design elevations by at least 50mm.
- .3 Determine position of centre gate rest for double gate. Provide recesses for drop bolts in open and closed positions. Provide gate stops at maximum 90 degree open position (for opening away from building) and 0 degree closed position. Gate stops not to oversail edge of pedestrian walk. Cast gate drop bolt recesses in concrete. Dome concrete very slightly around drop bolt recesses to shed water but not enough to create pedestrian trip hazard.

**END OF SECTION**

**1 General**

**1.1 RELATED WORK**

- .1 Section 31 00 99 - Earthwork for Minor Works

**1.2 SUBMITTALS**

- .1 Provide submittals as specified in Section 01 01 50 General Instructions.
- .2 Include maintenance data for care of seeding for incorporation into maintenance manual.
- .3 Provide product data for:
  - .1 Seed.
  - .2 Mulch.
  - .3 Tackifier.
  - .4 Fertilizer.
- .4 Submit in writing to Departmental Representative 5 days prior to commencing work:
  - .1 Volume capacity of hydraulic seeder in litres.
  - .2 Amount of material to be used per tank based on volume. Number of tankloads required per hectare to apply specified slurry mixture per hectare.

**1.3 SCHEDULING**

- .1 Schedule hydraulic seeding to coincide with preparation of soil surface.
- .2 Schedule hydraulic seeding using grass mixtures and mixtures containing Crownvetch Trefoil between dates recommended by the Provincial Agricultural Department.

**2 PRODUCTS**

**2.1 Materials**

- .1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
  - .1 Grass mixture: "Certified", "Canada No. 1 Low Maintenance and Erosion Control Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
- .2 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:
  - .1 Type I mulch:
    - .1 Made from wood cellulose fibre.
    - .2 Organic matter content: 95% plus or minus 0.5%.
    - .3 Value of pH:6.0.
    - .4 Potential water absorption: 900%.



- .2 Type II mulch:
  - .1 Made from newsprint, raw cotton fibre and straw, processed to produce fibre lengths of 15 mm minimum and 25 mm maximum. Greater proportions of ingredients to be straw.
- .3 Tackifier: water dilutable, liquid dispersion.
- .4 Water: free of impurities that would inhibit germination and growth.
- .5 Fertilizer:
  - .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
  - .2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.
- .6 Inoculants: inoculant containers to be tagged with expiry date.

### **3 EXECUTION**

#### **3.1 WORKMANSHIP**

- .1 Do not spray onto structures, signs, fences, plant material, utilities and other than surfaces intended.
- .2 Clean-up immediately, any material sprayed where not intended, to satisfaction of Engineer.
- .3 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.
- .4 Protect seeded areas from trespass until plants are established.

#### **3.2 PREPARATION OF SURFACES**

- .1 Fine grade areas to be seeded free of humps and hollows. Ensure areas are free of deleterious and refuse materials.
- .2 Ensure areas to be seeded are moist to depth of 150mm before seeding.

#### **3.3 PREPARATION OF SLURRY**

- .1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Departmental Representative. Supply equipment required for this work.
- .2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
- .3 After all other material is in the seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

#### **3.4 SLURRY APPLICATION**

- .1 Hydraulic seeding equipment:
-

- .1 Slurry tank.
- .2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and /or mechanical agitation method.
- .3 Capable of seeding by 50 m hand operated hoses and appropriate nozzles.
- .2 Slurry mixture to contain seed, mulch, tackifier, water and fertilizer in proper quantities to meet low maintenance and erosion control requirements.
- .3 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
  - .1 Using correct nozzle for application.
  - .2 Using hoses for surfaces difficult to reach and to control application.
- .4 Blend application 300 mm into adjacent grass areas or previous applications to form uniform surfaces.
- .5 Re-apply where application is not uniform.
- .6 Remove slurry from items and areas not designated to be sprayed.
- .7 Protect seeded areas from trespass satisfactory to Departmental Representative.
- .8 Remove protection devices as directed by Departmental Representative.

### **3.5 MAINTENANCE DURING ESTABLISHMENT PERIOD**

- .1 Perform following operations from time of seed application until acceptance by Engineer:
- .2 Grass Mixture:
  - .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
  - .2 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.

### **3.6 ACCEPTANCE**

- .1 Seeded areas will be accepted by Departmental Representative provided that:
  - .1 Seeded areas are free of rutted, eroded, bare or dead spots.
- .2 Areas seeded in fall will achieve final acceptance in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

### **3.7 MAINTENANCE DURING ONE YEAR WARRANTY PERIOD**

- .1 Perform following operations from time of acceptance until end of warranty period:
  - .1 Repair and reseed dead or bare spots to satisfaction of Departmental Representative.

**END OF SECTION**

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**Part 1 General****1.1 RELATED SECTIONS**

- |    |   |                     |
|----|---|---------------------|
| .1 | Cast-in-place concrete short form       | Section 03 30 00.01 |
| .2 | Earthwork For Minor Works               | Section 31 00 99    |
| .3 | Public Sanitary Utility Sewerage Piping | Section 33 31 13    |
| .4 | Storm Utility Drainage Piping           | Section 33 41 00    |

**1.2 MEASUREMENT PROCEDURES**

- .1 Measure manholes and catch basins in units within depth classifications as follows, measured from top of cover or grating to top of base slab:
  - .1 2 m or less.
  - .2 Greater than 2 m but not more than 2.5 m.
  - .3 Greater than 2.5 m but not more than 3 m.
  - .4 Greater than 3 m but not more than 3.5 m.
  - .5 Further stages in increments of 0.5 m.
- .2 Measure outfall structures in units.
- .3 Measure adjusting tops of existing manholes or catch basins in units adjusted.
- .4 Measure gratings in units supplied and installed.
- .5 Measure I-beam in metres of each size incorporated into work.
- .6 Measure sealing over existing manholes or catch basins in units sealed.
- .7 Excavation for all items is incidental to the items and will not be measured separately.

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C478M, Specification for Precast Reinforced Concrete Manhole Sections.
  - .2 ASTM A48, Specification for Gray Iron Castings.
  - .3 ASTM C-497, Test Methods for Concrete Pipe, Manhole Sections, or Tile
  - .4 ASTM-D-4101, Polyethylene Plastic Injection and Extrusion Materials.
  - .5 ASTM A615M, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - .6 ASTM C443M, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - .7 ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
  - .8 ASTM A185, Reinforcing steel welded mesh fabric
- .2 Canadian Standards Association (CSA International)
  - .1 CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

- .2 CSA-S157, Strength Design in Aluminum.
- .3 CSA A82.56, Aggregate for Masonry Mortar.
- .4 CAN/CSA-A8, Masonry Cement
- .5 CAN3-A165 Series, CSA Standards on Concrete Masonry Units.
- .6 CAN/CSA-A3001 - Cementitious Materials for Use in Concrete. Precast manhole units

#### 1.4 MATERIALS

- .1 Precast manhole and catch basin units to: ASTM C478M complete with ladder rungs.
- .2 Manhole lids: to be precast reinforced concrete designed to withstand H20 loading.
- .3 Cast iron frame and cover, cast with the word "Storm" or "Sanitary" as applicable:
  - .1 Frame and cover must conform to ASTM A48 be designed to withstand H20 loading.
  - .2 Frame and cover must bear manufacturer identification on castings.
- .4 Ladder rungs to be:
  - .1 To conform to ASTM C-497, C-478 load test.
  - .2 20 mm cold rolled steel, hot dipped after bending to CSA G164, welded to reinforcing bars and cast with manhole sections or epoxy grouted into manhole walls.
  - .3 20 mm aluminum allow #6351-T6 (CSA-S157 and NBC 1977), complete with polyethylene anchor precast or drilled holes in manhole sections.
  - .4 Polypropylene encased steel ladder rungs; polypropylene ASTM-D-4101 steel core to be ½ inch dia grade 60 as per ASTM A615M.
  - .5 Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.
  - .6 In compliance with all requirements of Workers' Compensation Board.
- .5 Precast catch basin sections: to ASTM C478M.
- .6 Catchbasin leads to be minimum 150 mm diameter and of PVC DR35.
- .7 Catchbasin lids: to be precast reinforced concrete designed to withstand H20 loading.
- .8 Cast iron catchbasin and lawn drain frame and grate:
  - .1 Frame and grate must conform to ASTM A48 and be designed to withstand H20 loading.
  - .2 Frame and grate must bear manufacturers identification on casting.
- .9 Joints: made watertight using cement mortar or rubber gaskets to ASTM C443.
- .10 Mortar:
  - .1 Aggregate: to CSA A82.56
  - .2 Cement: to CAN/CSA-A8.

- .11 Adjusting rings: to ASTM C478.
- .12 Concrete Brick: to CAN3-A165 Series.
- .13 Drop manhole pipe: same as sewer pipe.
- .14 Galvanized iron sheet: approximately 2 mm thick.
- .15 Concrete for cast-in-place bases and benching to be minimum 20 MPa with constituent materials conforming to CAN/CSA-A5, A23.5 and A23.1.
- .16 Precast concrete lawn drain units manufactured to withstand AASHTO H-20 loading, wet-cast from concrete with compressive strength of 4000 PSI at 28 days. Reinforcing mesh to ASTM A185. Reinforcing steel deformed bars to ASTM A615.

**Part 2 Execution****2.1 MANUFACTURER'S INSTRUCTIONS**

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

**2.2 EXCAVATION AND BACKFILL**

- .1 Excavate and backfill in accordance with Section 31 00 99 Earthwork for Minor Works and as indicated.
- .2 Obtain approval of the Departmental Representative for manholes or catch basins.

**2.3 CONCRETE WORK**

- .1 Do cast-in-place concrete work including surface tolerances, finishing and field quality control, in accordance with CAN/CSA-A23.1.
- .2 Position metal inserts in accordance with dimensions and details as indicated.

**2.4 INSTALLATION**

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Place minimum 100 mm of 25 mm bedding gravel compacted to minimum 95% Modified Proctor density in compliance with ASTM D1557.
- .3 Set all inlet and outlet pipes to specified alignments and elevations.
- .4 Connect concrete pipe into manhole using spigot or bell precast into manhole wall or, alternatively, grout pipe into pre-formed rough core in manhole wall using fast-setting grout.
- .5 Connect PVC pipe into manhole using "manhole adapter ring" or approved equal.
- .6 Ensure excavation free of water and approved by geotechnical engineer prior to placing concrete.
- .7 Set remaining precast riser sections plumb with joints consisting of cement mortar or gasket to ASTM C443.

- .8 Brace capped inlets or stubs to withstand testing head.
- .9 Set frames by firmly embedding in mortar on a minimum of 1, maximum of 3 courses of bricks or precast concrete riser rings, or cast-in-place form system with due regard to maximum distance to first step.
- .10 Plug lifting holes in pipe.
- .11 Ensure frames conform to design contour of pavement or existing surface.
- .12 Clean units of debris and foreign materials.
  - .1 Remove fins and sharp projections.
  - .2 Prevent debris, silt and contaminants from entering system.

## **2.5 ADJUSTING TOPS OF EXISTING UNITS**

- .1 Remove existing gratings, frames and store for re-use at locations designated by the Departmental Representative.
- .2 Precast units:
  - .1 Raise or lower precast units by adding or removing precast sections as required.
  - .2 When amount of raise is less than 300 mm use standard manhole bricks, precast riser rings or cast-in-place form system.
- .3 Re-set gratings and frames to required elevation on not more than 3 courses of brick. Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
- .4 Ensure adjustments conform to requirements regarding distance to first step.

## **2.6 CLEANING**

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General****1.1 SECTION INCLUDES**

- .1 Materials and installation for water mains, hydrants, valves, valve boxes, and valve chambers, including service connections.

**1.2 RELATED SECTIONS**

- .1 Section 31 00 99 –Earthworks for Minor Works.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 01 33 00 – Submittal Procedures.
- .4 Section 01 78 00 – Closeout Submittals.

**1.3 MEASUREMENT PROCEDURES**

- .1 Measure water main including trenching and backfilling, in metres of each size of pipe installed.
  - .1 Horizontal measurement will be made over surface, through valves and fittings, after work has been completed.
  - .2 Measure lateral connections from water main to hydrants as water main and include curb valve and adjustable valve box.
- .2 Measure hydrants including excavation and backfilling, in units installed.
- .3 Measure service connections including trenching and backfilling, in metres of each size of pipe installed.
- .4 Measure valves in units installed including excavation and backfilling, valves and valve boxes and thrust blocks.
- .5 Measure valve chambers including excavation and backfilling, in units installed.
- .6 Measure granular bedding and surround material in cubic metres.
- .7 Measure concrete for bedding, encasement of pipes, supports and thrust blocks in cubic metres.

**1.4 REFERENCES**

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA B300, Hypochlorites.
  - .2 ANSI/AWWA C500, Metal-Seated Gate Valves for Water Supply Service (Includes Addendum C500a-95).
  - .3 ANSI/AWWA C504, Rubber-Seated Butterfly Valves.
  - .4 ANSI/AWWA C651, Disinfecting Water Mains.
  - .5 ANSI/AWWA C800, Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials).
  - .6 ANSI/AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Distribution.



- .2 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
  - .2 ASTM B88M, Standard Specification for Seamless Copper Water Tube [Metric].
  - .3 ASTM C117, Standard Test Method for Material Finer Than 75 [MU] m (No. 200) Sieve in Mineral Aggregates by Washing.
  - .4 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .5 ASTM C478M, Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
  - .6 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m<sup>3</sup>)).
  - .7 ASTM D2310, Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
  - .8 ASTM D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
  - .9 ASTM D2992, Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
  - .10 ASTM D2996, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
  - .11 ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
  - .12 ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
  - .3 CAN/CGSB-1.88, Gloss Alkyd Enamel, Air Drying and Baking.
  - .4 CGSB 41-GP-25M, Pipe, Polyethylene, for the Transport of Liquids.
- .4 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-A257 Series-M92(R1998), Standards for Concrete Pipe.
  - .2 CAN/CSA-A3000-98(April 2001), Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
  - .1 CAN/CSA-A8, Masonry Cement.
  - .3 CSA B137 Series 02, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
    - .1 CSA B137.1, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
    - .2 CSA B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

- .4 CAN/CSA-G30.18-M92(R1998), Billet Steel Bars for Concrete Reinforcement.
- .5 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .5 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .6 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)
- .7 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - March 1998(R2002)
- .8 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S520, Hydrants.
  - .2 CAN4-S543, Internal-Lug, Quick Connect Couplings for Fire Hose.

## **1.5 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform the Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work, in addition to providing samples in accordance with Section 31 00 99 – Earthwork for Minor Works.
- .3 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 4 weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .4 Pipe certification to be on pipe.

## **1.6 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.

## **1.7 SCHEDULING OF WORK**

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to the Departmental Representative for approval and adhere to interruption schedule as approved by the Departmental Representative.
- .3 Notify the Departmental Representative minimum of 48 h in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 h at any one time and schedule this period in consultation with the Departmental Representative.

- .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.
- .6 Provide 300mm x 300mm x 13mm plywood marker sign clearly stencilled "NOT IN SERVICE" on hydrant not in use.

## **Part 2 Products**

### **2.1 PIPE, JOINTS AND FITTINGS**

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900. Pressure class 305, DR 14 unless stated otherwise.
  - .1 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket and/or coupling.
  - .2 Cast iron fittings: to ANSI/AWWA C110/A21.10, and for pipe diameters larger than NPS4 cement mortar lined to ANSI/AWWA C104/A21.4.
- .2 Fittings:
  - .1 All fittings shall be provided with integral tie lugs. Weld on lugs are unacceptable.
  - .2 Flange gaskets shall be 3.175 mm thick manufactured from natural rubber with lead tip and a layer of cotton on both sides.
  - .3 Tie rods, bolts and nuts shall conform to the requirements of ASTM specifications for steel bridges and buildings, serial designation A-7. All bolts shall have American Standard coarse screw threads with a Class 2 free fit. Rolled threads are unacceptable. Joint restraint devices for PCV watermain to be Underwriter Laboratories of Canada (UL) or Factory Mutual (FM) approved.
  - .4 Tie rods as well as thrust blocks shall be used at all directional change fittings; elbows, tees, etc. where the water pipe installation is of PVC (plastic) materials. Pipe joints shall be mechanically restrained / tie-rodged within specified distances of fittings as indicated on drawings.
- .3 Tapping sleeves for branch connectors 75mm and larger:
  - .1 Exterior condition of existing water mains as found in the field may alter type and / or materials.
  - .2 To AWWA C219 for sleeve and gasket materials and generally for design, manufacture and performance.
  - .3 Flanges flat faced conforming to the face dimension and drilling of ANSI B16.1, Class 125. Pressure rating minimum 1723kPa. Flange gaskets as above. Flanges and gaskets also to conform to AWWA C207 and C208 for fabricated steel sleeves. Flange gaskets for use with epoxy coated flanges to be annular ribbed type.
  - .4 Anit-corrosion coating of fabricated carbon steel and ductile iron sleeve assemblies to AWWA C111, stainless steel to ASTM F593 or F738 for bolts and ASTM F594 or F836 for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
  - .5 Ductile iron castings to ASTM A536, grade 65-45-12.

- .6 Branches shall include a threaded test plug 19mm NPS minimum if tapping machine to be used does not have provision for pressure testing.
- .7 Tapping sleeves for cast iron, asbestos cement, PVC to AWWA C900, pre-stressed concrete pressure pipe or steel mains for taps other than size-on-size:
  - .1 Split assembly to incorporate an annular gasket cemented or mechanically held in place on the branch end or split assembly incorporating ring seal and wrap around sleeve length gasket liner.

## 2.2 VALVES, VALVE BOXES, INDICATOR POSTS & SIAMESE CONNECTIONS

- .1 Mainline Valves – General Requirements:
  - .1 Valves to open counter-clockwise
  - .2 All valves to have manufacture's name, year of manufacture, size and working pressure on the bonnet or body.
  - .3 Valves 400 mm and larger to have by-pass sized to AWWA 500.
  - .4 Gate valves 400 mm and larger to have gear operators.
- .2 Mainline Gate valves:
  - .1 To AWWA C500: 75 to 300 mm to working pressure 1380 kPa; 400 mm and larger to working pressure 1035 kPa, gray cast iron or cast ductile iron body, bronze mounted solid wedge, or double disc, non-rising stem, hub or flanged ends.
  - .2 To AWWA C509: 75 to 300 mm to working pressure 1380 kPa; Gray cast iron or ductile iron body resilient seated, non-rising stem, hub or flanged ends.
  - .3 Stem seal to be O-ring type.
  - .4 Valves to be complete with 50 mm square operating nut for underground service.
  - .5 Acceptable products:
    - .1 Domestic service only (for domestic service only):  
75mm and smaller: Crane 438, Grinnell 3000, Kitz 40, Nibco T-113, Red & White 280, or equivalent approved.  
100mm and larger: Terminal City Iron Works 583 or equivalent approved.
    - .2 Fire Service (for combined domestic/fire service or fire service), ULC listed for fire service:  
75mm and smaller: Crane 438, Nibco T-1040 or equivalent approved.  
100mm and larger: Terminal City Iron Works 583; Darling 55FM or equivalent approved.
- .3 Mainline butterfly valves: **(NOT REQUIRED FOR THIS CONTRACT)**
  - .1 Butterfly valves: to AWWA C504 Class 150B.
- .4 Mainline Valve Boxes:
  - .1 All valves shall be fitted with minimum 135mm Nelson type cast iron valve box with cap on section of cast or ductile iron pipe down to the valve with a hub of the pipe over the valve.

- .2 Provide a 20mm dia proprietary valve stem extension with centering disc and 50mm square top nut. Base of extension to have suitable socket to fit over and pin to valve nut. Length of stem extension to be sufficient that top of extension is within 150mm of finished surface.
- .3 For valve boxes not in concrete or asphalt paved areas, centre valve boxes in 600mm x 600mm x 230mm concrete block set flush with finished grade.
- .5 Check Valves: **(NOT REQUIRED FOR THIS CONTRACT)**
  - .1 To AWWA C508: 50 to 300 mm to working pressure 1200 kPa; 400 to 500 mm to working pressure 1035 kPa; gray cast iron or ductile cast iron body, clear waterway type, metal to metal seat, mechanical joint ends to AWWA C111 or flanged ends to AWWA C110.
- .6 Indicator Posts: **(NOT REQUIRED FOR THIS CONTRACT)**
  - 1. Adjustable indicator post with built in 450 mm [18"] adjustable span with Schedule 80 lower barrel.
  - .2 Factory Mutual listed.
  - .3 Mueller model A-20800 adjustable type indicator post, and Mueller model A-20815 extension section and stem, or equivalent approved, as required.
- .7 Siamese Connections:
  - .1 Refer to Mechanical Engineer's Drawings.
  - .2 Free standing sidewalk siamese fire department connections.
  - .3 Brass escutcheon plate, polished brass pipe sleeve, 90 degree single clapper brass siamese connection, swivels, brass plugs and chains.
  - .4 Size: 64 mm x 64 mm x 100 mm siamese with a 600 mm overall height.
  - .5 Acceptable Products: National Fire Equipment model 207, or equivalent approved.

### 2.3 FIRE HYDRANTS

- .1 Compression dry-barrel hydrant type with two hose nozzles and one pumper nozzle, ULC listed and conforming to AWWA C502-85.
- .2 Hose and pumper nozzle threads, operating nut and cap nut shall conform to the standards of CSC, PWGSC and the local fire fighting authority.
- .3 Red enamel finish paint color.
- .4 Acceptable Products: Terminal City C71-P, Clow, Mueller, or equivalent approved.
- .5 Provide 300mm x 300mm x 13mm plywood marker sign clearly stencilled "NOT IN SERVICE" on hydrant not in use.

### 2.4 SERVICE CONNECTIONS (NOT REQUIRED IN THIS CONTRACT)

- .1 Copper tubing: to ASTM B88M type K, annealed.
- .2 Polyvinyl chloride pressure pipe: to CSA-B137.3, type 1120 series 160 1.1 MPa.
- .3 PVC joints: solvent welded in accordance with manufacturer's specifications.
- .4 Brass corporation stops: per District of Mission standards.

- .5 Brass inverted key-type curb stops: per District of Mission standards.
  - .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".
- .6 Service connections for PVC pipe:
  - .1 Service connections less than 100 mm: Corporation stop, 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 100 mm and over: Use tee fitting or tapping valve and sleeve.
- .7 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 C80.
- .8 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.

## **2.5 PIPE BEDDING AND SURROUND MATERIAL**

- .1 Pipe bedding and surround material per Section 31 00 99 – Earthwork for Minor Works.
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

## **2.6 BACKFILL MATERIAL**

- .1 Backfill material per Section 31 00 99 – Earthwork for Minor Works.

## **2.7 PIPE DISINFECTION**

- .1 Sodium hypochlorite to ANSI/AWWA B300 to disinfect water mains.
- .2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

## **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.

### **3.2 TRENCHING**

- .1 Do trenching work in accordance with Section 31 00 99 – Earthwork for Minor Works.
- .2 Trench depth to provide cover of not less than 1.2m from finished grade.

- .3 Trench alignment and depth require the Departmental Representative's 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 Where concrete encasement of pipes is required, trench to be trimmed to accept minimum 150mm concrete surround.
- .3 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation during concrete placement.
- .4 Do not backfill over concrete within 24 hours of placing.
- .5 Pipe joints to be spaced so that encased section of pipe does not span across joints or extend to within 300mm of joints.

### **3.4 GRANULAR BEDDING**

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .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% of corrected maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 00 99 – Earthwork for Minor Works.

### **3.5 PIPE INSTALLATION**

- .1 Lay pipes to ANSI/AWWA C600 and manufacturer's standard instructions and specifications. Do not use blocks except as specified / permitted elsewhere in contract documents.
- .2 Join pipes in accordance with ANSI/AWWA C600 and 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 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
  - .2 Take up and replace defective pipe.
  - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

- .8 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.
- .9 Position and join pipes with equipment and methods approved by the Departmental Representative.
- .10 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.
- .11 Align pipes before jointing.
- .12 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.
- .13 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.
- .14 Complete each joint before laying next length of pipe.
- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Departmental Representative.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Do hydrostatic and leakage test and have results approved by the Departmental Representative before surrounding and covering joints and fittings with granular material.
- .22 Backfill remainder of trench.

### **3.6 VALVE INSTALLATION**

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.
- .3 Install valve boxes or indicator posts on all valves.

### **3.7 SERVICE CONNECTIONS (NOT REQUIRED IN THIS CONTRACT)**

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main.



- .1 Install coupling necessary for connection to building plumbing.
- .2 If plumbing is already installed, make connection, otherwise 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 water main.
- .3 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 for PVC-C900 pipe to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .4 Maximum dried direct tappings (mm) for ductile iron pipe to conform to:

Nominal Pipe Size (mm)	Pressure Class/Max.				
	150	200	250	300	350
75	-	-	-	-	19
102	-	-	-	-	19
152	-	-	-	-	25
203	-	-	-	-	25
254	-	-	-	-	25
305	-	-	-	-	32
356	-	-	32	38	38
406	-	-	38	50	50
457	-	-	50	50	50
508	-	-	50	50	50
610	-	50	50	50	50
762	50	50	50	50	50

- .5 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .6 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .7 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .8 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300 mm apart along pipe.
- .9 Leave corporation stop valves fully open.
- .10 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .11 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.

- .12 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.
- .13 Place temporary location marker at ends of plugged or capped unconnected water lines.
  - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
  - .2 Paint exposed portion of stake blue with designation "WATER SERVICE LINE" in black.

### 3.8 FIRE HYDRANTS

- .1 Install fire hydrants with isolation valves at locations indicated on the drawings.
- .2 Fire hydrant installations shall be provided with thrust blocks and tie rods. Typically provide a thrust block at the tee on the main to the hydrant, at the hydrant isolation valve and at the hydrant boot. Provide 25mm diameter tie-rods between tees and valves and between valves and hydrants
- .3 Set fire hydrants plumb, with hose outlets parallel with the edge of the pavement or curb line.
- .4 To provide proper drainage for each hydrant standpipe, excavate a pit measuring not less than 1.0 x 1.0 x 0.5 m deep and backfill with drain rock (as specified elsewhere for soakaways) to a level 150 mm above the hydrant drain holes. Hydrant boot to rest on 100 x 300 x 300 mm precast concrete blocks bedded on a minimum of 300 mm of previously stated drain rock in previously stated pit. Generally comply with Master Municipal Construction Document 2000 Standard Drawing W4.

### 3.9 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete. Place heavy gauge polythene sheet between pipe fitting and concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed firm bearing soil or as directed by the Departmental Representative.
- .3 Valves shall be anchored to a block of concrete.
- .4 Anchors that restrain upward forces or forces in a direction in which no suitable undisturbed bearing surface is available shall consist of inverted U-bars at the joint being restrained set in the concrete of the thrust block. Thrust blocks in this application shall be of that mass or weight required to restrain the forces involved.
- .5 Keep joints and couplings free of concrete.

- .6 Minimum size of thrust blocks shall be as follows:

<b>Largest Pipe Size at thrust location</b>	<b>Dead Ends, Tees and Wet-Tap connections</b>	<b>90° Bends</b>	<b>45° Bends</b>	<b>22.5° Bends</b>
100 mm	0.36 m2	0.36 m2	0.27 m2	0.18 m2
150 mm	0.54 m2	0.63 m2	0.36 m2	0.36 m2
200 mm	0.72 m2	0.81 m2	0.54 m2	0.54 m2
250 mm	1.08 m2	1.62 m2	0.90 m2	0.72 m2
300 mm	1.62 m2	2.40 m2	1.26 m2	1.08 m2

- .7 Do not backfill over concrete within 24 hours after placing.
- .8 For restrained joints: only use restrained joints approved by the Departmental Representative.

### 3.10 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600 [C603].
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify the Departmental Representative at least 48 hours in advance of proposed tests.
- .1 Perform tests in presence of the Departmental Representative.
- .4 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.
- .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by the Departmental Representative.
- .6 Upon completion of pipe laying and after the Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
- .7 Leave hydrants, valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 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.
- .12 Fill asbestos cement pipe and concrete pipe at least 24 hours before testing to allow water absorption by pipe material.
- .13 Thoroughly examine exposed parts and correct for leakage as necessary.

- .14 Apply hydrostatic test pressure of 1725 kPa [250 psi] 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 Apply leakage test pressure of 690 kPa after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of [2] hours.
- .19 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 hours.
- .20 Do not exceed allowable leakage of 1.079 L/day/km/mm of pipe, including lateral connections.
- .21 Locate and repair defects if leakage is greater than amount specified.
- .22 Repeat test until leakage is within specified allowance for full length of water main.

### **3.11 PIPE SURROUND**

- .1 Upon completion of pipe laying and after the Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
  - .1 Do not dump material within 2 m of pipe.
- .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% of corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% of corrected maximum dry density.

### **3.12 BACKFILL**

- .1 Backfill and compact per Section 31 00 99 – Earthworks for Minor Works.

### **3.13 FLUSHING AND DISINFECTING**

- .1 Flushing and disinfecting operations: witnessed by the Departmental Representative carried out by specialist contractor.
  - .1 Notify the Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains 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.

**.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 the Departmental Representative approval, introduce strong solution of chlorine as approved by the Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7** Disinfect water mains to AWWA C651-86. This shall be done by a specialist contractor OR the contractor shall perform the treatment process under the supervision of an agency fully qualified in this work. A report shall be submitted outlining the treatment parameters upon completion of the water treatment. Pot type feeders shall be used on closed systems; and pump type feeders (with attendant agitators, level controls, etc.) shall be used in open systems. Ensure that chlorine disinfectant does not enter existing watermains during the disinfection procedures.
- .8** Rate of chlorine application to be proportional to rate of water entering pipe.
- .9** Chlorine application to be close to point of filling water main and to occur at same time.
- .10** Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .11** Flush line to remove chlorine solution after 24 hours.
- .12** Measure chlorine residuals at extreme end of pipe-line being tested.
- .13** Perform bacteriological tests on water main, after chlorine solution has been flushed out.
  - .1** Take samples daily for minimum of two 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. Take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

**3.14 TAPPING SLEEVE INSTALLATION**

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

**3.15 SURFACE RESTORATION**

- .1 After installing and backfilling over water mains, restore surface as specified elsewhere.

**END OF SECTION**

**Part 1 General****1.1 SECTION INCLUDES**

- .1 Materials and installation for gravity sewers.

**1.2 RELATED SECTIONS**

- .1 Earthwork for Minor Works Section 31 00 99
- .2 Manholes and Catch Basin Structures Section 33 05 13

**1.3 MEASUREMENT PROCEDURES**

- .1 Measure excavation and backfill requirements as shown on Contract Drawings.
- .2 Measure supply and installation of sewer including testing and including excavation and backfilling and granular bedding and surround horizontally from manhole face to manhole face in metres of each pipe size and depth class installed.
- .3 Measure concrete bedding and encasement of pipes in cubic metres in place.
- .4 Measure granular bedding and surround in cubic metres compacted in place.

**1.4 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - .2 ASTM D2412, Standard Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.
  - .3 ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
  - .4 ASTM F477, Specification for Elastomeric Seals (Gaskets) for joining Plastic Pipe.
  - .5 ASTM D1557, Specification for Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 kg) Rammer and 18 inch (475 mm) Drop.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B182.2, Large Diameter, Type PSM PVC Sewer Pipe and Fittings.
  - .2 CSA B182.11, Recommended Practice for the Installation of Plastic Drain and Sewer Pipe and Pipe Fittings.

**1.5 DEFINITIONS**

- .1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

**1.6 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate proposed method for installing carrier pipe for undercrossings.

- .3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Inform the Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling, in addition to providing samples as referred to in Section 31 00 99 – Earthwork for Minor Works.
- .5 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .6 Ensure certification is marked on pipe.
- .7 Submit manufacturers information data sheets and instructions in accordance with Section 01 33 00 - Submittal Procedures.

## **1.7 SCHEDULING**

- .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
- .3 Notify the Departmental Representative 24 hours minimum in advance of any interruption in service.

## **Part 2 Products**

### **2.1 PLASTIC PIPE**

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2.
  - .1 Standard Dimensional Ratio (SDR): 35.
  - .2 Locked-in or Separate gasket and integral bell system.
  - .3 Nominal lengths: 6 m.

### **2.2 SERVICE CONNECTIONS**

- .1 Type PSM Poly (Vinyl) Chloride: to CSA-B182.2.

### **2.3 CEMENT MORTAR**

- .1 Portland cement: to CAN/CSA-A5
- .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
  - .1 Add only sufficient water after mixing to give optimum consistency for placement.
  - .2 Do not use additives.

### **2.4 PIPE BEDDING AND SURROUND MATERIALS**

- .1 Grading requirements for granular pipe bedding are as per Section 31 00 99 articles 2.1.1, 2.1.2 and 2.1.4 (type 1 gradation).
- .2 Concrete encasement, where noted on drawings, to be minimum 20MPa, with constituent materials in conformance to CAN/CSA-A5, A23.5 and A23.1.



**2.5 BACKFILL MATERIAL**

- .1 As per Section 31 00 99 item 2.1 (applicable articles).

**Part 3 Execution****3.1 PREPARATION**

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of the Department Representative.

**3.2 TRENCHING**

- .1 Do not allow contents of sewer or sewer connection to flow into trench.
- .2 Trench alignment and depth as shown on Contract Drawings.
- .3 Water jetting of backfill under haunches of corrugated steel pipe may be permitted if recommended by manufacturer and approved by the Department Representative.

**3.3 GRANULAR BEDDING**

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in a uniform layer not exceeding 150 mm compacted thickness, surround material compacted with a hand compactor.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Compact each layer full width of bed to minimum 95% Modified Proctor Density in compliance with ASTM D1557.
- .5 Shape transverse depressions as required to suit joints.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

**3.4 INSTALLATION**

- .1 Handle pipe in accordance with manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.
- .2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. PVC pipe to CSA B182.11.
- .3 Install Pipes to the following tolerances:
  - Horizontal tolerances: plus or minus 50 mm from specified alignment;
  - Vertical tolerances: plus or minus 10 mm from specified grade. Reverse grade is not acceptable.
- .4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

- .6 Pipes on curved alignments:
  - .1 Smooth profile PVC pipe: for 100 mm to 300 mm sizes conform to required curvature by bending pipe barrel. In no case is radius of curvature to be less than 300 times outside diameter of the barrel. Joint deflection not permitted for smooth profile PVC pipe.
- .7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Whenever work is stopped, install removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.
- .8 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe and leave smooth end at right angles to axis of pipe.
- .9 Joints:
  - .1 Install gaskets as recommended by manufacturer on all pipe unless specified otherwise.
  - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .3 Align pipes carefully before joining.
  - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
  - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
  - .6 Complete each joint before laying next length of pipe.
  - .7 Minimize joint deflection after joint has been made to avoid joint damage.
  - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes of as otherwise specified.
- .11 When any stoppage of work occurs, restrain pipes in an approved manner to prevent "creep" during down time.
- .12 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available. Core neat circular holes in walls of existing manholes. Do not hammer or chip except as approved by the Department Representative.
- .13 Where concrete encasement of pipes is noted on drawings, trench to be trimmed to accept minimum 150mm concrete surround. Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation during concrete placement. Do not backfill over concrete within 24 hours of placing. Pipe joints to be spaced so that encased section of pipe does not span across joints or extend to within 300mm of joints.

### 3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.

**Abbotsford, BC – Fraser Valley Institution  
New 20-Person Living Unit**

- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
  - .1 Do not dump material within 1 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to underside of pipe to at least 95 % Modified Proctor
- .6 Surround material should be compacted with a hand compactor.

**3.6 BACKFILL**

- .1 Place unfrozen backfill material in accordance with Section 31 00 99 article 3.4.

**3.7 FIELD TESTING**

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 After substantially completing backfilling and compaction work, carry out leakage test of each section by means of low pressure air test in the presence of Departmental Representative, as follows:
  - .1 Wet inside perimeter of test section.
  - .2 Seal test section at openings by means of removable water-tight plugs.
  - .3 Increase pressure in test-section to 24kPa above average groundwater pressure and observe rate of drop.
  - .4 Maintain 25kPa above average groundwater pressure for at least 5 minutes before commencing test. (Do not exceed 35kPa above average groundwater pressure).
  - .5 Commence test when pressure decreases to 24.0kPa above average groundwater pressure. Do not add air to test section during test period. The sewer shall be deemed to have failed the test if the test period is less than:
    - .1 2 minutes and 32 seconds for 100mm pipe.
    - .2 3 minutes and 50 seconds for 150mm pipe.
    - .3 5 minutes and 6 seconds for 200mm pipe.
    - .4 6 minutes and 22 seconds for 250mm pipe.
    - .5 7 minutes and 39 seconds for 300mm pipe.
    - .6 8 minutes and 56 seconds for 350mm pipe.
    - .7 9 minutes and 35 seconds for 375mm pipe.
  - .6 In the case of test failure, repair leaks and repeat low pressure air testing.
  - .7 As the Departmental Representative will not witness the low pressure air test until after backfilling, the contractor is encouraged to check air-tightness regularly throughout pipe-laying and backfilling and to address any leakage issues early. This should minimize the potential for test failure when the witnessed test is done.
- .3 Acceptable Ponding: Mainline PVC sewers; 300 mm diameter or less: 20 mm maximum ponding over 3m length of pipeline.
- .4 Remove foreign material from sewers and related appurtenances by flushing with water.
- .5 Television and photographic inspections:

- .1 Immediately after flushing, carry out inspection of installed sewers by television camera and provide the Departmental Representative with two copies of inspection report and DVD recorded, logged and produced to WRc inspection and coding standards.
- .2 Provide means of access to permit Departmental Representative to do inspections.

**END OF SECTION**

**Part 1 General****1.1 SECTION INCLUDES**

- .1 Materials and installation for storm sewer.

**1.2 RELATED SECTIONS**

- .1 Earthwork For Minor Works Section 31 00 99
- .2 Manholes and Catch Basin Structures Section 33 05 13

**1.3 MEASUREMENT PROCEDURES**

- .1 Measure supply and installation of sewer including testing and including excavation and backfilling and granular bedding and surround horizontally from manhole face to manhole face in metres of each pipe size and depth class installed.
- .2 Measure concrete bedding and encasement of pipes in cubic metres in place.
- .3 Measure granular bedding and surround in cubic metres compacted in place.

**1.4 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - .2 ASTM D2412, Standard Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.
  - .3 ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
  - .4 ASTM F477, Specification for Elastomeric Seals (Gaskets) for joining Plastic Pipe.
  - .5 ASTM D1557, Specification for Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 kg) Rammer and 18 inch (475 mm) Drop.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B182.2, Large Diameter, Type PSM PVC Sewer Pipe and Fittings.
  - .2 CSA B182.11, Recommended Practice for the Installation of Plastic Drain and Sewer Pipe and Pipe Fittings.

**1.5 DEFINITIONS**

- .1 A pipe section is defined as length of pipe between successive catchbasins and/or manholes.

**1.6 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate proposed method for installing carrier pipe for undercrossings.

- .3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Inform the Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling, in addition to providing samples as referred to in Section 31 00 99 – Earthwork for Minor Works.
- .5 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .6 Ensure certification is marked on pipe.
- .7 Submit manufacturers information data sheets and instructions in accordance with Section 01 33 00 - Submittal Procedures.

## 1.7 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

## Part 2 Products

### 2.1 PLASTIC PIPE

- .1 Polyvinyl chloride pipe up to 1200 mm in diameter, DR35 Pipe to have minimum pipe stiffness (F/Y) of 320 kPa at 5.0% deflection, ASTM D2412. Pipe to be manufactured to specifications for pipe size ranges as follows:
  - 100 mm dia. – 375mm dia. To ASTM D3034
  - Pipes to be certified by Canadian Standards Association to standards for pipe size ranges below.
  - 100 mm dia. – 1200 mm dia. To CSA B182.2
- .2 Joints: To conform to ASTM D3212; pipe to include integral bell and spigot ends with stiffened wall section and formed groove for a rubber gasket; elastomeric gaskets to ASTM F477.
- .3 Maximum installed deflection not to exceed 7.5% of the base inside diameter.

### 2.2 PIPE BEDDING AND SURROUND MATERIAL

- .1 Grading requirements for granular pipe bedding are as per Section 31 00 99 articles 2.1.1, 2.1.2 and 2.1.4 (type 1 gradation).

### 2.3 BACKFILL MATERIAL

- .1 As per Section 31 00 99 item 2.1 (applicable articles).

## Part 3 Execution

### 3.1 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Department Representative.

**3.2 TRENCHING**

- .1 Do not allow contents of sewer or sewer connection to flow into trench.
- .2 Trench alignment and depth as shown on Contract Drawings.
- .3 Water jetting of backfill under haunches of corrugated steel pipe may be permitted if recommended by manufacturer and approved by the Department Representative.

**3.3 GRANULAR BEDDING**

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in a uniform layer not exceeding 150 mm compacted thickness, surround material compacted with a hand compactor.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Compact each layer full width of bed to minimum 95% Modified Proctor Density in compliance with ASTM D1557.
- .5 Shape transverse depressions as required to suit joints.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

**3.4 INSTALLATION**

- .1 Handle pipe in accordance with manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.
- .2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. PVC pipe to CSA B182.11.
- .3 Install Pipes to the following tolerances:
  - Horizontal tolerances: plus or minus 50 mm from specified alignment;
  - Vertical tolerances: plus or minus 10 mm from specified grade. Reverse grade is not acceptable.
- .4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Pipes on curved alignments:
  - .1 Smooth profile PVC pipe: for 100 mm to 300 mm sizes conform to required curvature by bending pipe barrel. In no case is radius of curvature to be less than 300 times outside diameter of the barrel. Joint deflection not permitted for smooth profile PVC pipe.
- .7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Whenever work is stopped, install removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.
- .8 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe and leave smooth end at right angles to axis of pipe.

- .9 Joints:
  - .1 Install gaskets as recommended by manufacturer on all pipe unless specified otherwise.
  - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .3 Align pipes carefully before joining.
  - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
  - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
  - .6 Complete each joint before laying next length of pipe.
  - .7 Minimize joint deflection after joint has been made to avoid joint damage.
  - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise specified.
- .11 When any stoppage of work occurs, restrain pipes in an approved manner to prevent "creep" during down time.
- .12 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available. Core neat circular holes in walls of existing manholes. Do not hammer or chip except as approved by the Department Representative.

### 3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
  - .1 Do not dump material within 1 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to underside of pipe to at least 95 % Modified Proctor
- .6 Surround material should be compacted with a hand compactor.

### 3.6 BACKFILL

- .1 Place backfill material in unfrozen condition and in accordance with Section 31 00 99 article 3.4.

### 3.7 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Acceptable Ponding: Mainline PVC sewers; 300 mm diameter or less; 20 mm maximum ponding over 3m length of pipeline.



- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Flushings to be vacuum pumped for disposal offsite to prevent foreign material, silts etc., from entering interceptors, filter chambers and soakaways. Offsite disposal to comply with environmental legislation / bylaws.
- .5 Television and photographic inspections:
  - .1 Immediately after flushing, carry out inspection of installed sewers by television camera and provide the Departmental Representative with two copies of an inspection report and DVD recorded, logged and produced to WRc inspection and coding standards.
  - .2 Provide means of access to permit Departmental Representative to do inspections.

**END OF SECTION**

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 31
- .2 Section 26 05 00 – Common Work
- .3 Section 26 05 28 - Grounding
- .4 Section 26 05 21 – Wire and Cables 0-1000V
- .5 Section 26 05 34 – Conduits, Tray, Wireways, Outlet Boxes & Fittings

**1.2 SUSTAINABLE REQUIREMENTS**

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

**1.3 REGULATORY REQUIREMENTS**

- .1 Coordinate and meet requirements of power supply authority. Ensure availability of power when required.

**1.4 SCOPE OF WORK**

- .1 Provide a complete system of underground conduits for the distribution of electric power, communication, electronic safety and security, and cable TV service.
- .2 Provide electrical services to site and landscape lighting.
- .3 Provide electrical services to miscellaneous equipment as detailed.
- .4 Provide all utility requirements.
- .5 Provide underground ducts, protection and encasements as indicated on drawings.
- .6 Conduit for site lighting and receptacles is drawn diagrammatically. Conduit to be routed in an orderly manner and where practical, shall maintain a minimum of 3m clear of existing vegetation as indicated on Landscape drawings.
- .7 Underground conduit and duct routing location to be clearly documented on the 'Record Drawings' with set back dimensions from key fixed points.

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**2 PRODUCTS**

**2.1 PVC DUCTS**

- .1 Main power and communication ducting to CSA C22.2 No. 211.1 M1984, Rigid type DB2 PVC conduit. Direct burial with cable marker above.
- .2 Concrete encased ducting where indicated to CSA C22.2 No. 211.1 M1984.
- .3 PVC underground telecommunication cable ducting: to CSA B196.3-1975.
- .4 Plastic underground power cable ducting: to CSA B196.1-1972.
- .5 Subcircuit ducting, (sub feeds and parking lot lighting, etc.) to be rigid PVC bedded in sand with cable marker above. Minimum depth of burial to be in accordance with code.

**2.2 PVC DUCT FITTINGS**

- .1 Rigid PVC solvent welded type couplings, bell end fittings, plugs, caps, adapters as required to provide a complete installation.
- .2 Expansion joints as required.
- .3 Rigid PVC 5 degree angle couplings as required.

**2.3 CABLE PULLING EQUIPMENT**

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

**2.4 CABLE MARKERS**

- .1 Yellow PVC, sized to suit full width of trench marked "DANGER - BURIED ELECTRICAL SERVICE"

**2.5 DUCT SPACERS**

- .1 Provide approved PVC duct spacers to maintain horizontal and vertical separation.

**2.6 SITE LIGHTING**

- .1 Refer to Lighting Fixture Schedule (Appendix A).
- .2 Provide all anchor bolts, poles and base plates.

**2.7 PULLBOXES FOR SUB DISTRIBUTION**

- .1 Provide 300mm[12"] x 500mm[20"] x 500[20"] deep sub distribution precast concrete junction boxes for site sub distribution and lighting, complete with galvanized chequer plate covers.

- .2 All junction boxes shall have open bottoms for the distribution wiring raceways to enter from below. Knockouts in the walls shall provide access for conduits to enter from the side.

## **2.8 CONCRETE ENCASEMENTS**

- .1 Concrete mixture to use screened 13 mm maximum water washed gravel. Concrete shall have 176 kg/cm<sup>2</sup> (2500 psi) compressive strength at twenty-eight (28) days. Bends and offsets shall be minimum 900 mm radius. Suitable factory made spacers, of cast concrete or plastic, shall be installed at 1200 mm maximum intervals, to maintain a clear spacing as shown between ducts for the concrete. Stain top of concrete duct by mixing red staining agents into top 25mm of the concrete.
- .2 Ducts and spacers shall be securely braced to prevent duct from floating when concrete is placed.
- .3 Care shall be taken to ensure that joints are watertight and concrete is vibrated between and under ducts. Water leaks through the duct bank shall be treated and duct bank repaired in a satisfactory manner.
- .4 Ducts shall be terminated with bell-end fittings.
- .5 Provide drainage openings at lowest point of duct run and tie into site drainage system.

## **3 EXECUTION**

### **3.1 UTILITY SERVICES**

- .1 The electrical and telephone services will be underground to the Electrical Room and telephone room as noted on plans.
- .2 Coordinate the work with the City of Abbotsford and BC Hydro for the provision of main services.
- .3 Provide CT metering cabinet, install meter socket, wiring and conduit.
- .4 Make grounding connections in accordance with Section 26 05 28 – Grounding and Bonding.

### **3.2 SITE & LANDSCAPE LIGHTING**

- .1 Install all site lighting and pull boxes. Coordinate concrete base installation. Mark out all trenches.
- .2 Precast concrete sub distribution junction boxes shall be installed flush with finished grade and shall be set on a 50 mm bed of coarse gravel.

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### **3.3 DUCT INSTALLATION**

- .1 Install duct as indicated and to manufacturer's instructions.
- .2 Clean inside of ducts before laying.
- .3 Ensure full, even support every 1.2 m throughout duct length.
- .4 Slope ducts to indicate inverts with 1 to 200 minimum slopes.
- .5 Provide drainage from lowest point of duct run and drain all ducts into the site drainage system.
- .6 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .7 Pull through each duct a mandrel not less than 300 mm long and of a diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .8 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .9 In no case shall the concrete envelope of duct banks be laid within 150 mm of any water, sewer or gas distribution pipes unless approved by Consultant.
- .10 A 300 mm minimum separation of well tamped material, must be maintained between different direct buried services.
- .11 Care shall be taken not to alter or remove, without consent of the owner or authority, any structure crossing or running parallel to the excavation.
- .12 Provide concrete reinforcement to any bends or off-sets for underground ductwork systems where direct burial of ducts are permitted.
- .13 Provide duct drains for utility ducts as required by the Utility standards.

### **3.4 EXISTING UNDERGROUND SERVICES**

- .1 Protect all existing services encountered.
- .2 Before starting the trenching, locate and expose any utility lines crossing the duct route and ensure that these lines are not damaged in the course of trenching operations. The Contractor is responsible for all damage caused by negligence.
- .3 Provide temporary bridges for the passage of traffic over any trenches where necessary. Provide temporary crossings at walkways in order to maintain all existing access ways and provide barriers, signs and lights as required.

### **3.5 EXCAVATION AND BACKFILLING**

- .1 Coordinate all excavation, sand levelling and bedding ready for the electrical installation. Level all trenches for underground conduit and duct lines with a 75mm layer of screened sand.
- .2 Conduit not encased in concrete to be bedded in screened sand and covered by a second 150mm layer of compacted screened sand. Provide warning tape above the buried sections of conduit or cable.
- .3 Supervise all backfilling of electrical services and underground conduit runs.

END OF SECTION

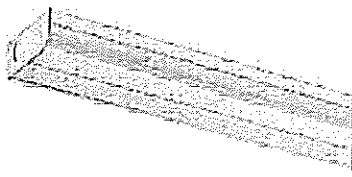
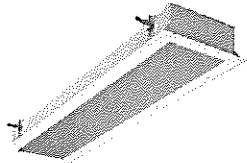
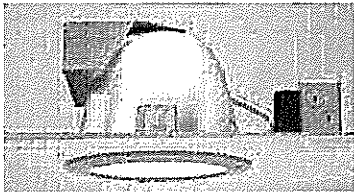
## APPENDIX A

### Lighting Fixture Schedule

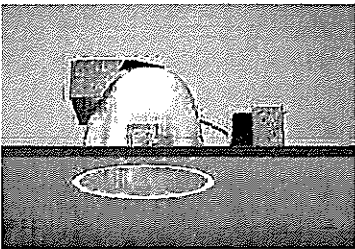
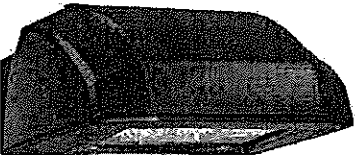
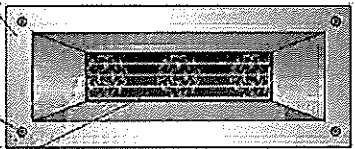

## LIGHTING FIXTURE SCHEDULE

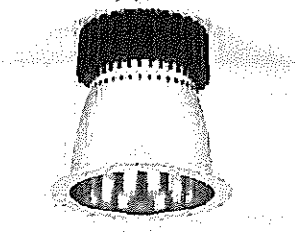
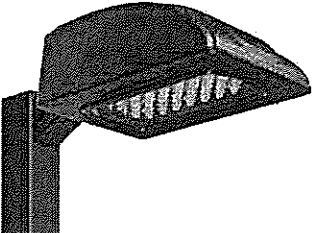

### General Notes:

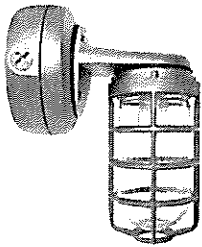
- All lighting fixtures shall meet the general requirements as specified in Section 26 50 00
- Manufacturers catalogue numbers must be verified with the luminaire description and confirmed with the vendor

Type	Detail	Description
A		<b>Under Shelf Task Luminaire</b> 62mm W x 27mmH x 1174mm L <i>Rating:</i> Interior, Dry Location <i>Lens:</i> Ribbed white opal acrylic <i>Housing:</i> Die-formed code gauge cold rolled steel. White baked enamel finish <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> One 28W, T5, 4100°K fluorescent lamp <b>Acceptable Product or Approved Equal:</b> <b>Lightolier TSL4128UNVPG-H-CO</b>
B		<b>Recessed Hard Ceiling Luminaire</b> 305mm W x 140mm H x 1220mm L <i>Rating:</i> Interior, Dry Location, Vandal Resistant <i>Lens:</i> Polycarbonate with pattern 12, 0.1875" nominal <i>Housing:</i> 14 gauge steel with baked acrylic enamel paint, overlapped and welded corners, 14 gauge steel double door frame secured by up to 4 TORX screws. Door frame comes complete with piano hinge <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamps and one 3W LED night light <b>Acceptable Product or Approved Equal:</b> <b>CFI RVX1FXDU228-UNVPG-NL3LED</b>
C		<b>Recessed Hard Ceiling Downlight Luminaire</b> 229mm D x 229mm H <i>Rating:</i> Interior, Dry/Wet Location, Vandal Resistant <i>Lens:</i> Flat polycarbonate lens <i>Housing:</i> Die cast aluminum <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Efficiency:</i> 43% <i>Lamp Loading:</i> Two 42W TTT, 4100°K compact fluorescent lamp <b>Acceptable Product or Approved Equal:</b> <b>Lightolier 8098VWH-8242HUV</b>



D		<p><b>Recessed Gird Ceiling Downlight Luminaire</b>          219mm D x 203mm H  <i>Rating:</i> Interior, Dry Location  <i>Reflector:</i> 16 gauge specular aluminium, clear low iridescence finish, self-flanged white trim  <i>Housing:</i> Die cast aluminum  <i>Ballast:</i> Instant start  <i>Input Power:</i> 120V  <i>Efficiency:</i> 72%  <i>Lamp Loading:</i> Two 26W TTT, 4100°K compact fluorescent lamp  <b>Acceptable Product or Approved Equal:</b>  <b>Lightolier 8038CCDW-S8242HUV</b></p>
F		<p><b>Exterior Wall Mounted Luminaire</b>  <i>Rating:</i> Exterior  <i>Lens:</i> Clear Glass  <i>Distribution:</i> Type 2, Full Cut-Off  <i>Housing:</i> Heavy duty die-cast aluminium with electrostatic powder coated black finish  <i>Driver:</i> Electronic LED Class 2, THD &lt; 20%, High Power Factor, Operating Temperature -40C to 50C  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 100W, 4000°K White LEDs, 4000 Lumens  <b>Acceptable Product or Approved Equal:</b>  <b>Keene NXFP-L-30-X-2-LED-A2-1-B</b></p>
G		<p><b>Recessed Wall Luminaire</b>          205mm W x 85mm H x 120mm D  <i>Rating:</i> Interior, Dry Location, Vandal Resistant  <i>Housing:</i> Die-cast Aluminium  <i>Lens:</i> 4mm Thick Toughened Glass  <i>Ballast:</i> Integral Electronic Power Supply  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> Three 1.2W CREE LEDs  <b>Acceptable Product or Approved Equal:</b>  <b>Sisternalux S.4679-SPS001535</b></p>
H		<p><b>Recessed Grid Ceiling Luminaire</b>          610mm W x 127mm H x 1220mm L  <i>Rating:</i> Interior, Dry Location  <i>Lens:</i> Pattern 12 prismatic virgin acrylic  <i>Housing:</i> Steel with baked acrylic enamel paint (86% reflectance), one piece embossed, flat steel door, mitered lens frames, flange and trim, spring loaded latches  <i>Ballast:</i> Instant Start Electronic  <i>Input Power:</i> 120V  <i>Efficiency:</i> 81%  <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamps  <b>Acceptable Product or Approved Equal:</b>  <b>CFI SPS2GFSVA228UNVPG</b></p>

J		<p><b>Recessed Gird Ceiling Downlight Luminaire</b>            131mm D x 153mm H  <i>Rating:</i> Interior, Dry Location  <i>Reflector:</i> 18 gauge specular aluminium, clear low iridescence finish, self-flanged white trim  <i>Housing:</i> Die cast aluminum  <i>Electronic Driver:</i> Overload and short circuit protected, thermal regulation against overheating, sound rating 'A'  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 16 high brightness royal blue LED array, 4000°K  <i>Dimmer:</i> Lutron Diva. Model No.: DVELV-300P  <b>Acceptable Product or Approved Equal:</b>  <b>Calculite C4L10N1-40K-CL-W</b></p>
P1		<p><b>Pole Mounted Luminaire</b>  <i>Rating:</i> Exterior, Wet Location  <i>Housing:</i> Painted Aluminium  <i>Reflector:</i> Clear Specular Alzak  <i>Lens:</i> Tempered Class  <i>Distribution:</i> Type 2  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 100W, 4000°K White LEDs, 4500 Lumens  <i>Pole:</i> 4500mm  <b>Acceptable Product or Approved Equal:</b>  <b>NXEL-B-45-40-X-2-LED-A2-1-B</b></p>
P2	Twin Head Version of Type P1	<p><b>Pole Mounted LED Luminaire</b>  <i>Rating:</i> Exterior, Wet Location  <i>Housing:</i> Painted Aluminium  <i>Reflector:</i> Clear Specular Alzak  <i>Lens:</i> Tempered Class  <i>Distribution:</i> Type 2  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 100W, 4000°K White LEDs, 4500 Lumens  <i>Pole:</i> 4500mm  <b>Acceptable Product or Approved Equal:</b>  <b>NXEL-B-45-40-X-2-LED-A2-1-B</b></p>
S		<p><b>Suspended Fluorescent Luminaire</b>            273mm W x 1220mm L  <i>Rating:</i> Interior, Damp Location  <i>Housing:</i> Injection moulded plastic. sealed  <i>Ballast:</i> Instant Start Electronic  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamp  <b>Acceptable Product or Approved Equal:</b>  <b>CFI VTN4228STUNVPG</b></p>

X		<p><b>Surface Wall Mounted Luminaire</b> <i>Rating:</i> Interior, Dry Location <i>Housing:</i> Panted Steel <i>Shielding:</i> Tempered glass lens <i>Ballast:</i> Rapid Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> 42W, Double Tube CFL <b>Acceptable Product or Approved Equal:</b> <b>Guth VPW-42T</b></p>
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## APPENDIX B

### Mechanical Equipment Schedule

UNIT ID.	UNIT DESCRIPTION	UNIT LOCATION	HP	KW	MCA	VOLT	PH	STARTER TYPE	STARTER BY	DISC SW BY	FED FROM	PROTECTION	FEEDER	NOTES
AHU-1	Main Building Level 1 Air Handling Unit	Mechanical Room 150			15	600	3		M	E	DP-1	20A, 3P	21mmC, 3C #12 + G	1
AHU-2	Main Building Level 2 Air Handling Unit	Mechanical Room 150			15	600	3		M	E	DP-1	20A, 3P	21mmC, 3C #12 + G	1
AC-1	Comm Room Air Conditioning Unit	Comm Room 136											21mmC, 3C #12 + G	2
CU-1	Condensing Unit for AC-1	Site			20	120	1	G-2,4	E	E	Panel C	30A, 1P	21mmC, 2C #10 + G	
CU-2	Condensing Unit for AHU-2	Site				600	3		M	E	DP-1	30A, 3P	27mmC, 3C #10 + G	
FU-1	Living Unit Level 1 Furnace	Mechanical Room 112				120	1	G-2,4	E	E	Panel A	20A, 1P	21mmC, 2C #12 + G	
FU-2	Living Unit Level 2 Furnace	Mechanical Room 212				120	1	G-2,4	E	E	Panel B	20A, 1P	21mmC, 2C #12 + G	
HRV-1	Main Building Level 1 Heat Recovery	Mechanical Room 150	1/2			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
HRV-2	Main Building Level 2 Heat Recovery	Mechanical Room 150	1/2			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
HRV-3	Living Unit Level 1 Heat Recovery	Mechanical Room 112		0.5		120	1	G-2,4	E	E	Panel A	15A, 1P	21mmC, 2C #12 + G	
HRV-4	Living Unit Level 2 Heat Recovery	Mechanical Room 212		0.5		120	1	G-2,4	E	E	Panel B	15A, 1P	21mmC, 2C #12 + G	
EF-1	Electrical Room Exhaust Fan	Electrical Room 137		0.328		120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
EF-2	Smudging Exhaust Fan	Multipurpose 147		0.455		120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
EF-3	Mechanical Room Exhaust Fan	Mechanical Room 150		0.325		120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
RH-1	Living Unit Level 1 Kitchen Hood Fan	Kitchen 118			2.9	120	1	N/A			Panel A	15A, 1P	21mmC, 2C #12 + G	
RH-2	Living Unit Level 1 Kitchen Hood Fan	Kitchen 118			2.9	120	1	N/A			Panel A	15A, 1P	21mmC, 2C #12 + G	
RH-3	Living Unit Level 2 Kitchen Hood Fan	Kitchen 218			2.9	120	1	N/A			Panel B	15A, 1P	21mmC, 2C #12 + G	
RH-4	Living Unit Level 2 Kitchen Hood Fan	Kitchen 218			2.9	120	1	N/A			Panel B	15A, 1P	21mmC, 2C #12 + G	
B-1	Condensing Boiler	Boiler Room 150a			15	120	1	G-2,4	E	E	Panel C	20A, 1P	21mmC, 2C #12 + G	
B-2	Condensing Boiler	Boiler Room 150a			15	120	1	G-2,4	E	E	Panel C	20A, 1P	21mmC, 2C #12 + G	
P-1	Boiler 1 Circulator	Boiler Room 150a	1/2			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
P-2	Boiler 2 Circulator	Boiler Room 150a	1/2			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
P-3	Heating Water Pump	Boiler Room 150a	2			208	3	VFD	M	E	Panel C	15A, 3P	21mmC, 3C #12 + G	
P-4	Heating Water Pump	Boiler Room 150a	2			208	3	VFD	M	E	Panel C	15A, 3P	21mmC, 3C #12 + G	
P-5	Domestic Hot Water Circulator	Boiler Room 150a	1/5			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
P-6	Sprinkler Pressure Pump	Mechanical Room 150	1/2			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
FFH-1	Living Unit Level 1 Stair Heater	Stair B1		1.5		120	1	N/A	N/A	E	Panel C	20A, 1P	21mmC, 2C #12 + G	
CUH-1	Hot Water Cabinet Unit Heater	Vestibule 131	Frac.			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
CUH-2	Hot Water Cabinet Unit Heater	Vestibule 149	Frac.			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
CUH-3	Hot Water Cabinet Unit Heater	Stair A1	Frac.			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
UH-1	Hot Water Unit Heater	Mechanical Room 150	Frac.			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
UH-2	Hot Water Unit Heater	Boiler Room 150a	Frac.			120	1	G-2,4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	

[illegible]

## NOTES:

- 1 Single point power connection for supply and air fans
- 2 AC-1 interlocks with CU-1, Provide power wiring between AC-1 and CU-1. Coordinate work with Mechanical Contractor on site
- 3 Coordinate power connection with the Mechanical Contractor on site. Control power to individual dampers by others
- 4 Coordinate power connection with the Mechanical Contractor on site

## APPENDIX C

### Panel Schedule

DESIGNATION	WATTAGE		PH.C	BRKR AMPS	CCT. NO.	PH.		PH.C	CCT. NO.	BRKR AMPS		WATTAGE		PH.C	DESIGNATION
	PH.A	PH.B				A	B					PH.A	PH.B		
Bed 101	360			15AF	1	Q			2	15		310			Kitchen, WC, Shower Lighting
Bed 102		360		15AF	3		Q		4	15			220		Mechanical, Laundry Lighting
Bed 103			360	15AF	5			Q	6	15				924	Corridor Lighting
Bed 104	360			15AF	7	Q			8	20		100			Housekeeping Receptacles
Bed 105		360		15AF	9		Q		10	15GF			1000		Washroom Receptacles
Bed 106			360	15AF	11			Q	12	15GF					Washroom Receptacles
Bed 107	360			15AF	13	Q			14	15		300			Dining Room Receptacles
Bed 108		360		15AF	15		Q		16	15			500		Laundry Receptacle
Bed 109				15AF	17			Q	18	15				500	Washing Machine
Bed 110	360			15AF	19	Q			20	15		500			Washing Machine
Dining 117/Kitchen 118 Lighting		756		15	21		Q		22	30			2000		Dryer
Fridge				15	23			Q	24	2P				2000	
Fridge	500			15	25	Q			26	30		2000			Dryer
Range		3000		40	27		Q		28	2P			2000		
Range	3000			2P	29			Q	30	20				1920	Furnace FU-1
Range				40	31	Q			32	15		500			Heat Recovery HRV-3
Range		3000		2P	33		Q		34	15			600		Range Hood
Kitchen Counter Receptacles			600	20GF	35			Q	36						
Kitchen Counter Receptacles	600			20GF	37	Q			38						
DDC Panel		100		15	39		Q		40						
Freezer			500	15	41			Q	42						
Freezer	500			15	43	Q			44	15					Spare
Kitchen Counter Receptacles		600		20GF	45		Q		46	15					Spare
Kitchen Counter Receptacles			600	20GF	47			Q	48	15					Spare
Motorized Dampers Control Box	100			15	49	Q			50	15					Spare
Bed Night Lights		30		15	51		Q		52	15					Spare
Corridor Night Lights			10	15	53			Q	54	20					Spare

6140	8566	6290
------	------	------

LOCATION: Refer to Electrical Drawings

VOLTS: 120 /208

PHASE: 3

WIRE: 4

PANEL TYPE: 54 Circuit

MOUNTING: Recessed

MAIN BUS AMPS: 225A

INTERRUPTING CAPACITY: 14 kA

FEEDER AWG: Refer to Electrical Drawings

MAIN BREAKER AMPS: N/A

TOTAL LOAD	3710	6320	6344
AMPS/PH	9850	14886	12634
	82.1	124.1	105.3

TOT. LOAD 37.4 KW

Notes:

Ground Fault Breaker: 15GF  
Standard 1 Pole Breaker: 15  
Standard 2 Pole Breaker: 15-2p  
Standard 3 Pole Breaker: 15-3p  
Standard 1 Pole Breaker c/w Lock On Device: 15\*  
Arc Fault Breaker 15AF



DESIGNATION	WATTAGE		PH.C	BRKR AMPS	CCT. NO.	PH.			WATTAGE		PH.C	DESIGNATION
	PH.A	PH.B				A	B	C	PH.A	PH.B		
Bed 201	360			15AF	1	Q			310			Kitchen, WC, Shower Lighting
Bed 202		360		15AF	3		Q			220		Mechanical, Laundry Lighting
Bed 203			360	15AF	5			Q			924	Corridor Lighting
Bed 204	360			15AF	7	Q			100			Housekeeping Receptacles
Bed 205		360		15AF	9		Q			1000		Washroom Receptacles
Bed 206			360	15AF	11			Q			1000	Washroom Receptacles
Bed 207	360			15AF	13	Q			300			Dining Room Receptacles
Bed 208		360		15AF	15		Q			500		Laundry Receptacle
Bed 209			360	15AF	17			Q			500	Washing Machine
Bed 210	360			15AF	19	Q			500			Washing Machine
Dining 117/Kitchen 118 Lighting		756		15	21		Q			2000		Dryer
Fridge			500	15	23			Q			2000	
Fridge	500			15	25	Q			2000			Dryer
Range		3000		40	27		Q			2000		
			3000	2P	29			Q			1920	Furnace FU-2
Range	3000			40	31	Q			500			Heat Recovery HRV-3
				2P	33		Q			600		Range Hood
Kitchen Counter Receptacles		3000	600	20GF	35			Q				
Kitchen Counter Receptacles	600			20GF	37	Q						
DDC Panel		100		15	39		Q					
Freezer			500	15	41			Q				
Freezer	500			15	43	Q						
Kitchen Counter Receptacles		600		20GF	45		Q					Spare
Kitchen Counter Receptacles			600	20GF	47			Q				Spare
Motorized Dampers Control Box	100			15	49	Q						Spare
Bed Night Lights		30		15	51		Q					Spare
Corridor Night Lights			10	15	53			Q				Spare

6140	8566	6290
------	------	------

TOTAL LOAD	3710	6320	6344
AMPS/PH	9850	14886	12634
	82.1	124.1	105.3

LOCATION: Refer to Electrical Drawings

VOLTS: 120 /208

PHASE: 3

WIRE: 4

PANEL TYPE: 54 Circuit

MOUNTING: Recessed

MAIN BUS AMPS: 225A

INTERUPTING CAPACITY: 14 kA

FEEDER AWG: Refer to Electrical Drawings

MAIN BREAKER AMPS: N/A

TOT. LOAD 37.4 KW

Notes:

- Ground Fault Breaker: 15GF
- Standard 1 Pole Breaker: 15
- Standard 2 Pole Breaker: 15-2p
- Standard 3 Pole Breaker: 15-3p
- Standard 1 Pole Breaker c/w Lock On Device: 15\*
- Arc Fault Breaker 15AF

DESIGNATION	WATTAGE		PH.C	BRKR AMPS	CCT.		PH. A	PH. B	PH. C	BRKR WATTAGE		PH.C	DESIGNATION
	PH.A	PH.B			NO.	Q				AMPS	PH.A	PH.B	
Housekeeping Receptacles	100			20	1	Q				15	300		Multipurpose 146 AV Receptacle
Utility Room Receptacles		100		20	3		Q			15		100	Multipurpose 146 Projector
Exterior Receptacles			100	15GF	5			Q		15			Multipurpose 146 Receptacles
Exterior Receptacles	100			15GF	7	Q				15	300		Multipurpose 147 AV Receptacle
Vesibule 131 Door Operators		300		15	9		Q			15		100	Multipurpose 147 Projector
Elevator Room & Pit Receptacle/Light			142	15GF	11			Q		15			Multipurpose 147 Receptacles
Activity 145 Lighting	540			15	13	Q				15	300		Activity 145 AV Receptacle
Multipurpose 146/147 Lighting		1140		15	15		Q			15		100	Activity 145 Projector
Utility Room Lighting			900	15	17			Q		15			Activity 145 Receptacles
Level 1 Admin Lighting	716			15	19	Q				15GF	100		Washroom Receptacles
Level 1 Admin Lighting		538		15	21		Q			15		100	Interview 142/Janitor 144 Receptacles
Condensing Unit CUH-1			2400	30	23			Q		15			Open CX 133/Medical 140 Receptacles
X-Ray Machine	1000			20	25	Q				15	300		Open CX 133/Storage 133a Receptacles
Key Cabinet		100		15	27		Q			15		500	Medical 140 Fridge
PPA Antenna/PA Systems			200	15	29			Q		15			Heat Recovery HRV-1
Ion Scanner	100			15	31	Q				15	373		Heat Recovery HRV-2
Innate Computer Stations		300		15	33		Q			15		217	Exhaust Fan EF-1
Multipurpose 147 Counter Receptacles			300	20GF	35			Q		15			Exhaust Fan EF-2
Stair Lighting	390			15	37	Q				15	124		Boiler Pump P-1
Exterior Lughing		1066		20	39		Q			15		124	Boiler Pump P-2
Level 1 Admin Unswitched Lighting			378	15	41			Q		20			Force Flow Heater FFH-1
Exterior Pole Lighting	492			15	43	Q				15	200		Cabinet Unit Heater CUH-1
Domestic Hot Water Circulator P-5		149		15	45		Q			15		200	Cabinet Unit Heater CUH-2
Molonized Dampers Control Box			100	15	47			Q		15			Unit Heater UH-1
DDC Panel	100			15	49	Q				15	744		Domestic Hot Water Tank DHWT-1
Metal Detector		100		15	51		Q			15		744	Domestic Hot Water Tank DHWT-2
Fire Alarm Panel			100	15	53			Q		15			Exhaust Fan EF-3
Pump P-6		370		15	55	Q				20	1800		Boiler B-1
Security/CATV Systems		100		15	57		Q			20		1800	Boiler B-2
Spare				15	59			Q		15		200	Cabinet Unit Heater CUH-3
Heating Water Pump P4		497		15	61	Q				15	200		Unit Heater UH-2
		497		3P	63		Q			15			Spare
			497		65			Q		15			Spare
				15	67	Q				15			Spare
Heating Water Pump P-3		497		3P	69		Q			15			Spare
			497		71			Q		20			Spare

4902	4887	5614
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LOCATION: Refer to Electrical Drawings  
VOLTS: 120/208  
PHASE: 3  
WIRE: 4

PANEL TYPE: 72 Circuit  
MOUNTING: Surface  
MAIN BUS AMPS: 225A  
INTERUPTING CAPACITY: 14 kA  
FEEDER AWG: Refer to Electrical Drawings  
MAIN BREAKER AMPS: N/A

TOTAL LOAD AMPS/PH	4741	3985	3653
	9643	8872	9267
	80.4	73.9	77.2

TOT. LOAD 27.8 KW

Notes:

Ground Fault Breaker: 15GF  
Standard 1 Pole Breaker: 15  
Standard 2 Pole Breaker: 15-2p  
Standard 3 Pole Breaker: 15-3p  
Standard 1 Pole Breaker c/w Lock On Device: 15-  
Arc Fault Breaker 15AF

DESIGNATION	WATTAGE		PH.C	BRKR AMPS	CCT. NO.	PH.			PH.C	WATTAGE		PH.B	PH.C	DESIGNATION
	PH.A	PH.B				A	B	C		PH.A	PH.B			
Housekeeping Receptacles	100			15	1	0								Spare
Fridge		500		15	3		0							Spare
Kitchen Counter Receptacles			600	20	5			0					100	Meeting 246 Receptacles
Kitchen Counter Receptacles	600			20	7	0				300				Multipurpose 233 AV Receptacle
Level 2 Admin Lighting		670		15	9		0							Multipurpose 233 Projector
Level 2 Admin Lighting			900	15	11			0				100		Multipurpose 233 Receptacles
Level 2 Admin Lighting	1130			15	13	0				300				Parole 247/Admin 249 Receptacles
Level 2 Admin Lighting		1090		15	15		0					300		Manager 245 Receptacles
Photocopier			1300	20	17			0					600	Office 244 Receptacles
Printer	1000			20	19	0								Spare
Shredder		300		20	21		0					300		Admin 249 Receptacles
Exhaust Fan EF-4			140	15	23			0					100	Washroom Receptacles
Exhaust Fan EF-5	140			15	25	0				300				Storage Receptacles
Photocopier		1300		20	27		0					600		Inmate Effects 237 Receptacles
Printer			1000	20	29			0					1100	Microwave
Shredder	300			20	31	0								
					33		0							
					35			0						
					37	0								
Stair Lighting Unswitched		504		15	39		0							
Level 2 Admin Lighting Unswitched			324	15	41			0						
					43	0								
					45		0							
					47			0						
					49	0								
Spare				15	51			0						
Spare				15	53			0						Spare

3270	4364	4264
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900	1300	2000
4170	5664	6264
34.8	47.2	52.2

LOCATION: Refer to Electrical Drawings

VOLTS: 120 /208

PHASE: 3

WIRE: 4

PANEL TYPE: 54 Circuit

MOUNTING: Recessed

MAIN BUS AMPS: 225A

INTERUPTING CAPACITY: 14 kA

FEEDER AWG: Refer to Electrical Drawings

MAIN BREAKER AMPS: N/A

TOT. LOAD 16.1 KW

Notes:

- Ground Fault Breaker: 15GF
- Standard 1 Pole Breaker: 15
- Standard 2 Pole Breaker: 15-2p
- Standard 3 Pole Breaker: 15-3p
- Standard 1 Pole Breaker c/w Lock On Device: 15\*
- Arc Fault Breaker 15AF

DESIGNATION	WATTAGE		PH.C	BRKR AMPS	CCT. NO.	PH.			CCT. NO.	BRKR AMPS	WATTAGE		PH.C	DESIGNATION
	PH.A	PH.B				A	B	C			PH.A	PH.B		
Communication Rack	600			20	1	Ø			2	15	100			Communication Room Receptacles
Communication Rack		600		20	3		Ø		4	15		100		Communication Room Receptacles
Communication Rack			600	20	5			Ø	6	15			100	Communication Room Receptacles
Communication Rack	600			20	7	Ø			8					
					9		Ø		10					
					11			Ø	12					
					13	Ø			14					
					15		Ø		16					
					17			Ø	18					
					19	Ø			20					
				15	21		Ø		22					
Spare				15	23			Ø	24	20				Spare
Spare														

1200	600	600
------	-----	-----

LOCATION: Refer to Electrical Drawings

VOLTS: 120 /208

PHASE: 3

WIRE: 4

PANEL TYPE: 24 Circuit

MOUNTING: Surface

MAIN BUS AMPS: 225A

INTERUPTING CAPACITY: 14 kA

FEEDER AWG: Refer to Electrical Drawings

MAIN BREAKER AMPS: N/A

TOTAL LOAD	100	100	100
AMPS/PH	1300	700	700
	10.8	5.8	5.8

TOT. LOAD 2.7 KW

Notes:

- Ground Fault Breaker: 15GF
- Standard 1 pole breaker: 15
- Standard 2 pole breaker: 15-2p
- Standard 3 pole breaker: 15-3p
- Standard 1 pole breaker c/w Lock On Device: 15\*

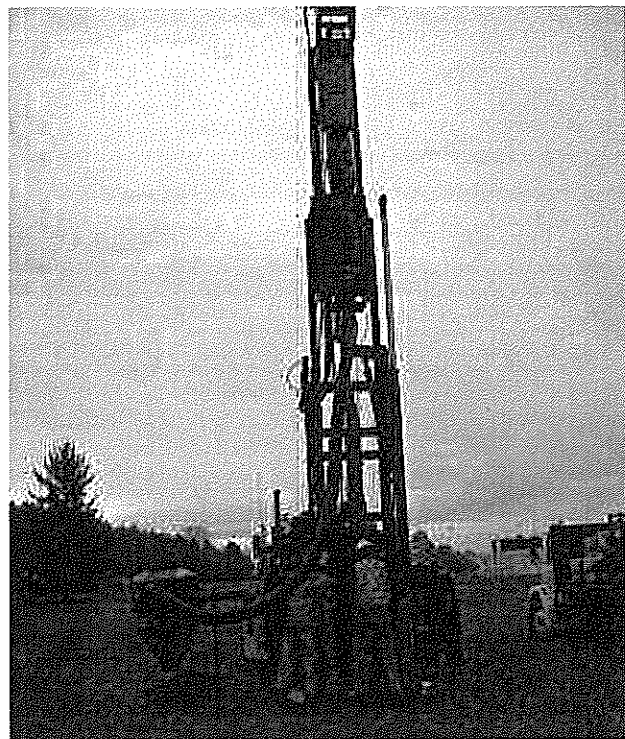
## APPENDIX D

### Geotechnical Assessment

# PROPOSED 20 MEN INMATE LIVING BUILDING

## Geotechnical Assessment

*FINAL*



*Prepared for:*

Public Works and Government Services Canada  
641 – 800 Burrard Street  
Vancouver, BC V6Z 2V8

*Prepared by:*

Stantec Consulting Ltd.  
4370 Dominion Street, Suite 500  
Burnaby, BC V5G 4L7  
Tel: (604) 436-3014 Fax: (604) 436-3752

*Project No.:*

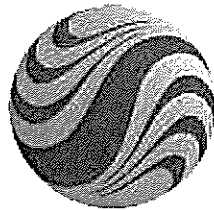
1233-10756

*Date:*

December 1, 2011



**Stantec**



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**Stantec**

## TABLE OF CONTENTS

<b>1</b>	<b>Introduction .....</b>	<b>1</b>
<b>2</b>	<b>Project Description .....</b>	<b>1</b>
<b>3</b>	<b>Site Description.....</b>	<b>1</b>
<b>4</b>	<b>Site Investigation .....</b>	<b>2</b>
4.1	Site Investigation by Klohn Crippen Berger December 2010 .....	2
4.2	Stantec Site Investigation November 2011 .....	2
<b>5</b>	<b>Soil and Groundwater Conditions.....</b>	<b>3</b>
5.1	Surficial Geology .....	3
5.2	Soil Conditions .....	3
5.3	Groundwater Conditions .....	4
<b>6</b>	<b>Discussions and Geotechnical Recommendations .....</b>	<b>4</b>
6.1	General.....	4
6.2	Site Preparation .....	5
6.3	Foundation Design .....	5
6.4	Slab-On-Grade Floor.....	5
6.5	Excavations and Groundwater Considerations.....	6
6.6	Excavation Backfill and Compaction Requirements .....	6
6.7	Perimeter Drainage .....	6
6.8	Seismic Design Considerations .....	6
6.9	Concrete.....	7
<b>7</b>	<b>Closure.....</b>	<b>8</b>

## List of Tables

Table 1:	Seismic Design Parameters Based on 2010 NBCC Site Class C .....	7
Table 2:	Summary of Chemical Testing on Native Soils .....	7



## List of Appendices

Appendix A:	.....	Statement of General Conditions
Appendix B:	.....	Test Hole Location Plan
Appendix C:	.....	Test Hole Logs
Appendix D:	.....	Interpreted SPT-(N1)60 Values from Becker Penetration Testing
Appendix E:	.....	Klohn Crippen Berger Logs
Appendix F:	.....	Chemical Analysis

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## 1 INTRODUCTION

Stantec Consulting Ltd. (Stantec), acting in general accordance with the terms of reference provided in our proposal (Proposal No. 1233P900607, dated October 25, 2011), has completed a geotechnical assessment for the proposed 20 man inmate living building at the Matsqui Institution, in Abbotsford, British Columbia. Authorization to proceed with the work was received from Public Works and Government Services Canada (PWGSC) on November 3, 2011.

The scope of work for this geotechnical assessment consisted of a site investigation, visual assessment of the site conditions, laboratory testing, geotechnical engineering analyses, and preparation of this report.

PWGSC also provided Stantec with a geotechnical report, Fraser Valley Institution Inmate Housing, prepared by Klohn Crippen Berger, dated December 10, 2010. The results of the geotechnical investigation completed by Klohn Crippen Berger were considered during the preparation of this report.

This report presents the results of the geotechnical assessment and provides geotechnical engineering recommendations for the design and construction of the proposed 20 man inmate building. Use of this report is subject to the Statement of General Conditions provided in **Appendix A**

## 2 PROJECT DESCRIPTION

Based on the proposed building drawing titled *Main Floor Plan Upper Floor Plan*, Option 1, dated September 30, 2011, the proposed 20 man inmate building will be two (2) stories with a total floor area of approximately 1000 m<sup>2</sup> (11,000 ft<sup>2</sup>). The main floor and upper floor will be approximately 750 m<sup>2</sup> and 250 m<sup>2</sup>, respectively. It is assumed that the proposed grade of the main floor area will be similar to the existing grade within the subject area.

Stantec understands that the proposed building size and location has not been finalized. Therefore, any changes to the building size or location will need to be reviewed by Stantec in order to confirm that our recommendations are still valid.

## 3 SITE DESCRIPTION

The Matsqui Institution is located at 33344 King Road, Abbotsford, BC. The site is bounded by King Road to the north, Huntington Road to the south, and primarily farmer fields to the east and west. Based on the aerial site plan provided by PWGSC, the proposed 20 man inmate building will be located within the southern half of the site along the south side of the interior access road. Based on our observations during the field investigation, the proposed building location is relatively flat and is level with the paved access road. The proposed building area is located in an open grassy area, outside of the fenced compounds. The approximate location of the proposed building is shown on Drawing 1 (**Appendix B**).

## 4 SITE INVESTIGATION

### 4.1 Site Investigation by Klohn Crippen Berger December 2010

The site investigation completed by Klohn Crippen Berger consisted of six (6) solid stem auger holes and one combined open-ended and closed-end Becker Hammer borehole. The auger holes were advanced to depths ranging from 4.6 to 12.2 m, and the Becker Hammer borehole was advanced to a depth of 11.9 m. The boreholes were completed as part of a previous proposed development consisting of new inmate housing with associated service buildings. The proposed development area was located within the central fenced compound, northwest of the proposed 20 man inmate building. A copy of the Klohn Crippen Berger drill hole location plan and borehole logs are enclosed in **Appendix E**.

### 4.2 Stantec Site Investigation November 2011

The geotechnical investigation was completed in the period of November 7 to November 9, 2011. It consisted of two (2) combined open-ended and close-ended (i.e., Becker Penetration Tests (BPT)) Becker Hammer boreholes (BH11-1 and BH11-2), and three (3) shallow test pits (TP11-1 to TP11-3). The boreholes were completed with a truck-mounted Becker Hammer drill-rig, and the test pits were completed with a rubber-tired backhoe. The Becker Hammer boreholes were advanced to depths of 14 m and 11.9 m for boreholes BH11-1 and BH11-2, respectively. The test pits were advanced to depths of 2.4 m and 2.6 m. The approximate locations of the boreholes and test pits are shown on Drawing 1 (**Appendix B**). It should be noted that the intent was to complete two (2) Becker Hammer boreholes in the vicinity of the proposed building area; however, due to a miscalculation in the field, borehole BH11-1 and test pit TP11-1 were completed outside the proposed building footprint.

Test pits were excavated adjacent to the boreholes (i.e., TP11-1 and TP11-2) in order to visually identify the changes to soil strata within the top 2 m of the ground surface. Therefore, all descriptions and soil layer thicknesses within the top 2 m will only reference the conditions observed at the test pits.

The BPT comprises of driving a 140 mm OD close-ended casing into the ground using a diesel hammer and recording the blow count for every 0.3 m of penetration. The BPT blow count is used to provide an indication of the density of granular soils, similar to the Standard Penetration Test (SPT). The BPT is used in sand and gravel deposits, since the SPT blow counts are erroneously impacted by the larger soil particles when using the smaller SPT split-spoon sampler. A Stantec field engineer directed the BPT work and recorded the blow counts as well as the bounce chamber pressure of the diesel hammer indicating the hammer efficiency. The Becker Hammer blow counts and bounce chamber pressures are shown on the boreholes logs enclosed in **Appendix C**.

A 50 mm diameter standpipe piezometer with a flush-mounted road-box cover was installed at the location of borehole BH11-1 upon completion of the Becker Hammer Borehole.

The field work was continuously monitored by a Stantec field engineer, who located the test holes, selected and identified the sample locations, classified the soils, kept a detailed log of each test hole and observed, and recorded pertinent site features.

## 5 SOIL AND GROUNDWATER CONDITIONS

### 5.1 Surficial Geology

Based on our review of Surficial Geology Map 1485A for this area of Abbotsford, the anticipated subsurface conditions would consist of *recessional channel and floodplain deposits laid down by proglacial streams; gravel and sand up to 40 m thick, normal range of thickness between 5 to 25 m.* Underlying the gravel and sand deposits is *glaciomarine deposits, marine sediments and minor till.*

### 5.2 Soil Conditions

The soil deposits encountered during the geotechnical investigation consisted of topsoil, sandy silt, sand, sand and gravel, clayey silt and glacial till, which are in general agreement with the soil conditions encountered by Klohn Crippen Berger during their 2010 geotechnical investigation. A summary of the encountered soil conditions are provided below with details presented on the logs enclosed in **Appendix C**.

#### Topsoil

Topsoil was encountered in each of the test holes. The topsoil layer is approximately 400 mm thick at the location of test pit TH11-1, and approximately 300 mm thick and the location of test pits TP11-2 and TP11-3. The topsoil consists of sandy silt with trace organics and clay.

#### Sandy Silt

Firm to stiff sandy silt with trace clay was encountered below the topsoil layer. The sandy silt layer ranged from approximately 350 to 500 mm thick.

#### Granular Soil (Sand, and Sand and Gravel)

The granular deposits (i.e., sand, and sand and gravel) were encountered at a depth of 0.6 to 0.9 m below the ground surface. The granular deposits consist of sand which grades to sand and gravel with depth. The granular deposits extended to a depth of 7.6 to 8.2 m below the ground surface. A sandy gravel layer was encountered at a depth of 10.7 m in borehole BH11-1 and was 2.1 m thick.

Based on the results of the BPT's, the granular deposit is loose to compact to a depth of approximately 2 m, and dense to very dense below.

The density of the granular soil deposits was based on converting the BPT field blow counts into equivalent SPT  $N_{60}$  and subsequently  $(N_1)_{60}$  blow counts. The conversion of the blow counts considered the methods of Harder<sup>1</sup> and Sy<sup>1</sup>. A BPT energy transfer ratio of 40% (this indicates the efficiency of the Becker Hammer) was assumed in the conversion, which was based on previous experience with the subject equipment.

---

<sup>1</sup> "Twentieth Canadian Geotechnical Colloquium: Recent developments in the Becker penetration test: 1986-1996", by A. Sy, Canadian Geotechnical Journal, v. 34, 1997

It should be noted that it was not possible to convert some of the high BPT field blow counts in some of the zones of the sand, and sand and gravel deposits using the Sy method as the field data exceeded the upper limits of the relationship. The relationship is based on empirical data, and therefore cannot be extrapolated. However, it can be inferred that these zones are dense to very dense as indicated by the Harder method. Zones with high BPT field blows which could not be converted to equivalent SPT blow counts are indicated by the absence of data on the charts in **Appendix D**.

#### **Clayey Silt**

Stiff to hard clayey silt was encountered below the sand and gravel layer at a depth of 7.6 m and 8.2 m in boreholes BH11-1 and BH11-2, respectively. The clayey silt layer was 3.1 m and 2.25 m thick in boreholes BH11-1 and BH11-2, respectively. Natural water contents of samples collected from the clayey silt layer were 14 and 33%.

#### **Glacial Till**

Hard glacial till was encountered in boreholes BH11-1 and BH11-2 at a depth of 12.8 m and 9.45 m, respectively. Boreholes BH11-1 and BH11-2 were terminated within the glacial till layer. The glacial till consists predominantly of sandy clayey silt, with some gravel. Natural water contents of samples collected from the glacial till were 12%.

### **5.3 Groundwater Conditions**

Groundwater was encountered at a depth of 7 m during advancement of borehole BH11-1. Subsequently, the groundwater level was measured at a depth of 10.3 m in the 50 mm diameter standpipe piezometer installed in borehole BH11-1. The screen was installed within the sandy gravel layer between the clayey silt and glacial till deposits. The groundwater level reading was taken two (2) days following the installation of the piezometer, and read 10.3 m below the ground surface. Details of the standpipe piezometer installation are shown on the borehole log in **Appendix C**. Based on the drilling observation and the measured groundwater level, it is expected that perched groundwater may exist above the discontinuous zones of low permeable clayey silt soil. Seasonal fluctuations of the perched groundwater level should be expected.

## **6 DISCUSSIONS AND GEOTECHNICAL RECOMMENDATIONS**

### **6.1 General**

Based on the encountered soil conditions, we consider that the building can be supported on conventional spread footings with a slab-on-grade floor. Detailed recommendations for site preparation and foundation design are provided in the following sections.

## 6.2 Site Preparation

The site preparation activities for the proposed 20 man inmate living building are as follows:

1. Remove the topsoil/organics and the native sandy silt to 1 m beyond the building footprint to expose the native sand layer. We anticipate excavation depths up to 1 m will be required.
2. Compact the exposed native sand with a large smooth-drum vibratory roller (1.5 m diameter drum) to at least 100% Standard Proctor maximum dry density (SPMDD).
3. Following compaction of the native sand, the excavation should be backfilled with clean (less than 10% fines) imported sand and gravel fill, and compacted to at least 100% SPMDD. Maximum loose lift thicknesses should not exceed 300 mm.

## 6.3 Foundation Design

The proposed 20 man inmate building can be supported on conventional spread footings and founded on the compacted native sand or imported sand and gravel fill. Minimum footing widths should be 450 mm and 900 mm for strip and pad footings, respectively. For design under Serviceability Limit States design (SLS), strip and pad footings founded on the compacted sand or sand and gravel fill can be designed for a bearing pressure of 150 kPa (3000 psf). Under Ultimate Limit States design (ULS), the factored ultimate bearing resistance should not exceed 250 kPa (5000 psf) for strip and pad footings found on the compacted native sand or imported sand and gravel fill. The factored ULS value is based on a geotechnical resistance factor of 0.5 for shallow foundations. For preliminary design, the factored ULS value can be increased by 33% for seismic conditions, which should be confirmed in the detailed design phase by the geotechnical engineer upon knowledge of the footing dimensions and layout.

For frost protection and confinement, the footing underside should be founded at minimum 0.5 m depth.

For foundations designed and prepared as recommended above, we estimate the total post construction settlements would be less than 25 mm. Differential settlements would be less than 20 mm over a distance of 10 m (1:500 rotation).

## 6.4 Slab-On-Grade Floor

The floor of the building can be constructed as slab-on-grade. The floor slab should be placed on a minimum 150 mm thick bedding layer consisting of 19 mm minus crushed gravel with a maximum fines content of 5%. The base course should be compacted to 100 % SPMDD.

Often, a vapour barrier is considered below concrete slab areas. However, the usage of a vapour barrier could result in curling of the concrete slab at joints. Floor covers sensitive to moisture typically requires the usage of a vapour barrier. A materials or structural engineer should be consulted regarding the detailing of the vapour barrier below concrete slabs. The American Concrete Institutes ACI 360R-06 Design of Slabs on Grade and ACI 302.1R-04 Guide for Concrete Floor and Slab Construction are recommended references for vapour barrier selection and floor slab detailing.

Experience has indicated that cracking in the floor slab at or near connections can occur and at times can be beyond tolerable limits. This is primarily the result of shrinkage of the floor slab. One possible solution is to construct the floor slab such that a perimeter strip is connected to the foundation elements as required by the building code. The center, however, is jointed and/or free of the perimeter strip such that shrinkage cracking is controlled. In addition, the detailing of connections between floor slabs and foundation elements that are required by the 2010 BC Building Code to address seismic issues should also be carefully reviewed by a materials or structural engineer.

## 6.5 Excavations and Groundwater Considerations

The native granular deposits (i.e., sand, and sand and gravel) are competent to sustain near-vertical unsupported excavated cuts for utility trenches and foundations up to a maximum depth of 1.2 m. Deeper temporary slopes should be no steeper than 1H:1V. All excavations should be carried out in accordance with the Work Safe BC, and reviewed on a regular basis, during and before worker entry.

Excavated material should be stockpiled no closer than 2 m from the crest of the excavation slopes. Equipment should also be kept a minimum of 2 m from the crest of excavations.

Groundwater is not considered to be a construction issue, as it is envisaged that any trench or foundation excavation would be above the groundwater level. However, in the event that seepage is encountered during excavation, side slopes may have to be flattened and ponded water can be handled with small sumps and low capacity pumps.

## 6.6 Excavation Backfill and Compaction Requirements

All utility trench and foundation excavations should be backfilled with imported well-graded granular fill with maximum fines content of 10%, and compacted to at least 100% SPMDD. Any source of imported backfill should be tested and approved by a geotechnical engineer prior to use on-site.

## 6.7 Perimeter Drainage

Provided that the final slab elevation of the main floor is at least 150 mm above the final exterior grades, we consider that a perimeter drainage system is not required.

## 6.8 Seismic Design Considerations

Based on the results of the geotechnical site investigation (BPT results), competent native soils (i.e. dense sand and gravel, stiff clayey silt and hard glacial till deposits) are present below the proposed building location. However, isolated zones with lower converted  $(N_1)_{60}$  blow counts were encountered within the top 2 m of the ground surface, and between the depths of 8 to 10 m (shown on the tables in **Appendix D**). Based purely on the lower  $(N_1)_{60}$  blow counts (i.e., less than 20 blows/0.3m) this would indicate loose to compact soils are present, and may be susceptible to liquefaction. However, the groundwater level measured in the standpipe piezometer was approximately 10 m below the ground surface, and without the presence of groundwater within the loose zones, liquefaction cannot occur within the top 2 m zone. Furthermore, the soil conditions

between the depths of 8 to 10 m consist of stiff to very stiff clayey silt, and not granular soil. Consequently, it is expected that liquefaction of the native subgrade soils is unlikely in the event of a design earthquake with a return period of 1 in 2,475 years as to the 2010 NBCC. For seismic design, we consider it appropriate to classify this site as Site Class 'C' *Very dense soil and soft rock* in accordance with 2010 NBCC (Table 4.1.8.4. A). The site class, 5% damped spectral accelerations, peak firm-ground acceleration (PGA), based on the 1 in 2,475 year, 2010 NBCC design earthquake (obtained from the National Research of Canada website based on the site coordinates) are presented in Table 1.

**Table 1: Seismic Design Parameters Based on 2010 NBCC Site Class C**

Site Class	S <sub>a</sub> (0.2)	S <sub>a</sub> (0.5)	S <sub>a</sub> (1.0)	S <sub>a</sub> (2.0)	PGA
C	0.98	0.66	0.32	0.17	0.48

Thus, the structural design of the proposed development should be based on seismic site coefficients of  $F_a$  and  $F_v$  of 1 and 1, respectively.

## 6.9 Concrete

Laboratory tests were conducted to measure the water soluble sulphate content, conductivity, and pH of the native sand & gravel. The results of the chemical tests are summarized in Table 2.

**Table 2: Summary of Chemical Testing on Native Soils**

Test Pit	Sample Depth (m)	Soluble Sulphate (mg/L)	Soluble Conductivity (µS/cm)	Soluble pH
TP11-2	0.3	<10	52.3	6.24
TP11-2	1.0	17	57.2	6.12

Based on the above-noted soluble sulphate values, the degree of sulphate exposure is negligible (per CSA A23.1-04, Table 3). Therefore, Type GU or GUB cement may be used for concrete in contact with site soils.

Air entrainment to meet the requirements outlined in CSA A23.1-04 should be specified for all concrete in contact with freezing temperatures. Stricter specifications may be required for structural requirements, other exposure conditions, or other considerations.

The pH and specific conductance values of the soil indicate a low level of corrosivity. The potential for attack on exposed steel is low.

The results of the laboratory chemical testing are included in **Appendix F**.



## 7 CLOSURE

This report was prepared for the exclusive use of Public Works and Government Services Canada and their agents. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Stantec.

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes, and assumed structural loads. Stantec should be provided with final architectural and structural drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary.

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**. It is the responsibility of the Public Works and Government Services Canada, who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the Report
- Standard of Care
- Interpretation of Site Conditions
- Varying or Unexpected Site Conditions
- Planning, design or construction.

This report has been prepared by Ben Huynh, P.Eng., and Henrik Kristiansen, M.A.Sc., P.Eng.

Respectfully submitted,

**Stantec Consulting Ltd.**

Reviewed by:

Ben Huynh, P.Eng.  
Geotechnical Engineer

Henrik Kristiansen, M.A.Sc., P.Eng.  
Senior Associate

BH/HK/pf

# **APPENDIX A**

## **Statement of General Conditions**



## Statement of General Conditions

**USE OF THIS REPORT:** This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third part without the express written consent of Stantec Consulting Ltd. (Stantec) and the Client. Any use which a third party makes of this report is the responsibility of such third party.

**BASIS OF THE REPORT:** The information, opinions, and/or recommendations made in this report are in accordance with Stantec's present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site-specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

**STANDARD OF CARE:** Preparation of this report, and all associated work was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

**INTERPRETATION OF SITE CONDITIONS:** Soil Rock, or other material descriptions, and statements regarding their conditions, made in the report are based on site conditions encountered by Stantec at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact but rather reflective of the anticipated material behavior. Extrapolation of *in situ* conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

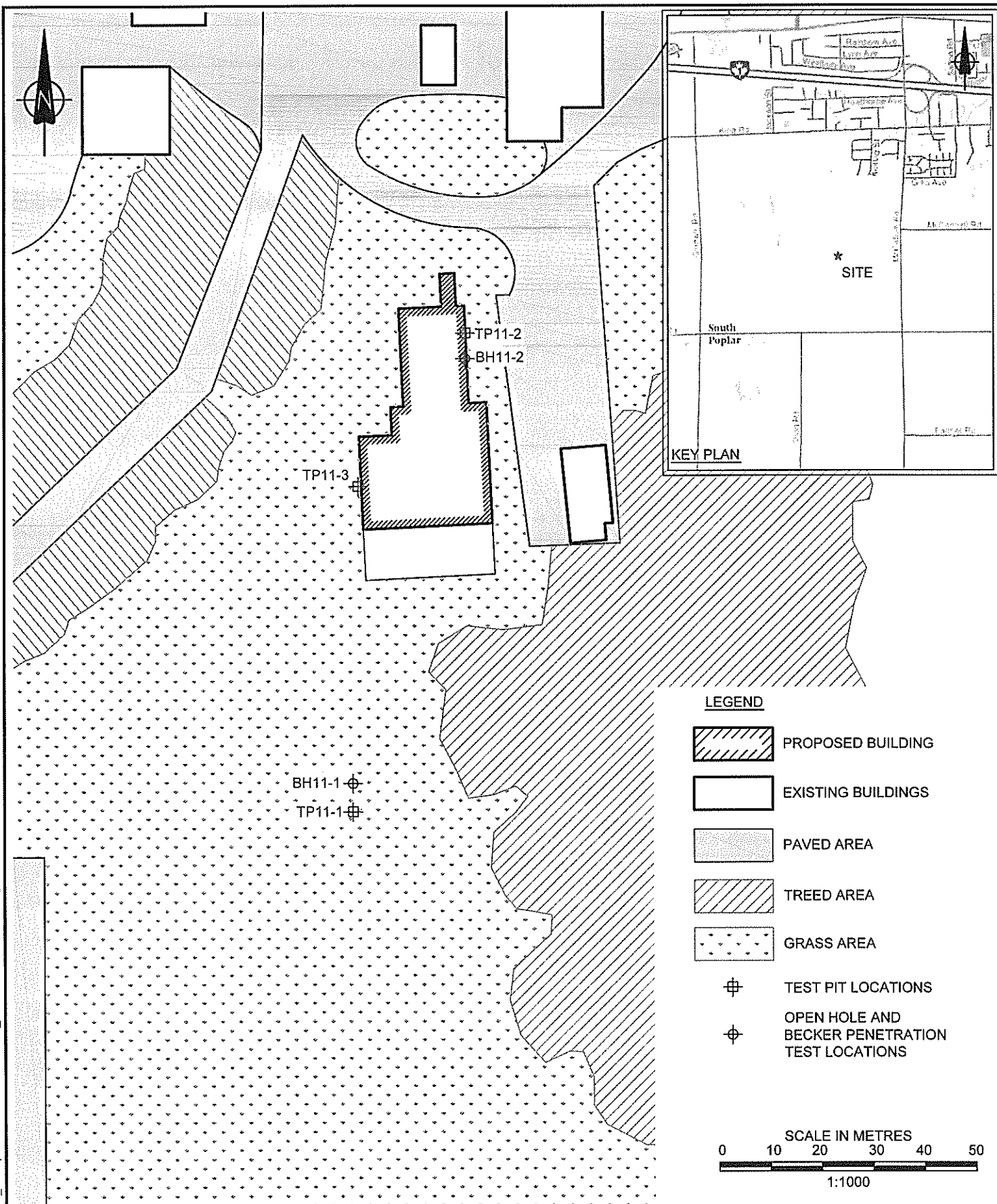
**VARYING OR UNEXPECTED CONDITIONS:** Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec will not be responsible to any party for damages incurred as a result of failing to notify Stantec that differing site or subsurface conditions are present upon becoming aware of such conditions.

**PLANNING, DESIGN, OR CONSTRUCTION:** Development or design plans and specifications should be reviewed by Stantec, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc.) to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present.

# APPENDIX B

## Test Hole Location Plan





**NOTE:** THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# **TEST HOLE LOCATION PLAN** **GEOTECHNICAL SITE ASSESSMENT** **MATSQUI 20 MAN BUILDING** **33344 KING ROAD, ABBOTSFORD**

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

**Job No.:** 123310756

**Scale:** 1:1000

**Date:** 17-Nov-11

**Dwn. By:** SS

**App'd By:** JP

**Dwg. No.:**

**1**



**Stantec**

# APPENDIX C

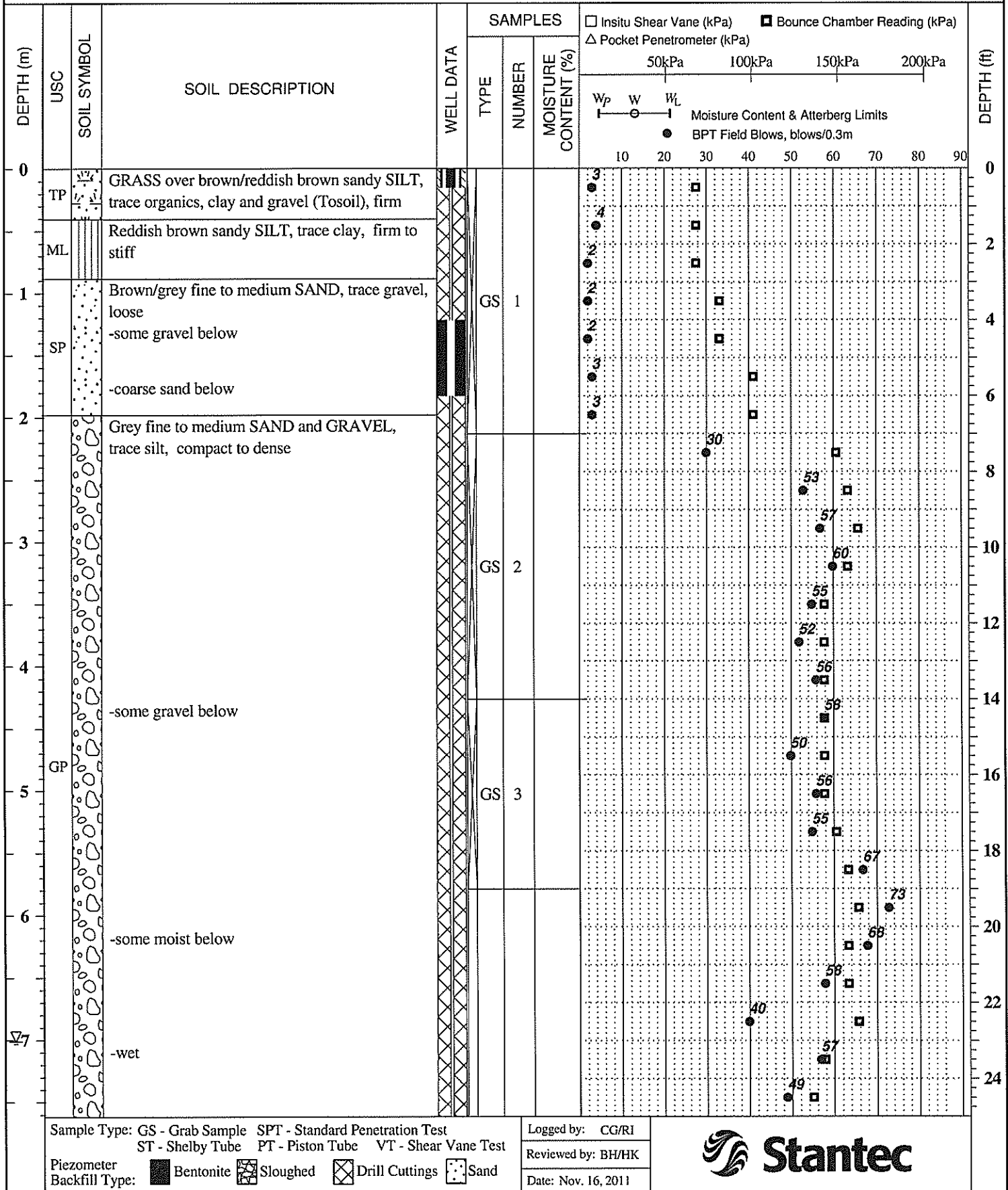
## Test Hole Logs



# BOREHOLE RECORD

BH11-1

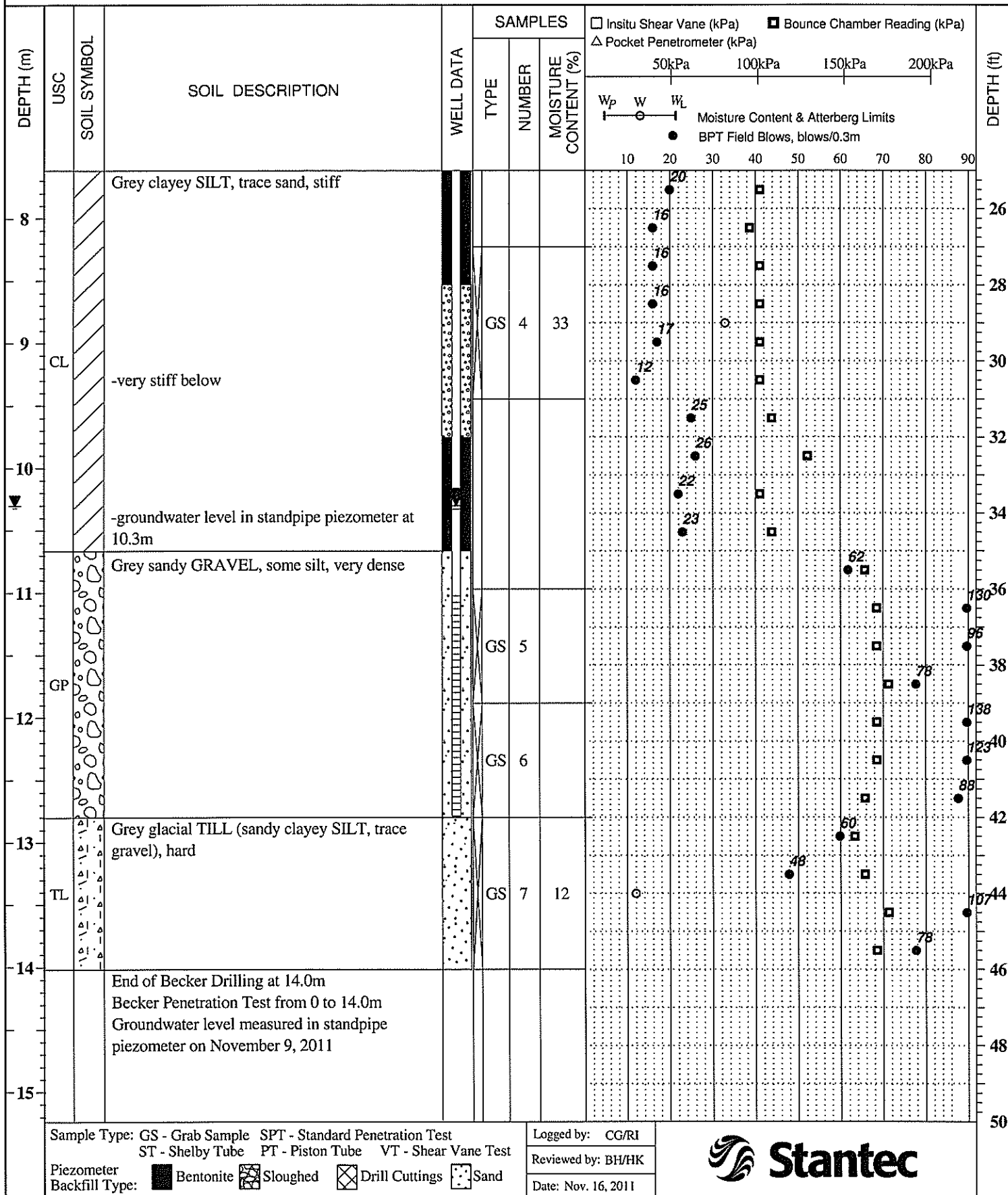
CLIENT Public Works and Government Services Canada PROJECT No. 123310756  
 PROJECT 20 Men Living Inmate Building DATUM \_\_\_\_\_  
 LOCATION 33344 King Road, Abbotsford ELEVATION \_\_\_\_\_  
 DRILLING DATE Nov. 7, 2011 DRILLING CO. Foundex Explorations Ltd. DRILLING METHOD Becker Hammer



# BOREHOLE RECORD

**BH11-1** cont'd

CLIENT <u>Public Works and Government Services Canada</u>	PROJECT No. <u>123310756</u>
PROJECT <u>20 Men Living Inmate Building</u>	DATUM _____
LOCATION <u>33344 King Road, Abbotsford</u>	ELEVATION _____
DRILLING DATE <u>Nov. 7, 2011</u>	DRILLING CO. <u>Foundex Explorations Ltd.</u> DRILLING METHOD <u>Becker Hammer</u>

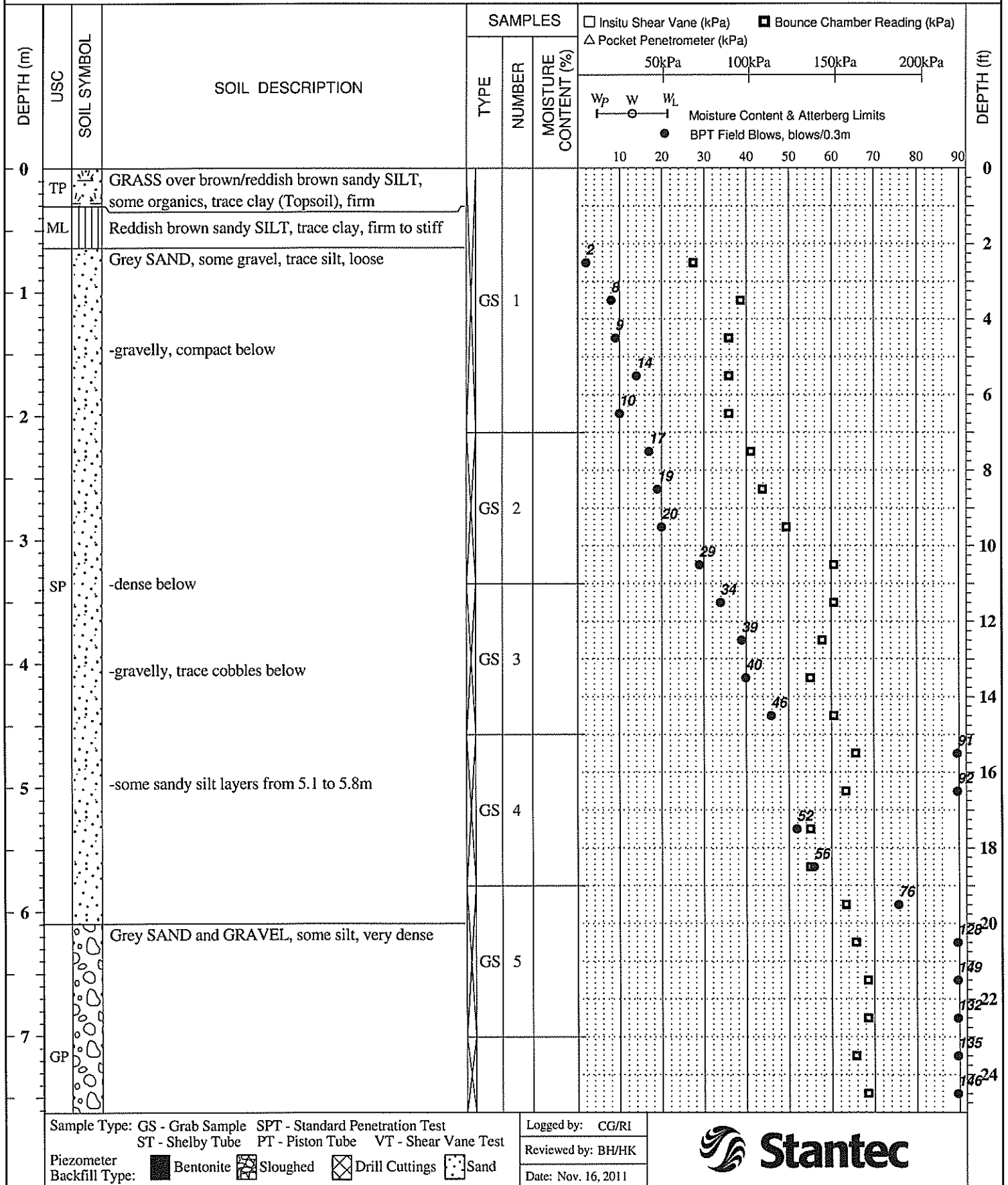




# BOREHOLE RECORD

## BH11-2

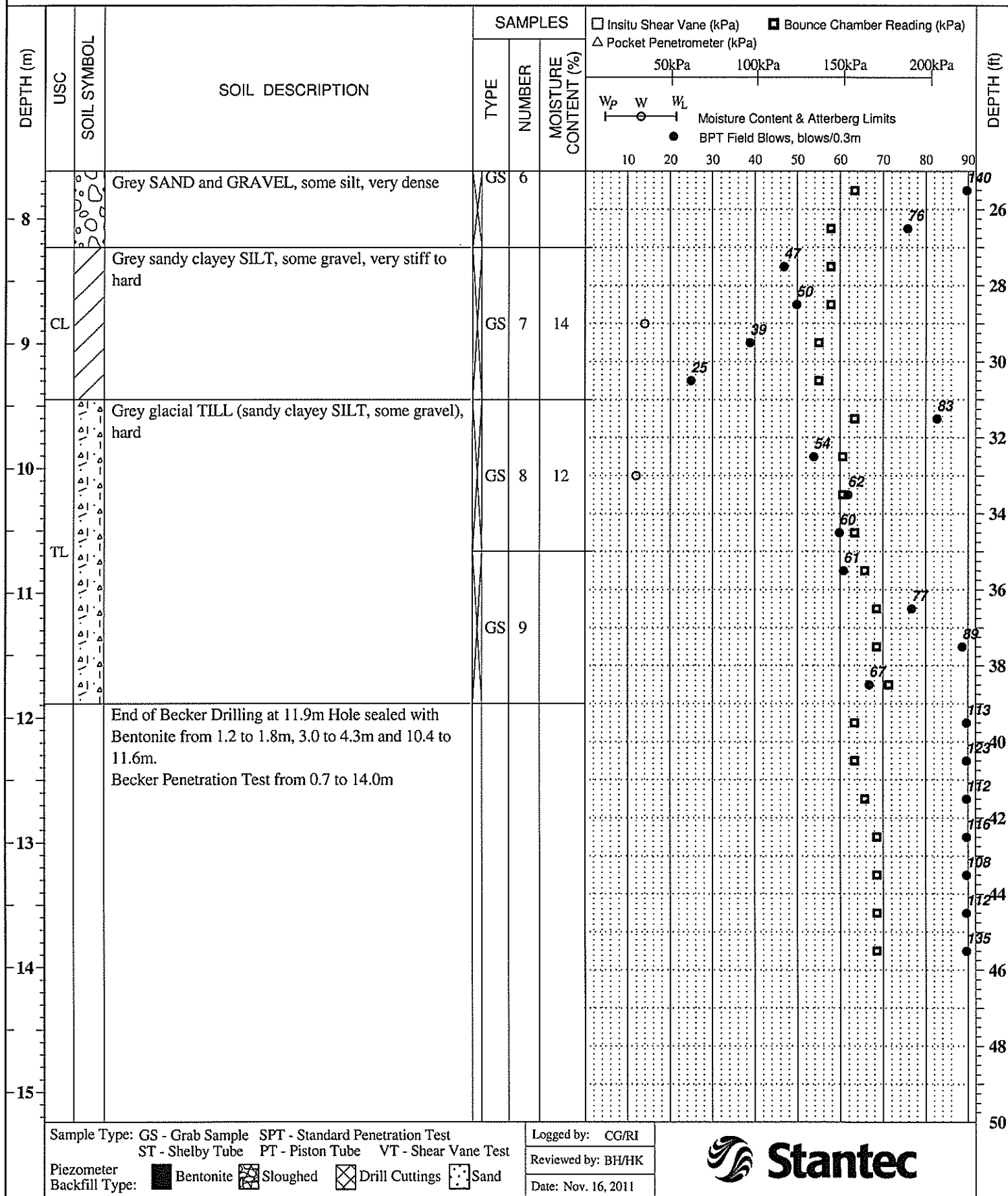
CLIENT Public Works and Government Services Canada PROJECT No. 123310756  
 PROJECT 20 Men Living Inmate Building DATUM \_\_\_\_\_ NORTHING 5430178  
 LOCATION 33344 King Road, Abbotsford ELEVATION \_\_\_\_\_ EASTING 551166  
 DRILLING DATE Nov. 8, 2011 DRILLING CO. Foundex Explorations Ltd. DRILLING METHOD Becker Hammer



# BOREHOLE RECORD

BH11-2 cont'd

CLIENT Public Works and Government Services Canada PROJECT No. 123310756  
 PROJECT 20 Men Living Inmate Building DATUM                      NORTHING 5430178  
 LOCATION 33344 King Road, Abbotsford ELEVATION                      EASTING 551166  
 DRILLING DATE Nov. 8, 2011 DRILLING CO. Foundex Explorations Ltd. DRILLING METHOD Becker Hammer



## TP11-1

PROJECT No. 123310756

DATUM \_\_\_\_\_

ELEVATION \_\_\_\_\_

EXCAVATION METHOD Test Pit[illegible]

**TP11-2**

PROJECT No. 123310756

DATUM \_\_\_\_\_

ELEVATION \_\_\_\_\_

EXCAVATION METHOD Test Pit[illegible]

**TP11-3**

PROJECT No. 123310756

DATUM \_\_\_\_\_

ELEVATION \_\_\_\_\_

EXCAVATION METHOD Test Pit

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input checked="" type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input checked="" type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		GRASS over brown/reddish brown sandy SILT, trace organics (Topsoil), firm	<input checked="" type="checkbox"/> GS	1	39					0
	ML		Reddish brown sandy SILT, trace clay, stiff to very stiff	<input checked="" type="checkbox"/> GS	2	30					2
1	SM		Grey/light brown silty SAND, trace gravel, compact to dense	<input checked="" type="checkbox"/> GS	3						4
	GP		Grey/light brown medium SAND and GRAVEL, trace silt, compact	<input checked="" type="checkbox"/> GS	4						6
2			<input checked="" type="checkbox"/> GS	5							8
			<input checked="" type="checkbox"/> GS	6							10
			<input checked="" type="checkbox"/> GS	7							12
3			End of Test Pit at 2.4m No seepage encountered in test pit								16
4											18
5											20
6											22
7											24

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test

Piezometer Backfill Type: ☒ Bentonite    ☒ Sloughed    ☒ Drill Cuttings    ☒ Sand

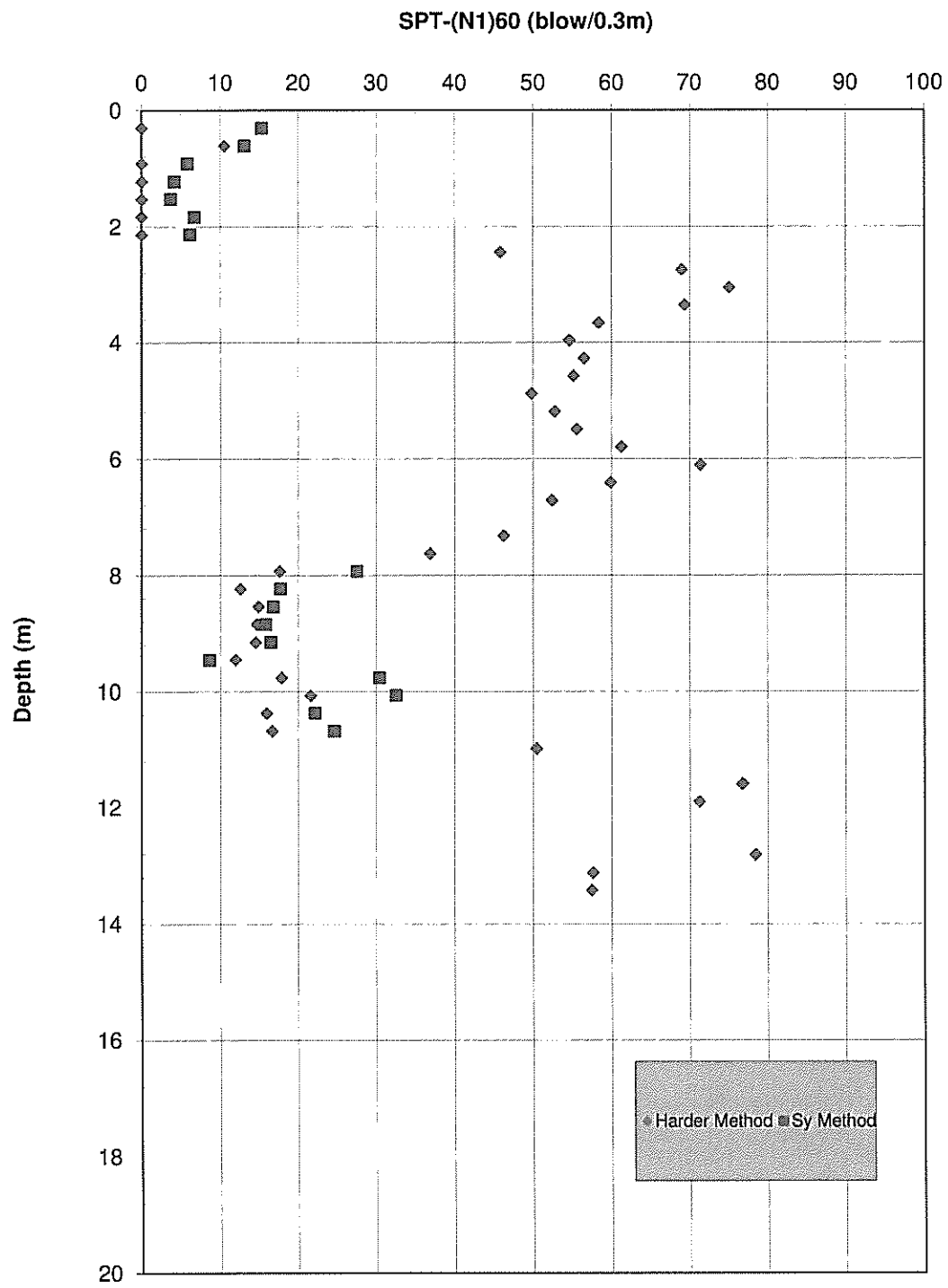
Logged by: CG/RI  
 Reviewed by: BH/HK  
 Date: Nov 15, 2011

# APPENDIX D

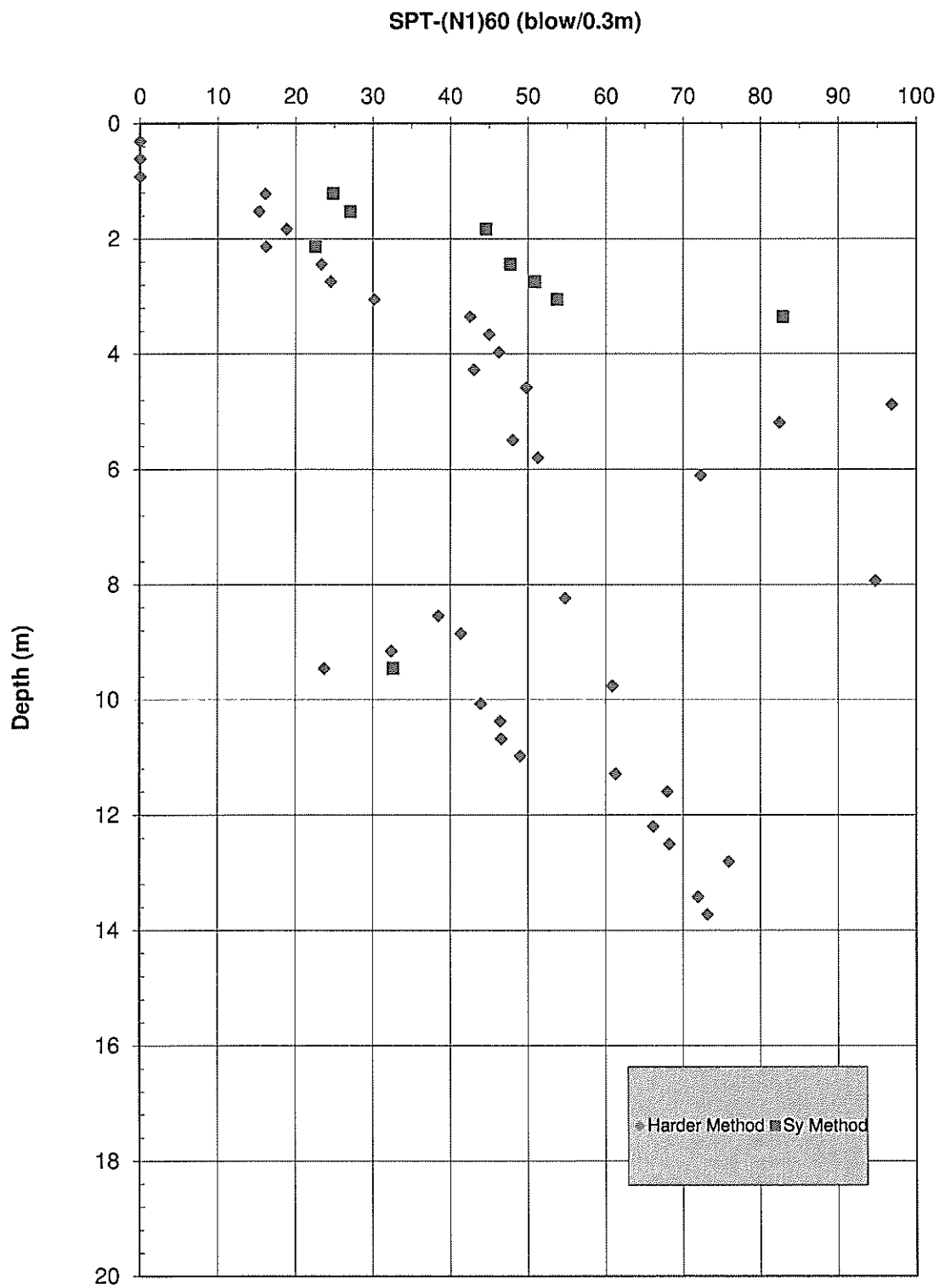
## Interpreted SPT- $(N_1)_{60}$ Values from Becker Penetration Testing



# BPT11-1 Conversion of BPT Field Blows to SPT Blow Counts



## BPT11-2 Conversion of BPT Field Blows to SPT Blow Counts

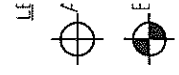
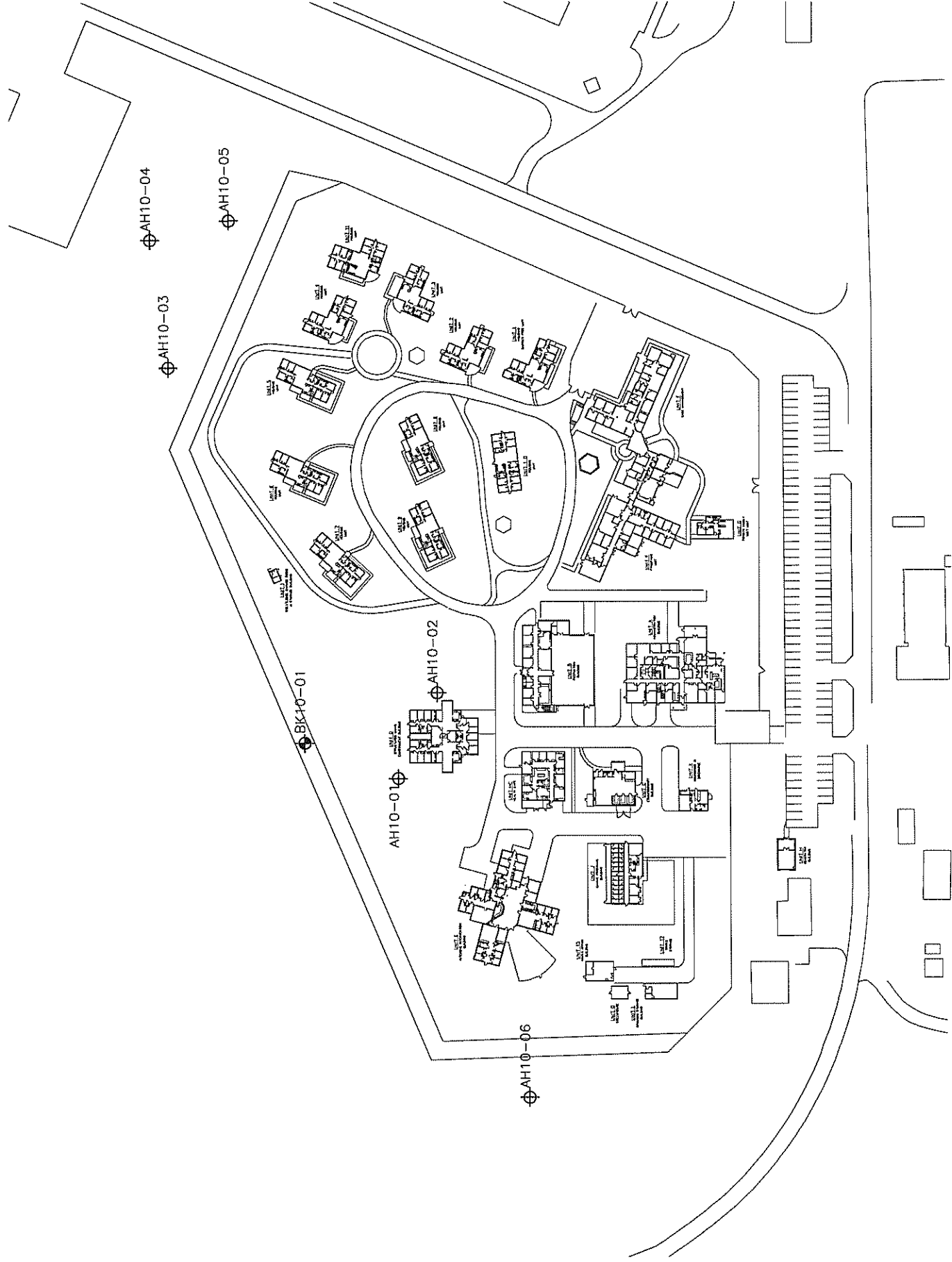




# **APPENDIX E**

## **Klohn Crippen Berger Logs**





Scale: 1" = 100'

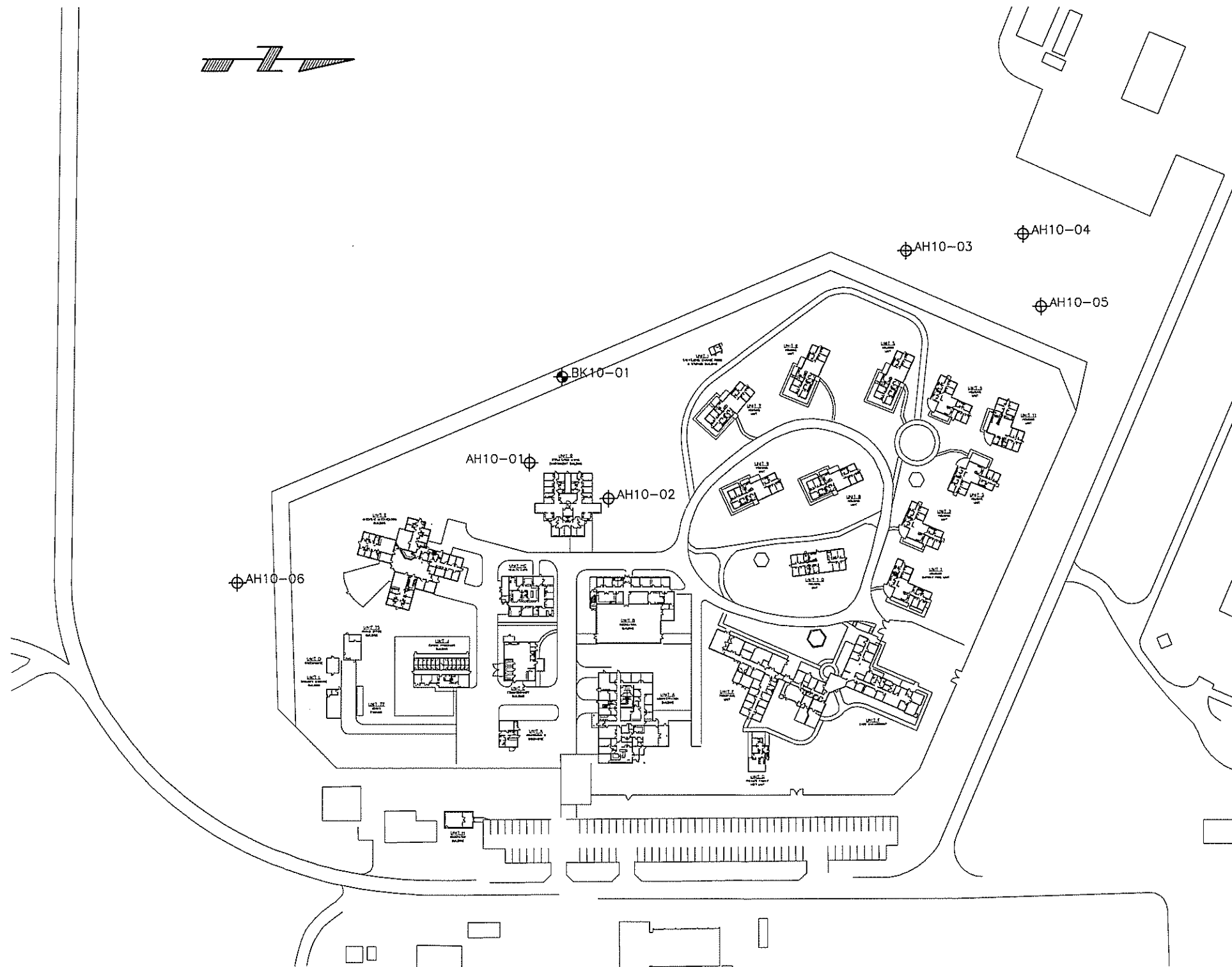
NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN REPORT DATED 11/11/2010



CLIENT: Public Works and Government Services Canada

PROJECT: AS A MUTUAL PROTECTION TO THE CITY OF OTTAWA

Public Works and Government Services Canada



LEGEND:

-  AH10-01 2010 AUGER HOLE
-  BK10-01 2010 BECKER HAMMER HOLE



NOTES:

1. INFORMATION PROVIDED BY PUBLIC WORKS AND GOVERNMENT SERVICES CANADA, SEPTEMBER 13, 2010.
2. DRILL HOLE LOCATIONS ARE APPROXIMATE.

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN REPORT DATED \_\_\_\_\_

SCALE 0 50m

<p>AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.</p>	<p>CLIENT</p> <p> Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada</p>	<p>PROJECT</p> <p>FRASER VALLEY INSTITUTION NEW HOUSING UNITS</p>
	<p> Klohn Crippen Berger</p>	<p>TITLE</p> <p>DRILL HOLE LOCATION PLAN</p>
	<p>PROJECT No.</p> <p>P09625A06</p>	<p>FIG. No.</p> <p>FIG. 1</p>



### BASIC SYMBOLS

SAND



SILT



CLAY



GRAVEL



ORGANICS



FILL



ROCK



### SYMBOL VARIATIONS - EXAMPLES<sup>(1)</sup>

SAND and GRAVEL



GRAVEL, clayey



SAND, silty



ORGANIC SILT or CLAY, low plasticity



ORGANIC SILT or CLAY, high plasticity



CLASSIFICATION BY PARTICLE SIZE			
Name	Size Range		
	(mm) <sup>(3)</sup>	U.S. Standard Sieve Size	
		Retained	Passing
Boulders	> 200	8 inch	-
Cobbles	75 - 200	3 inch	8 inch
Gravel: coarse	19 - 75	0.75 inch	3 inch
fine	5 - 19	No. 4	0.75 inch
Sand: coarse	2 - 5	No. 10	No. 4
medium	0.4 - 2	No. 40	No. 10
fine	0.075 - 0.4	No. 200	No. 40
Fines (Silt or Clay) <sup>(4)</sup>	< 0.075	-	No. 200

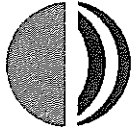
PROPORTION OF MINOR COMPONENTS BY WEIGHT <sup>(2)</sup>	
and y/ey some trace	35 - 50% 20 - 35% 10 - 20% 0 - 10%

PARTICLE SHAPE	
Flat	width/thickness > 3
Elongated	length/width > 3

DENSITY OF GRANULAR SOILS		
Description	SPT N <sup>(5)</sup>	SPT (N) <sub>60</sub> <sup>(6)</sup>
Very Loose	0 - 4	0 - 3
Loose	4 - 10	3 - 8
Compact	10 - 30	8 - 25
Dense	30 - 50	25 - 42
Very Dense	> 50	> 42

CONSISTENCY OF COHESIVE SOILS			
Description	S <sub>u</sub> <sup>(7)</sup>		SPT N <sup>(8)</sup>
	(kPa) <sup>(9)</sup>	(ksf) <sup>(8)</sup>	
Very Soft	< 12	< 0.25	< 2
Soft	12 - 25	0.25 - 0.5	2 - 4
Firm	25 - 50	0.5 - 1	4 - 8
Stiff	50 - 100	1 - 2	8 - 15
Very Stiff	100 - 200	2 - 4	15 - 30
Hard	> 200	> 4	> 30

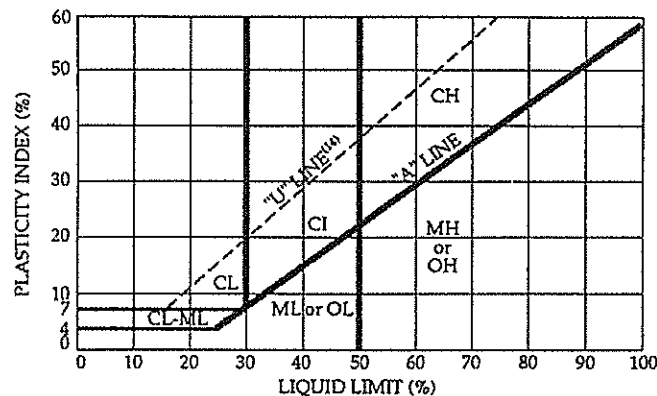
- (1) Only selected examples of the possible variations or combinations of the basic symbols are illustrated.
- (2) Example: SAND, silty, trace of gravel = sand with 20% to 35% silt and up to 10% gravel, by weight.
- (3) Approximate metric conversion.
- (4) Fines are classified as silt or clay on the basis of Atterberg limits (refer to Plasticity Chart).
- (5) Standard Penetration Test (SPT) blow count (uncorrected), after Terzaghi and Peck, 1948.
- (6) Standard Penetration Test blow count, based on above N value corrected to 60% hammer efficiency and 96 kPa (1.0 ton/ft<sup>2</sup>) effective overburden pressure, after Skempton, 1986.
- (7) Undrained shear strength can be estimated by vane (gives S<sub>u</sub>), pocket penetrometer (gives unconfined compressive strength, i.e., 2 S<sub>u</sub>), or unconfined compression test (gives 2 S<sub>u</sub>).
- (8) ksf = 1000 pounds per square foot = 0.5 tsf (ton/ft<sup>2</sup>) = approximately 0.5 kg/cm<sup>2</sup>.
- (9) Very approximate correlation with Standard Penetration Test blow counts, after Terzaghi and Peck, 1948.



PLASTICITY OF COHESIVE SOILS <sup>(10)</sup>		
Description	Silt	Clay
High	$W_L^{(11)} > 50$	$W_L > 50$
Medium	—	$30 < W_L < 50$
Low	$W_L < 50$	$W_L < 30$
Non-Plastic	NP <sup>(12)</sup>	—

SENSITIVITY OF COHESIVE SOILS	
Description	Undisturbed Strength Remoulded Strength <sup>(13)</sup>
High	$> 8$
Medium	4 to 8
Low	$< 4$

PLASTICITY CHART FOR SOILS PASSING NO. 40 SIEVE<sup>(10)</sup>



CLASSIFICATION OF GROUND ICE <sup>(15)</sup>			
GROUP		SUBGROUP	
Symbol	Description	Symbol	Description
N	Ice not visible by unaided eye	Nf	Poorly bonded or friable
		Nbn	Well bonded, no excess ice
		Nbe	Well bonded, excess ice
V	Visible ice less than 25 mm thick	Vx	Individual ice crystals or inclusions
		Vc	Ice coatings on soil particles
		Vr	Random or irregularly oriented ice
		Vs	Stratified or distinctly oriented ice
ICE	Visible ice greater than 25 mm thick	ICE + (soil type)	Ice with soil inclusions
		ICE	Ice without soil inclusions

(10) This plasticity classification conforms to the Unified Soil Classification System (USCS) and the ASTM D-2487 plasticity chart, except for the addition of an intermediate category for clay, where the liquid limit is between 30% and 50% (CI). Under ASTM and USCS, all clays with a liquid limit less than 50% are classified as low plasticity (CL).

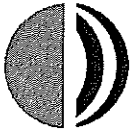
(11)  $W_L$  = Liquid Limit (%).

(12) NP = Non Plastic (silts only).

(13) Dimensionless ratio.

(14) "U" Line marks typical upper limit. "A" Line divides clays from silts and organic soils.

(15) For soil descriptions, estimate percentage of ground ice based on volume, after National Research Council of Canada, 1963.



# SYMBOLS AND TERMS

## FOR SOIL TEST HOLE LOGS

### TEST TYPES<sup>(1)</sup>

DH	Drill Hole - <i>typical drilling methods include tricone, percussion, wash boring, machine auger with SPT or thin-walled tube samples and coring.</i>
BK	Becker hammer drill hole - <i>both open and closed test at the same location.</i>
BKS	Becker hammer drill hole - <i>open casing, sampled.</i>
BPT	Becker penetration test - <i>closed casing.</i>

TP	Test pit - <i>machine or hand dug.</i>
CPT	Electric cone penetration test with pore pressure measurements.
DCT	Dynamic cone penetration test.
VST	Vane shear test.
AH	Auger hole - <i>machine or hand auger, no SPT or thin-walled tube samples taken.</i>

### IN SITU TESTS OR DOWNHOLE INSTRUMENTATION<sup>(2)</sup>

BM	Benchmark
DMT	Dilatometer test
IN	Inclinometer
PMT	Pressuremeter test

PT	Permeability test
PZ	Piezometer
SW	Shear wave velocity test

### LABORATORY AND/OR FIELD TESTS<sup>(3)</sup>

$S_u$  Undrained shear strength, measured by:<sup>(4)</sup>

- ◆ Field Vane (peak)
- ◇ Field Vane (remoulded)
- Lab Vane (peak)
- Lab Vane (remoulded)
- ▲ Unconfined Compression
- △ Pocket penetrometer

- Standard Penetration Test (SPT) blow count, uncorrected (N)
- $W\%$  In situ moisture content
- ✕  $W_p\%$  Plastic limit
- ✕  $W_L\%$  Liquid limit
- ⌋ Becker penetration test blow counts, closed casing
- ⌋ Becker penetration test blow counts, open casing
- ▽ or ▽ Water level, measured on date and from piezometer indicated on log

### OTHER LABORATORY TESTS<sup>(5)</sup>


CD	Consolidated, drained triaxial test
CUP	Consolidated, undrained triaxial test with pore pressure measurements
CUCY	Consolidated, undrained triaxial test with cyclic loading
UU	Unconsolidated, undrained triaxial test
UC	Unconfined (uniaxial) compression test
DS	Direct shear test
DSS	Direct simple shear test

GSD	Grain size distribution ( <i>by sieve or hydrometer</i> )
MDR	Moisture-density relationship ( <i>i.e. standard or modified Proctor test</i> )
ORG	Organic content
OED	Oedometer consolidation test
RD	Relative density ( <i>also known as density index</i> )
GS	Specific gravity
K	Permeability
UW	Unit Weight

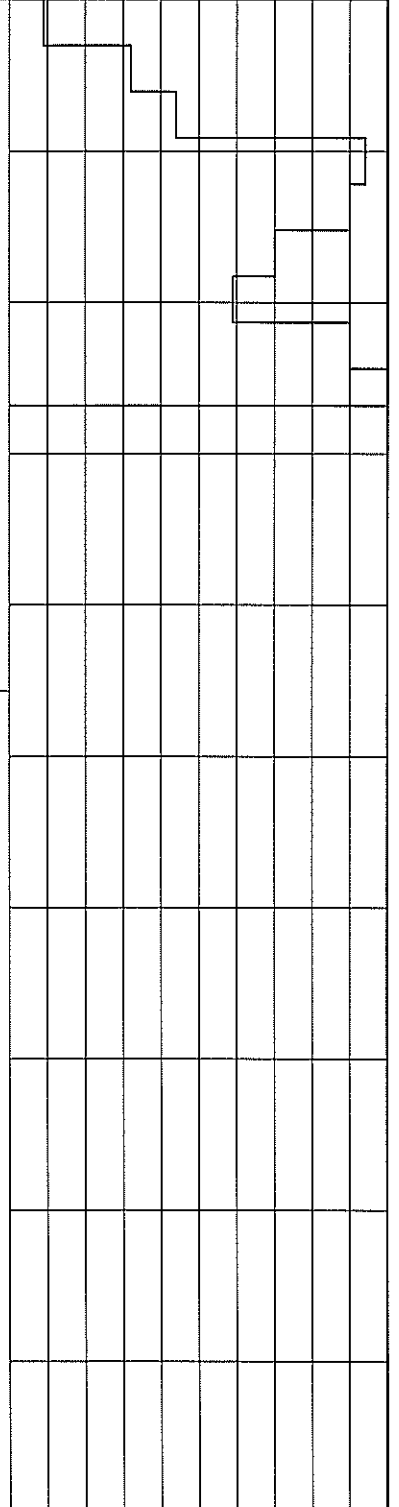
- (1) Test type abbreviation is typically followed by a two-part number indicating year and chronological sequence of test. Example: CPT93-1 indicates the first electric cone penetration test at a particular site in 1993.
- (2) In situ test or downhole instrumentation abbreviations are typically shown in brackets following the appropriate test type designation. Example: DH93-1(PZ) indicates a piezometer was installed in drill hole 93-1.
- (3) These symbols are for laboratory and/or field test results shown on the test hole log.
- (4) Vane gives  $S_u$ . Pocket penetrometer and unconfined compression tests give  $2 S_u$ , so results are divided by 2 for plotting on log.
- (5) Where other laboratory test results are available but not shown on the test hole log, the applicable abbreviation appears under the heading "Other Tests" on the log.

# TEST HOLE LOG

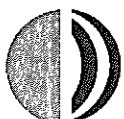
## DYNAMIC CONE PENETRATION TEST

Rod O.D.:	Shoe O.D.:		
Hammer Weight: 140 lb	Height Drop: 30 inches		
● SPT N ★ % FINES △ P.PEN/2 (psi)	 DCPT (blows/0.3m)		
W <sub>p</sub> % X	W% ○	W <sub>L</sub> % X	
20	40	60	80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 2, 2010 FINISHED: Nov 2, 2010	INSTRUMENT	DETAILS
					DRILL METHOD: Solid Stem Auger		
					GROUND ELEV. (m):		
					COORDINATES (m):		
					DESCRIPTION OF MATERIALS		
1		Grab	S1	0.2	SILT (ML) trace sand, soft, brown, moist, rootlets.		
					SAND (SP) medium to coarse, some gravel, trace silt; compact, sub-angular to sub-rounded light brown to grey, moist, largest observed size 50 mm.		
2				0.9	SAND and GRAVEL (SP-GP) trace to some silt, dense, sub-angular to sub-rounded, grey, wet, largest observed size 50 mm; poor recovery from 1.2 m (~50 to 30%).		
3		Grab	S2	2.6	CLAY (CL) trace sand with increasing gravel with depth, very stiff to hard, grey, moist, blocky, moderate cementation, no dilatancy, poor recovery from 2.6 m to 3.0 m (~50 to 30%). (TILL)		
4		Grab	S3				
5				4.6	End of Hole at 4.6 m		
6					1) Drill hole was conducted using a truck-mounted auger drill operated by Downrite Drilling of Chilliwack, BC. 2) Solid Stem Auger hole terminated at 4.6m depth. DCPT terminated at 2.7m depth.		
7							
8							
9							
10							



KCBL\_DCT-SI 2010-11-02\_03 INVESTIGATION - R2 METRIC.GPJ KC\_DATA.GDT 12/10/10



**Klohn Crippen Berger**

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

LOGGED BY: VL

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SHEET 1 OF 1

HOLE NO.: AH10-01

# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

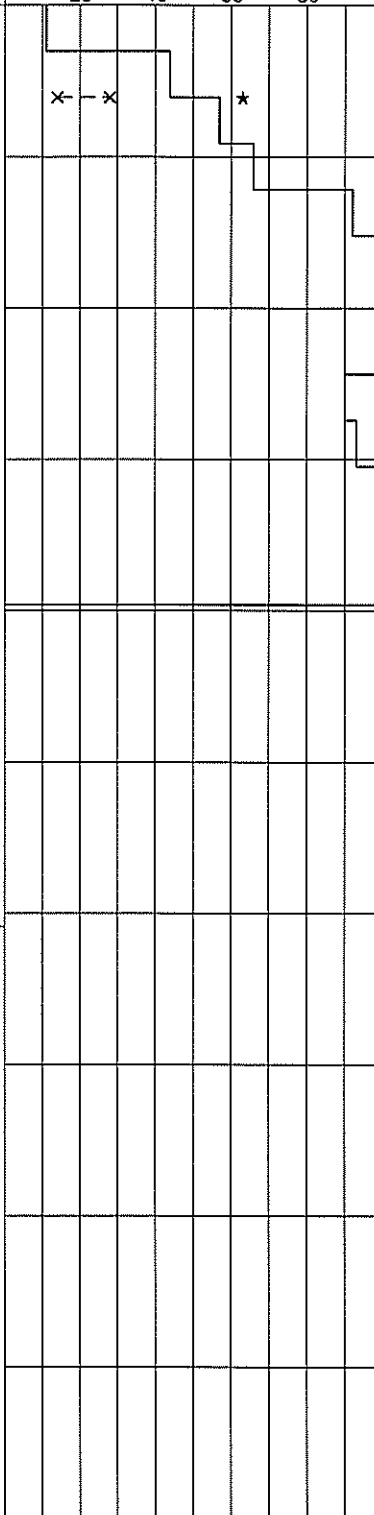
Rod O.D.: Shoe O.D.:

Hammer Weight: 140 lb Height Drop: 30 inches

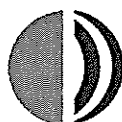
● SPT N ★ % FINES  
 Δ P.PEN/2 (psi) DCPT (blows/0.3m)

W<sub>p</sub>% W% W<sub>L</sub>%  
 x 20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 2, 2010 FINISHED: Nov 2, 2010	INSTRUMENT
					DRILL METHOD: Solid Stem Auger	DETAILS
					GROUND ELEV. (m):	
					COORDINATES (m):	
					DESCRIPTION OF MATERIALS	
0.1		Grab	S1		CLAY (CL) trace sand, soft, brown, moist, rootlets.	
		Grab	S2		CLAY (CL) trace gravel, very stiff to hard, light brown to grey, moist, blocky, moderate cementation, no dilatancy.	
2.1						
		Grab	S3		CLAY (CL) trace sand and gravel, very stiff to hard, grey, moist to dry, blocky, moderate cementation, no dilatancy. (TILL)	
		Grab	S4		@3.9m: Hard Drilling	
		Grab	S5			
6.1						
					End of Hole at 6.1 m	
					1) Drill hole was conducted using a truck-mounted auger drill operated by Downrite Drilling of Chilliwack, BC.	
					2) Solid Stem Auger hole terminated at 6.1m depth. DCPT terminated at 3.9m depth.	



KCBL\_DCT-SI 2010-11-02 03 INVESTIGATION - RE METRIC.GPJ KC\_DATA.GDT 12/10/10



Klohn Crippen Berger

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

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SHEET 1 OF 1

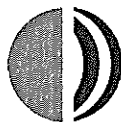
HOLE NO.: AH10-02



# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 2, 2010    FINISHED: Nov 2, 2010		INSTRUMENT DETAILS	DYNAMIC CONE PENETRATION TEST																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
					DRILL METHOD: Solid Stem Auger			Hammer Weight: 140 lb		Height Drop: 30 inches																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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Klohn Crippen Berger

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

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SHEET 1 OF 1

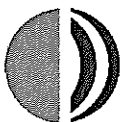
HOLE NO.: AH10-03

# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 2, 2010    FINISHED: Nov 2, 2010		INSTRUMENT DETAILS	DYNAMIC CONE PENETRATION TEST			
					DRILL METHOD: Solid Stem Auger			Hammer Weight: 140 lb	Height Drop: 30 inches		
					GROUND ELEV. (m):			● SPT N    ★ % FINES	DCPT (blows/0.3m)		
					COORDINATES (m):			△ P.PEN/2 (psi)			
					DESCRIPTION OF MATERIALS			W <sub>p</sub> % X --- X	W <sub>90</sub> % O --- O	W <sub>L</sub> % X --- X	
								20	40	60	80
		Grab	S1		0.3	SILT (ML) trace sand, soft, brown, moist, rootlets.					
						SILT (ML) some sand, trace gravel, firm, brown, moist, trace rootlets.					
1		Grab	S2		0.9	SAND (SP) medium to coarse, trace to some gravel, trace silt, compact, brown to grey, moist.					
		Grab	S3								
2						@2.1m: Poor Recovery (~30-50%), wet					
		Grab	S4								
3											
		Grab	S5		4.0						
4		Grab	S6			CLAY (CL) sandy to trace sand, trace fine gravel, trace clay, very stiff to hard, brown to grey, moist, blocky, largest observed size 50 mm. (TILL)					
5											
		Grab	S7								
6											
		Grab	S8		6.6						
7						End of Hole at 6.6 m					
						1) Drill hole was conducted using a truck-mounted auger drill operated by Downrite Drilling of Chilliwack, BC. 2) Solid Stem Auger hole terminated at 6.6m depth. DCPT terminated at 6.0m depth.					
8											
9											
10											

KCB\_L\_DCT-SI\_2010-11-02\_03 INVESTIGATION - R2 METRIC.GPJ KC\_DATA.GDT 12/10/10



**Klohn Crippen Berger**

**PROJECT NO.:** P09625 A06

**PROJECT:** Fraser Valley Institute Inmate Housing

**LOCATION:** Abbotsford, BC

**LOGGED BY:** VL


**CHECKED BY:**

**SHEET 1 OF 1**

**HOLE NO.:** AH10-04

# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

Rod O.D.:	Shoe O.D.:		
Hammer Weight: 140 lb	Height Drop: 30 inches		
● SPT N   ★ % FINES △ P.PEN/2 (psi)	 DCPT (blows/0.3m)		
W <sub>p</sub> % X 20	W% O 40	W <sub>L</sub> % X 60	80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 3, 2010   FINISHED: Nov 3, 2010	DRILL METHOD: Solid Stem Auger	GROUND ELEV. (m):	COORDINATES (m):	DESCRIPTION OF MATERIALS	INSTRUMENT	DETAILS
1		Grab	S1		0.2	SILT (ML) trace sand, soft, brown, moist, rootlets.			ORGANIC SILT (OS) trace sand and gravel, firm, brown, moist.		
2		Grab	S2		0.9	SAND (SP) fine to medium, some gravel, trace silt, loose, grey, moist to wet, largest observed size 70 m.					
3		Grab	S3						@2.6m to 3.0 m: Poor Recovery (50%)		
4		Grab	S4						@4.0m to 4.6m: Poor Recovery (30-50%), wet		*
5		Grab	S5		4.6	SILT (ML) trace sand and gravel, soft, light brown to grey, wet.					
6		Grab	S6		5.0	SAND (SP) medium to coarse, some gravel, trace silt, compact, grey, wet.			@5.5m to 6.1m: Poor Recovery (~30%)		
7		Grab	S7						@6.6m to 7.2m: Poor Recovery (~30%)		
8		Grab	S8		7.2	SILT (ML) sandy, trace gravel, very stiff to hard, light brown to grey, wet.					
9		Grab	S9		7.6	CLAY (CL) sandy, trace gravel with depth, very stiff to hard, grey, moist to dry. (TILL)					
10									@8.8m to 12.1m: Hard Drilling @9.1m to 10.7m: Poor Recovery (~10-30%)		

Continued Next Page

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

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SHEET 1 OF 2

HOLE NO.: AH10-05



Klohn Crippen Berger

# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

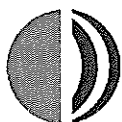
Rod O.D.: Shoe O.D.:

Hammer Weight: 140 lb Height Drop: 30 inches

● SPT N ★ % FINES  
Δ P.PEN/2 (psi) DCPT (blows/0.3m)

W<sub>p</sub>% W% W<sub>L</sub>%  
X --- O --- X  
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 3, 2010 FINISHED: Nov 3, 2010	INSTRUMENT DETAILS
					DRILL METHOD: Solid Stem Auger	
					GROUND ELEV. (m):	
					COORDINATES (m):	
					DESCRIPTION OF MATERIALS	
11		Grab	S10			
12		Grab	S11		@11.6m to 12.2m: Poor Recovery (~50-60%)	
12.2					End of Hole at 12.2 m	
13					1) Drill hole was conducted using a truck-mounted auger drill operated by Downrite Drilling of Chilliwack, BC.	
14					2) Solid Stem Auger hole terminated at 9.1m depth. DCPT terminated at 10.6m depth.	
15					3) 1.5" diameter PVC standpipe installed to 7.1m depth and completed with flush mount surface monument.	
16					4) Water level measured November 29, 2010 at 4.48m depth.	
17						
18						
19						
20						



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PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

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SHEET 2 OF 2

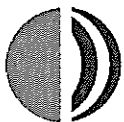
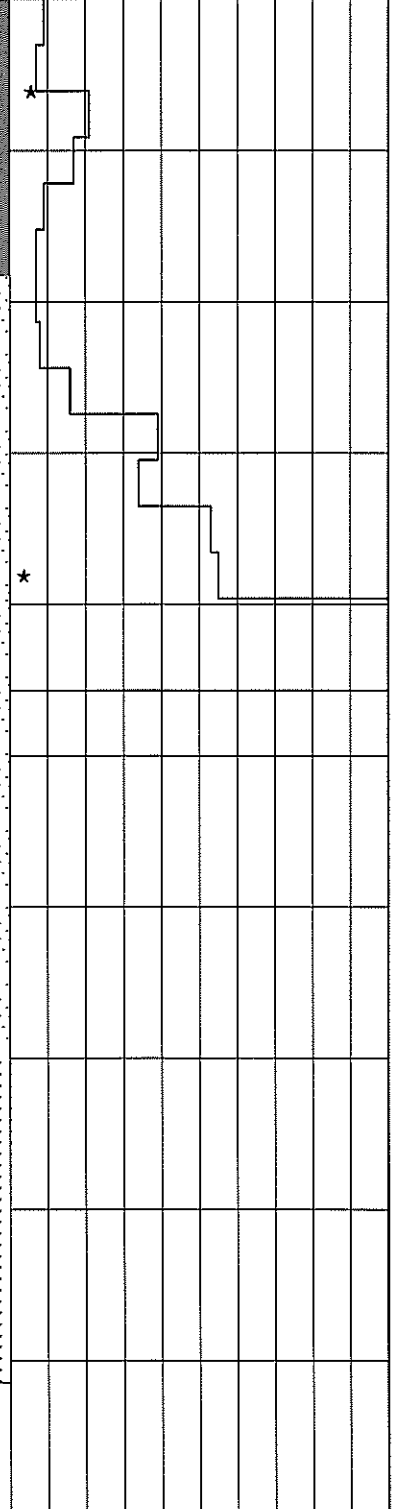
HOLE NO.: AH10-05

# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

Rod O.D.:	Shoe O.D.:
Hammer Weight: 140 lb	Height Drop: 30 inches
● SPT N   ★ % FINES Δ P.PEN/2 (psi)	 DCPT (blows/0.3m)
<div style="display: flex; justify-content: space-between;"> <div> <math>W_p\%</math>              20         </div> <div> <math>W\%</math>              40         </div> <div> <math>W_L\%</math>              60         </div> </div>	<div style="display: flex; justify-content: space-between;"> <div> <math>W_p\%</math>              20         </div> <div> <math>W\%</math>              40         </div> <div> <math>W_L\%</math>              60         </div> </div>

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 3, 2010 FINISHED: Nov 3, 2010	DRILL METHOD: Solid Stem Auger	GROUND ELEV. (m):	COORDINATES (m):	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0.0		Grab	S1		0.0	TOPSOIL			SAND (SP) gravelly, very loose to loose, maximum size observed 50 mm, rounded to sub-rounded, brown to grey, moist.	
1										
2		Grab	S2						@2.6m to 3.0m: Poor Recovery (~30%)	
3										
4		Grab	S3						@4.3m to 4.6m: Poor Recovery (~30%)	
5										
6		Grab	S4		4.9	CLAY (ML) some gravel to gravelly at depth, gravel is rounded to sub-rounded, stiff to hard, brown to grey at depth, moist to wet, maximum size observed 50 mm. (TILL)			@5.0m to 9.1m: Hard Drilling	
7		Grab	S5						@7.0m to 7.6m: Poor recovery (~10-20%)	
8									@7.6m to 9.1m: Poor Recovery (~10-30%)	
9		Grab	S6							
9.1					9.1				End of Hole at 9.1 m	
10									1) Drill hole was conducted using a truck-mounted auger drill operated by Downrite Drilling of Chilliwack	




# TEST HOLE LOG

## DYNAMIC CONE PENETRATION TEST

Rod O.D.: Shoe O.D.:

Hammer Weight: 140 lb Height Drop: 30 inches

● SPT N ★ % FINES  
 Δ P.PEN/2 (psi)  DCPT (blows/0.3m)

W<sub>p</sub>% W% W<sub>L</sub>%  
 X --- O --- X  
 20 40 60 80

INSTRUMENT  
DETAILS

STARTED: Nov 3, 2010 FINISHED: Nov 3, 2010

DRILL METHOD: Solid Stem Auger

GROUND ELEV. (m):

COORDINATES (m):

DESCRIPTION OF MATERIALS

DEPTH (m)

SPT BLOWS  
PER 0.15m

SAMPLE TYPE

SAMPLE No.

SYMBOL

BC.  
 2) Solid Stem Auger hole terminated at 12.2m depth.  
 DCPT terminated at 4.6m depth.  
 3) 1.5" diameter PVC standpipe installed to 7.1m  
 depth and completed with flush mount surface  
 monument.  
 4) Water level measured November 29, 2010 at  
 6.08m depth.

11

12

13

14

15

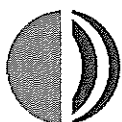
16

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Klohn Crippen Berger

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

LOGGED BY: VL

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SHEET 2 OF 2

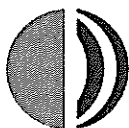
HOLE NO.: AH10-06

# BECKER TEST HOLE LOG

BECKER TEST HOLE LOG								Casing O.D.:		CLOSE ENDED (blows/0.3m)	
DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED:Nov 29, 2010	FINISHED: Nov 29, 2010	INSTRUMENT DETAILS	Hammer Energy: 11 kJ max. rated		OPEN ENDED (blows/0.3m)	
					DRILL RIG MODEL: Becker Hammer						
					GROUND ELEV. (m):						
					COORDINATES (m):						
					DESCRIPTION OF MATERIALS						
								★ % FINES	BOUNCE PRESS (kPa)		
								W <sub>p</sub> % X	W% O	W <sub>L</sub> % X	
								20	40	60	80
1		Grab	G1		0.9						
				SAND (SP) some gravel, occasional cobbles, trace silt, greyish brown colour, dry.							
2		Grab	G2		1.8						
				SAND and GRAVEL (SP-GP) some cobbles, light brown, dry. Becomes more difficult to drill through. Broken rock fragments in drill cuttings. Drill kicks sideways at 2.5 m and needs to be repositioned.							
3		Grab	G3		3.4						
				SILT (ML) some fine sand to sandy, trace to some fine gravel, light brown, very stiff. (TILL)							
4		Grab	G4		4.0						
				SILT (ML) trace sand, trace gravel, light grey, very stiff to hard. (TILL)							
5					4.6						
				CLAY (CL) trace sand, medium plasticity, light grey, dry to moist, very stiff to hard. (TILL)							
6		Grab	G5		7.6						
				CLAY (CL) some sand, some gravel, moist, grey, very stiff to hard. (TILL)							
8		Grab	G6		8.2						
				CLAY (CL) grey, dry, very stiff to hard. (TILL)							
9		Grab	G7								
10											

Continued Next Page

Continued Next Page



Klohn Crippen Berger

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing




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

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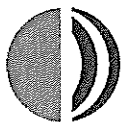
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# BECKER TEST HOLE LOG

## BECKER PENETRATION TEST

Casing O.D.:		CLOSE ENDED (blows/0.3m)
Hammer Energy: 11 kJ max. rated		OPEN ENDED (blows/0.3m)
★ % FINES		BOUNCE PRESS (kPa)
W <sub>p</sub> % X	W% O	W <sub>L</sub> % X
20	40	60
		80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: Nov 29, 2010    FINISHED: Nov 29, 2010		INSTRUMENT DETAILS
					DRILL RIG MODEL: Becker Hammer		
					GROUND ELEV. (m):		
					COORDINATES (m):		
					DESCRIPTION OF MATERIALS		
11		Grab	G8		10.4	CLAY (CL) sandy, trace gravel, grey, moist, very stiff to hard. (TILL)	
				11.0	CLAY (CL) trace to some sand, trace fine gravel, dry, very stiff to hard. (TILL)		
12				11.9	End of Becker Drill Hole at 11.9 m		
13						1) Drill hole was conducted using a truck-mounted Becker Hammer drill operated by Foundex Explorations of Surrey, BC. 2) Closed Becker hole terminated at 9.1m depth. Open Becker hole terminated at 11.9m depth.	
14							
15							
16							
17							
18							
19							
20							



Klohn Crippen Berger

PROJECT NO.: P09625 A06

PROJECT: Fraser Valley Institute Inmate Housing

LOCATION: Abbotsford, BC

LOGGED BY: AP

CHECKED BY:

SHEET 2 OF 2

HOLE NO.: BK10-01





# APPENDIX F

## Chemical Analysis



Your P.O. #: 16300R-20  
 Your Project #: 1233 10756-200 MATSQUI INSTITU  
 Site Location: ABBOTSFORD  
 Your C.O.C. #: G045916

**Attention: Ben Huynh**  
 STANTEC CONSULTING LTD  
 BURNABY - NATIONAL CONTRACT  
 4370 DOMINION ST. 5TH FLOOR  
 BURNABY, BC  
 Canada V5G4L7

Report Date: 2011/11/22

## CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B1B1008**  
**Received: 2011/11/15, 14:30**

Sample Matrix: Soil  
 # Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Conductivity (Soluble)	2	2011/11/18	2011/11/19	BBY6SOP-00029	SM-2510 B
pH (2:1 DI Water Extract)	2	2011/11/17	2011/11/17	BBY6SOP-00028	Carter, SSMA 16.2
Saturated Paste	2	2011/11/18	2011/11/18	BBY6SOP-00030	Carter SSMA 18.2.2
Sulphate (soluble) (soil)	2	2011/11/22	2011/11/23	BBY6SOP-00017	SM 4500-SO42- E

\* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

TABITHA RUDKIN, Project Manager  
 Email: TRudkin@maxxam.ca  
 Phone# (604) 638-2639

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B1B1008  
Report Date: 2011/11/22

STANTEC CONSULTING LTD  
Client Project #: 1233 10756-200 MATSQUI INSTITU  
Site Location: ABBOTSFORD  
Your P.O. #: 16300R-20  
Sampler Initials: CG

## RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		CD1633	CD1634		
Sampling Date		2011/11/09 09:00	2011/11/09 09:15		
	Units	TP11-2 @ 1'-2 FT	TP11-2 @ 39"	RDL	QC Batch
<b>ANIONS</b>					
Soluble Sulphate (SO4)	mg/L	<10	17	10	5384540
<b>Physical Properties</b>					
Soluble (2:1) pH	pH Units	6.24	6.12	0.01	5367731
<b>Soluble Parameters</b>					
Soluble Conductivity	uS/cm	52.3	57.2	1.0	5374401
Saturation %	%	77.4	39.3	1.0	5374386

## QUALITY ASSURANCE REPORT

QC Batch	Parameter	Date	Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
5367731	Soluble (2:1) pH	2011/11/17	101	96 - 104			0.9	20
5374386	Saturation %	2011/11/18	99	80 - 120	<1.0	%	1.6	30
5374401	Soluble Conductivity	2011/11/19	100	80 - 120	<1.0	uS/cm	0.2	35
5384540	Soluble Sulphate (SO4)	2011/11/23			<10	mg/L		

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.



**Stantec**

**Stantec Consulting Ltd.**  
4370 Dominion Street, 5<sup>th</sup> Floor  
Burnaby, BC V5G 4L7  
Tel: (604) 436-3014  
Fax: (604) 436-3752

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**VIA COURIER**

August 9, 2012

Project No: 1233-10756

**Public Works and Government Services Canada**  
641 – 800 Burrard Street  
Vancouver, BC V6Z 2V8

**Attention: Patrick V. Truong, P.Eng.**

Dear Mr. Truong

**Reference:     Parking Lot Pavement Design**  
**20 Men Living at the Matsqui Institution, Abbotsford, BC**

## **1            INTRODUCTION**

In accordance with your request, Stantec Consulting Ltd. (Stantec) has prepared this letter to provide pavement design recommendations for the proposed asphalt paved parking lot at the proposed 20 Men Living Building at the Matsqui Institution in Abbotsford, BC.

Based on the Site Grading & Landscaping Plan prepared by Wedler Engineering, Sheet CO2, Revision 4, dated June 21, 2012, the parking lot will be located along the southwest side of the proposed building. The parking lot will consist of twenty (20) parking stalls and will serve primarily passenger vehicles with occasional garbage trucks. The entrance to the parking lot will tie into the existing access road along the east side, and the design grades will be similar to the existing site grades.

Based on the site conditions encountered during the Stantec subsurface investigation in November 2011, the soil conditions in the vicinity of the proposed building and parking lot consist of topsoil, sandy silt, sand, sand and gravel, clayey silt and glacial till. Details of the soil conditions are presented in the Stantec Geotechnical report, dated December 1, 2011.

## **2            SITE PREPARATION**

Prior to construction the asphalt paved parking lot and entrance, all topsoil and organic soils should be stripped to expose the native firm to stiff sandy silt. It is anticipated that stripping depths could be in the order of 300 mm to 400 mm. Following stripping, the sandy silt subgrade should be proof-

Reference: **Parking Lot Pavement Design**  
**20 Men Living at the Matsqui Institution, Abbotsford, BC**

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rolled with a smooth drum roller vibratory roller (1.5 m diameter drum) in the presence of a Stantec geotechnical inspector. Any soft and wet areas should be sub-excavated and backfilled with 75 mm minus crushed granular subbase and should be compacted to at least 100% Standard Proctor maximum dry density (SPMDD)

### 3 PAVEMENT DESIGN

Based on the anticipated traffic loading of the parking lot, the recommended pavement section is presented in Table 1.

**Table 1: Design Pavement Section**

Description	Thickness
Asphalt	35 mm Upper Course 45 mm Lower Course
19 mm Minus Granular Base	150 mm
75 mm Minus Crushed Granular Subbase	300 mm


All base and subbase course layers should be compacted to at least 100% SPMDD. Gradation of the base and subbase course layers should be in accordance with the Master Municipal Construction Documents (MMCD) specifications. Asphalt should be compacted to at least 97% Marshall Density.

### 4 CLOSURE

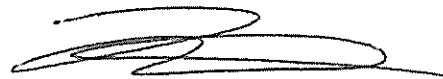
We trust this letter meets your immediate needs. Should you have any questions regarding this letter report, please do not hesitate to contact the undersigned.

Respectfully submitted,

**Stantec Consulting Ltd.**

  
Ben Huynh, P.Eng.  
Geotechnical Engineer  
Aug 9, 2012

Reviewed by:

  
Nigel Denby, M.Eng., P.Eng.  
Senior Principal, Geotechnical

BH/ND

Addendum No 1

## **1 GENERAL**

This Addendum forms part of the Contract Documents and amends the original Electrical Drawings and Specifications. The following revisions supersede the information contained in the original Drawings and Specifications issued to the extent referenced and shall become part thereof. No adjustment to the Contract Price will be considered or allowed due to the Contractor or to any sub-contractor or supplier not being familiar with this Addendum.

## **2 SPECIFICATIONS**

### **2.1 GENERAL**

- .1 **Revise:** All references to CSA C22.1-09 Canadian Electrical Code to read, "CSA C22.1-12 Canadian Electrical Code"

### **2.2 SPECIFICATION 27 11 19 – STRUCTURED CABLING COMMUNICATIONS SYSTEMS**

- .1 **Revise:** Item 2.1.2.3 to read, "Provide one spare 25 pair, Category 3, outside plant cable from Building A CER via the Building A Penthouse IT Room to the Twenty Bed Living Unit Comm. Room 136 for future. Cable shall be terminated on both ends. Provide enough slack in the cable to reach the farthest point in the room. Coordinate termination location with the Departmental Representative on site."
- .2 **Revise:** Item 2.1.3.3 to read, "Provide one spare 12 fiber, multi-mode, 50/125, OM3, outside plant cable from Building A CER via the Building A Penthouse IT Room to the Twenty Bed Living Unit Comm. Room 136 for future. Cable shall be tested and terminated into a lockable cabinet at both ends. Provide enough slack in the cable to reach the farthest point in the room. Coordinate termination location with the Departmental Representative on site."

### **2.3 SPECIFICATION 27 51 16 – PUBLIC ADDRESS SYSTEM**

- .1 **Delete:** Item 1.2.3.

### **2.4 SPECIFICATION 27 51 23 – INTERCOMMUNICATIONS AND PROGRAM SYSTEMS**

- .1 **Add:** Specification with footer reference 'Issued for Electrical Addendum 1' attached.

### **2.5 SPECIFICATION 28 13 27 – SECURITY DOOR SUPERVISION**

- .1 **Replace:** Specification with footer reference 'Issued for Electrical Addendum 1' attached.



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**2.6 SPECIFICATION 28 31 01 – FIRE ALARM SYSTEM**

- .1 **Revise:** Item 1.2.6.3 to read, "Updating of existing fire alarm annunciator graphic(s). Incorporate new Twenty Bed Living Unit complete with floor plans to existing computer based graphic screens."
- .2 **Revise:** Item 2.3.2.2 to read, "Cause electrically operated doors off of Vestibule 131 to be released."
- .3 **Delete:** Item 2.3.2.5.
- .4 **Revise:** Item 2.11.1.1 to read, "Combination type; ionization, smoke detector."
- .5 **Revise:** Item 2.14.1 to read, "80 character, 2 line, LCD alphanumeric type."

**2.7 APPENDIX A – LIGHTING FIXTURE SCHEDULE**

- .1 **Replace:** Schedule with footer reference 'Issued for Electrical Addendum 1' attached.

**2.8 APPENDIX B – MECHANICAL EQUIPMENT SCHEDULE**

- .1 **Replace:** Schedule with footer reference 'Issued for Electrical Addendum 1' attached.

**2.9 APPENDIX C – PANEL SCHEDULE**

- .1 **Revise:** Panel A Mounting to read, "Surface."
- .2 **Revise:** Panel B Mounting to read, "Surface."

**3 DRAWINGS**

**3.1 DRAWING E002**

- .1 **Revise:** Detail B, Key Note 2 to read, "Security lockable cabinet. Ensure sufficient wall space is provided to accommodate a second cabinet for future system expansion. Coordinate cabinet installation with Security System Manufacturer."
- .2 **Revise:** Detail B, Key Note 5 to read, "Communications lockable cabinet. Refer to Drawing E500 for Communications Cabinet Profile."

**3.2 DRAWING E003**

- .1 **Replace:** Detail A, Fire Alarm Riser Diagram with detail shown in ESK-E003-01 attached.
- .2 **Replace:** Detail B, Telecommunication Riser Diagram with detail shown in ESK-E003-02 attached.

- .3 **Revise:** Detail C, Note 2 to read, "Cable to be pulled via new Manhole C10 and existing Manholes C9, C1, C2 and C6 and into the Building A Penthouse IT Room. Coordinate splice and cable installation with the Institution."
- .4 **Revise:** Detail D, Note 3 to read, "Cable to be pulled via new Manhole C10 and existing Manholes C9, C1, C2 and C6, into the Building A Penthouse IT Room and down to the Building A CER via existing cable tray and conduit. Coordinate work with the Institution."
- .5 **Delete:** Detail D, Note 2.
- .6 **Revise:** Detail D service cable description to read, "4 F, 12 MM, 62.5/125, CM3, OSP fiber cable to Building A CER via Building A Penthouse IT Room."

### 3.3 DRAWING E101

- .1 **Add:** General Note 3 to read, "Manhole checker plate lid to be shipped to site with manhole identification number. Verify identification requirements with Departmental Representative during the shop drawing submittal process."

### 3.4 DRAWING E201

- .1 **Revise:** Level 2 Lighting Layout with ESK-E201-01 attached.

### 3.5 DRAWING E300

- .1 **Revise:** Key Note 5 to read, "2 x 103 mm ducts for elevator power and control. 1 x 27 mm duct for elevator cab lighting complete with a local fused disconnect connected to a dedicated 15 A, 120 V circuit (Circuit C-59). Coordinate requirements and installation with Elevator Contractor on site."
- .2 **Add:** One 'Housekeeping Receptacle' to the south wall of Vestibule 100. Connect receptacle to Circuit A-8.

### 3.6 DRAWING E301

- .1 **Add:** One 'Housekeeping Receptacle' to the south wall of Vestibule 200. Connect receptacle to Circuit B-8.
- .2 **Add:** Key Note 2 to read, "Exhaust Fan located in Attic Space above. Coordinate with Mechanical Contractor on site." Key Note 2 to point to exhaust fans EF-4 and EF-5 in Admin Area 249 and Vestibule 200 respectively.

### 3.7 DRAWING E400

- .1 **Revise:** Key Note 1 to read, "63 mm and 41 mm conduits terminated into two 152 mm x 152 mm x 102 mm junction boxes (one for power and one for comm.) for future multimedia equipment. Rough-in requirements to be reviewed with Departmental Representative on site prior to rough-in."
- .2 **Add:** One structured cabling outlet (OT/1D) to the south wall of Multipurpose/Activity Room 146 adjacent to the future media equipment.

- .3 **Revise:** Structured cabling outlet on north wall of Multipurpose/Activity Room 146 to read, "1T/2D"
- .4 **Add:** One structured cabling outlet (0T/1D) to the south wall of Multipurpose/Activity Room 147 adjacent to the future media equipment.
- .5 **Add:** One structured cabling outlet (0T/1D) to the south wall of Visit Room 145 adjacent to the future media equipment.
- .6 **Revise:** Relocate Key Note 3 in Corridor 116 to Mech. Room 112. Key note to point to fire alarm control relay module.
- .7 **Add:** One fire alarm horn and strobe to east wall of Mech. Room 112.
- .8 **Relocate:** Vestibule 131 fire alarm pull station to the east side of Door 131b; latch side
- .9 **Relocate:** Vestibule 149 fire alarm pull station to the north side of Door 148; latch side
- .10 **Add:** One wall mounted telephone outlet in Corridor 148 located on the east wall of Storage 126a complete with Key Note 7 reference.

### 3.8 DRAWING E401

- .1 **Revise:** Key Note 1 to read, "63 mm and 41 mm conduits terminated into two 152 mm x 152 mm x 102 mm junction boxes (one for power and one for comm.) for future multimedia equipment. Rough-in requirements to be reviewed with Departmental Representative on site prior to rough-in."
- .2 **Revise:** Structured cabling outlets on north and south walls of Meeting Room 246 to read, "1T/2D"
- .3 **Delete:** One fire alarm smoke detector in Shared Office 237.
- .4 **Clarification:** Hardware Controller in Admin. Area 249 shall be connected to the Door 249 Electric Strike via a 21 mm EMT conduit. Coordinate work with Door Supplier.
- .5 **Add:** One structured cabling outlet (0T/1D) to the north wall of Multipurpose/Activity Room 233 adjacent to the future media equipment.
- .6 **Revise:** Relocate Key Note 3 in Corridor 216 to Mech. Room 212. Key note to point to fire alarm control relay module.
- .7 **Delete:** One fire alarm control relay module in Corridor 216.
- .8 **Add:** One fire alarm horn and strobe in Inmate Effects Storage 243; located on the latch side of the door.

### 3.9 DRAWING E500

- .1 **Revise:** Detail D; relocate UPS from Cabinet 1 to 2.

## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Division 01 – Submittal Procedures
- .2 Section 26 05 00 – Common Work

### **1.2 REFERENCES**

- .1 Install in accordance with CSA C22.12, electrical bulletins and local by laws

### **1.3 SYSTEM DESCRIPTION**

- .1 The video intercom system shall be used for communication between staff members and/or inmates with the master station in the Open CX 133 with the following functionality:
  - .1 Answering slave station call in hands free mode:
    - .1 Press call button
    - .2 Chime tone sounds, caller is seen on video monitor and outside sound is heard
    - .3 Audio and video turn off after approximately 45 seconds if not answered.
    - .4 Press talk button momentarily, then communicate hands-free. Red transmit LED lights when you talk and goes off as you listen to caller or hear sounds
    - .5 Press talk button once to end call
  - .2 Outdoor slave station monitoring:
    - .1 Press monitor button
    - .2 Video monitor displays image from door station and incoming audio is heard. Sound from inside is not heard outside
    - .3 Press monitor button again to end
    - .4 When busy tone sounds while pressing talk button, another station is in use

### **1.4 SUBMITTALS**

- .1 Submit shop drawings in accordance with the requirements of Section 26 05 00 – Common Work.
- .2 Include wiring diagrams to indicate wiring for each item of equipment and interconnections between items of equipment.
- .3 Include manufacturer's model numbers, ratings, power requirements, equipment layout and device arrangements.
- .4 Two year warranty letter which is to commence from the date of Substantial Completion.

---

## **2 PRODUCTS**

### **2.1 MANUFACTURER**

- .1 Aiphone Corporation, JF Series or approved equal.

### **2.2 MASTER STATION**

- .1 JF-2MED Model:
  - .1 Remote mounted power supply (Model No.: PS-1820UL). Master station shall be wall mounted.
  - .2 Calling; chime, image and audio for approximately 45 seconds.
  - .3 Communication; automatic hands-free
  - .4 Camera; colour CCD
  - .5 Video monitor; 3.5 inch direct view TFT colour LCD, 525 scanning lines, minimum illumination of 5 lux at 1 foot

### **2.3 OUTDOOR SLAVE STATION**

- .1 JF-DVF Model:
  - .1 Vandal resistant, weather resistant, stainless steel faceplate complete with 5 Pin TORX Screws
  - .2 Flush mounted
  - .3 Microphone, speaker and call button
  - .4 Camera; colour CCD with white illuminator LEDs
  - .5 Operating temperatures; -10 degrees C to 60 degrees C

### **2.4 INDOOR SLAVE STATION**

- .1 JF-2SD Model:
  - .1 Audio only
  - .2 Microphone, speaker, call and talk buttons
  - .3 Receive and chime tone volume control

### **2.5 WIRE AND CABLE**

- .1 Factory manufactured field interface cables to be provided, as required, for all devices.
- .2 Wiring from master station to slave station shall be one single pair #22 AWG (signal) and one single pair #18 AWG (power) installed in a conduit no smaller than 21 mm EMT.
- .3 Wires shall not be nicked, have strands removed, or have frayed strands when removing insulation or terminating. Nicked wires shall be replaced with new.
- .4 Wiring to conform to manufacturer's recommendations and shall be supervised for opens, shorts or tampering.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install video intercom system in accordance with manufacturer's recommendations at locations indicated on Drawings.
- .2 Mount equipment plumb, level, square and secure

**3.2 TESTING AND ADJUSTING**

- .1 Arrange and pay for testing & adjusting of the system by a qualified manufacturer representative.
- .2 Adjust video intercom system for proper operation in accordance with manufacturer's recommendations.
- .3 Test system components to ensure correct operation of system. Final system test shall be completed a qualified manufacturer representative in the presence of the Departmental Representative.
- .4 If tests do not conform to manufacturer requirements, repair, replace, adjust, or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

**3.3 DEMONSTRATION AND TRAINING**

- .1 Demonstrate to the operational personnel that the video intercom system functions properly. Demonstration to be performed by a qualified manufacturer representative at the completion of the final system test.
- .2 Provide instruction and training to operational personnel by a qualified manufacturer representative. Allow for three separate training sessions.

END OF SECTION

---

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - Submittal Procedures
- .2 Section 26 05 00 – Common Work
- .3 Section 26 05 31 - Splitters, Junction Boxes, Pull Boxes, and Cabinets

**1.2 REFERENCES**

- .1 C22.1-12 – Canadian Electrical Code, Part 1

**1.3 SCOPE OF WORK**

- .1 An existing Security Door Supervision System is being used to monitor the doors of various inmate living units at Fraser Valley Institution. The supervised doors installed under this contract shall be connected to the existing system. Modifications to the existing system shall be performed by Senstar. The intent is for Senstar's work to be co-ordinated with and carried by the Contractor.
- .2 Senstar shall be responsible for the following:
  - .1 Supply and terminate at the security control panel in Communication Room 136.
  - .2 Provide all necessary hardware and software upgrades for a complete and fully operational system.
  - .3 Connection to the existing system, modifications of the FASS touch screen interface, system programming, testing, verification and commissioning.
  - .4 Provide product submittals, operational and maintenance manuals and update existing as-built drawings.
- .3 Contractor shall be responsible for the following:
  - .1 Supply, install, terminate and test the four core, 62.5/125, MM dedicated fibre from the existing security system located in the Building A CER Room to Communication Room 136.
  - .2 Install the security control panel in Communication Room 136. Coordinate work with the manufacturer.
  - .3 Provide conduit, junction boxes, back boxes, door position switches and wire from the security control panel in Communications Room 136 to the door position switches.
  - .4 Terminate wires to the field devices.
- .4 Corresponding door frame junction boxes shall be provided by the door manufacturer. Coordinate door rough-in requirements with door manufacturer/door installer on site.

**1.4 SYSTEM DESCRIPTION**

- .1 The alarm annunciation, control and communication system shall annunciate and display the door position switches on the existing FAAS system.

- .2 Alarm processing operations shall be performed using a keyboard, mouse, trackball and/or touch screen monitor. All system events, operator actions and maintenance information shall be stored on the computer hard disk to maintain a permanent record of system activity.
- .3 The system shall provide the capability of creating site specific maps and databases. The system shall be programmable for the unique alarm response requirements. Site information and alarm data shall be displayed on color maps.
- .4 The alarm signal communications network shall be designed specifically for security monitoring applications. The network shall provide communications between a centralized control facility and the remote security devices.
- .5 Provide a complete data network that will connect the system, monitoring station, I/O modules and devices in accordance with Division 27.

## **1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Division 01.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Division 01.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Division 01.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten, and place in designated area for recycling.

## **2 PRODUCTS**

### **2.1 MANUFACTURER**

- .1 Senstar; Contact: Tom Coxford, Phone: 1-800-390-5796, Email: [tcoxford@senstar.com](mailto:tcoxford@senstar.com)

### **2.2 NETWORK DEVICE**

- .1 Transponder Unit:
  - .1 16 programmable inputs; connects to network controller via redundant RS-485 multi-drop data lines.
  - .2 16 VAC output, 120 VAC input, 60 Hz
  - .3 Lockable enclosure complete with tamper switch and mounting rails for media converter



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**2.3 DOOR POSITION SWITCHES**

- .1 Door position switches and magnets suitable for flush mounting on doors in high security locations, non-biased, Form C, 25 mm diameter, 25 mm gap.
- .2 Door position switches to be equipped with a 2K2 ohm resistor across the terminals.
- .3 Acceptable products: General Electric Magnetic Steel Door Contact, Model No.: 1076W.

**2.4 CABLING**

- .1 2 conductor, #18 AWG twisted, PVC jacket.
- .2 Provide a dedicated home run from each device back to the control panel.

**3 EXECUTION**

**3.1 TESTING AND COMMISSIONING**

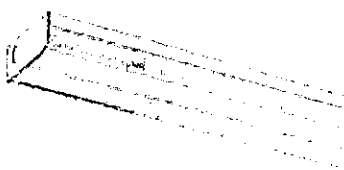
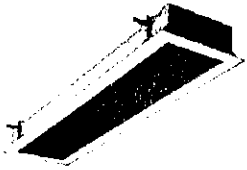
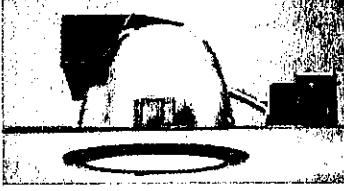
- .1 Provide a detailed Acceptance Test Procedure (ATP) to the Departmental Representative for approval at least two weeks prior to the start of the installation of the Door Supervision System.
- .2 Complete all the tests outlined in the ATP prior to the ATP testing being carried out by the Departmental Representative.
- .3 The equipment warranty will commence on the date the ATP test is carried out by the Departmental Representative.

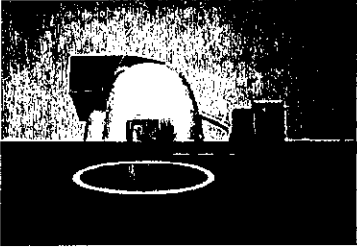
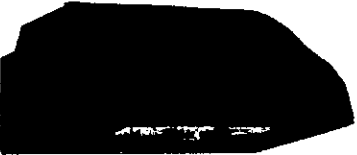


END OF SECTION

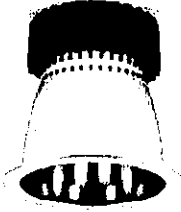
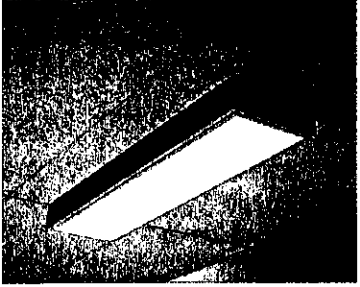
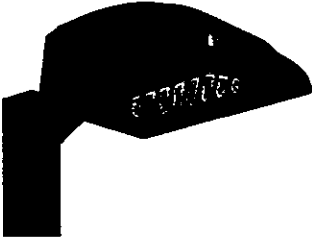
## LIGHTING FIXTURE SCHEDULE

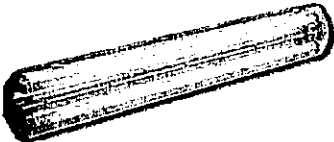
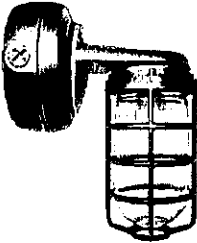
### General Notes:

- All lighting fixtures shall meet the general requirements as specified in Section 26 50 00
- Manufacturers catalogue numbers must be verified with the luminaire description and confirmed with the vendor

Type	Detail	Description
<b>A</b>		<b>Under Shelf Task Luminaire</b> 62mm W x 27mmH x 1174mm L <i>Rating:</i> Interior, Dry Location <i>Lens:</i> Ribbed white opal acrylic <i>Housing:</i> Die-formed code gauge cold rolled steel. White baked enamel finish <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> One 28W, T5, 4100°K fluorescent lamp <b>Acceptable Product or Approved Equal:</b> <b>CFI: TSL-4-1-28-UNV-PG-HCO</b>
<b>B</b>		<b>Recessed Hard Ceiling Luminaire</b> 305mm W x 140mm H x 1220mm L <i>Rating:</i> Interior, Dry Location, Vandal Resistant <i>Lens:</i> 3.2mm K12 lens (fixture side) and 3.2mm clear polycarbonate lens (environment side), continuous piano hinge and 5 point TORX screws plus screws for lens frame support. <i>Housing:</i> 14 gauge steel with baked acrylic enamel paint, overlapped and welded corners, 14 gauge steel double door frame secured by up to 5 – 5 point TORX screws. Door frame comes complete with piano hinge <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamps and one 3W LED night light <b>Acceptable Product or Approved Equal:</b> <b>CFI: RV-X-1-F-XD-US-2-28-UNV-PG-NL3LED</b>
<b>C</b>		<b>Recessed Hard Ceiling Downlight Luminaire</b> 229mm D x 229mm H <i>Rating:</i> Interior, Dry/Wet Location, Vandal Resistant <i>Lens:</i> Flat polycarbonate lens <i>Housing:</i> Die cast aluminium <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Efficiency:</i> 43% <i>Lamp Loading:</i> Two 42W TTT, 4100°K compact fluorescent lamp <b>Acceptable Product or Approved Equal:</b> <b>Lightolier: 8098VWH-8242HUV</b>

D		<p><b>Recessed Gird Ceiling Downlight Luminaire</b>            219mm D x 203mm H  <i>Rating:</i> Interior, Dry Location  <i>Reflector:</i> 16 gauge specular aluminium, clear low iridescence finish, self-flanged white trim  <i>Housing:</i> Die cast aluminium  <i>Ballast:</i> Instant start  <i>Input Power:</i> 120V  <i>Efficiency:</i> 72%  <i>Lamp Loading:</i> Two 26W TTT, 4100°K compact fluorescent lamp  <b>Acceptable Product or Approved Equal:</b>  <b>Lightolier: 8038CCLW-S8242BU</b></p>
F		<p><b>Exterior Wall Mounted Luminaire</b>  <i>Rating:</i> Exterior  <i>Lens:</i> Clear Glass  <i>Distribution:</i> Type 2, Full Cut-Off  <i>Housing:</i> Heavy duty die-cast aluminium with electrostatic powder coated black finish  <i>Driver:</i> Electronic LED Class 2, THD &lt; 20%, High Power Factor, Operating Temperature -40C to 50C  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 100W, 4000°K White LEDs, 4000 Lumens  <b>Acceptable Product or Approved Equal:</b>  <b>Keene: NXFP-L-30-40-X-2-LED-A2-1-B</b></p>
G		<p><b>Recessed Wall Luminaire</b>            205mm W x 85mm H x 120mm D  <i>Rating:</i> Interior, Dry Location, Vandal Resistant  <i>Housing:</i> Die-cast Aluminium  <i>Lens:</i> 4mm Thick Toughened Glass  <i>Ballast:</i> Integral Electronic Power Supply  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> Three 1.2W CREE LEDs  <b>Acceptable Product or Approved Equal:</b>  <b>Sisternalux: S.4679-SPS001535</b></p>
H		<p><b>Recessed Grid Ceiling Luminaire</b>            610mm W x 127mm H x 1220mm L  <i>Rating:</i> Interior, Dry Location  <i>Lens:</i> Pattern 12 prismatic virgin acrylic  <i>Housing:</i> Steel with baked acrylic enamel paint (86% reflectance), one piece embossed, flat steel door, mitered lens frames, flange and trim, spring loaded latches  <i>Ballast:</i> Instant Start Electronic  <i>Input Power:</i> 120V  <i>Efficiency:</i> 81%  <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamps  <b>Acceptable Product or Approved Equal:</b>  <b>CFI: SP-S-2-G-FS-VA-2-28-UNV-PG</b></p>

J		<p><b>Recessed Gird Ceiling Downlight Luminaire</b>          131mm D x 153mm H  <i>Rating:</i> Interior, Dry Location  <i>Reflector:</i> 18 gauge specular aluminium, clear low iridescence finish, self-flanged white trim  <i>Housing:</i> Die cast aluminium  <i>Electronic Driver:</i> Overload and short circuit protected, thermal regulation against overheating, sound rating 'A'  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 16 high brightness royal blue LED array, 4000°K  <i>Dimmer:</i> Lutron Diva. Model No.: DVELV-300P  <b>Acceptable Product or Approved Equal:</b>  <b>Lightolier: C4L10N1/C4L10DL40K-CCLW</b></p>
K		<p><b>Surface Mounted Fluorescent Luminaire</b>          305mm W x 127mm H x 1220mm L  <i>Rating:</i> Interior, Dry Location, Vandal Resistant  <i>Lens:</i> 3.2mm K12 lens (fixture side) and 3.2mm clear polycarbonate lens (environment side), continuous piano hinge and 5 point TORX screws plus screws for lens frame support.  <i>Housing:</i> 14 gauge steel with baked acrylic enamel paint, overlapped and welded corners, 14 gauge steel double door frame secured by up to 5 – 5 point TORX screws. Door frame comes complete with piano hinge  <i>Ballast:</i> Instant Start Electronic  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamp  <b>Standard of Acceptance or Approved Equal:</b>  <b>CFI :- RV-X-1-S-XD-US-2-28-UNV-PG</b></p>
P1		<p><b>Pole Mounted Luminaire</b>  <i>Rating:</i> Exterior, Wet Location  <i>Housing:</i> Painted Aluminium  <i>Reflector:</i> Clear Specular Alzak  <i>Lens:</i> Tempered Glass  <i>Distribution:</i> Type 2  <i>Input Power:</i> 120V  <i>Lamp Loading:</i> 100W, 4000°K White LEDs, 4500 Lumens  <i>Pole:</i> 4500mm  <b>Acceptable Product or Approved Equal:</b>  <b>Keene: NXEL-B-45-40-X-2-LED-A2-1-B</b></p>

<b>P2</b>	<b>Twin Head Version of Type P1</b>	<b>Pole Mounted LED Luminaire</b> <i>Rating:</i> Exterior, Wet Location <i>Housing:</i> Painted Aluminium <i>Reflector:</i> Clear Specular Alzak <i>Lens:</i> Tempered Glass <i>Distribution:</i> Type 2 <i>Input Power:</i> 120V <i>Lamp Loading:</i> 100W, 4000°K White LEDs, 4500 Lumens <i>Pole:</i> 4500mm <b>Acceptable Product or Approved Equal:</b> <b>Keene: NXEL-B-45-40-X-2-LED-A2-1-B</b>
<b>S</b>		<b>Suspended Fluorescent Luminaire</b> 273mm W x 1220mm L <i>Rating:</i> Interior, Damp Location <i>Housing:</i> Injection moulded plastic, sealed <i>Ballast:</i> Instant Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> Two 28W, T5, 4100°K fluorescent lamp <b>Acceptable Product or Approved Equal:</b> <b>CFI: VTN-4-2-28-HCO-ST-UNV-HI</b>
<b>X</b>		<b>Surface Wall Mounted Luminaire</b> <i>Rating:</i> Interior, Dry Location <i>Housing:</i> Painted Steel <i>Shielding:</i> Tempered glass lens <i>Ballast:</i> Rapid Start Electronic <i>Input Power:</i> 120V <i>Lamp Loading:</i> 42W, Double Tube CFL <b>Acceptable Product or Approved Equal:</b> <b>Guth: VPW-42T</b>

Mechanical Equipment Schedule

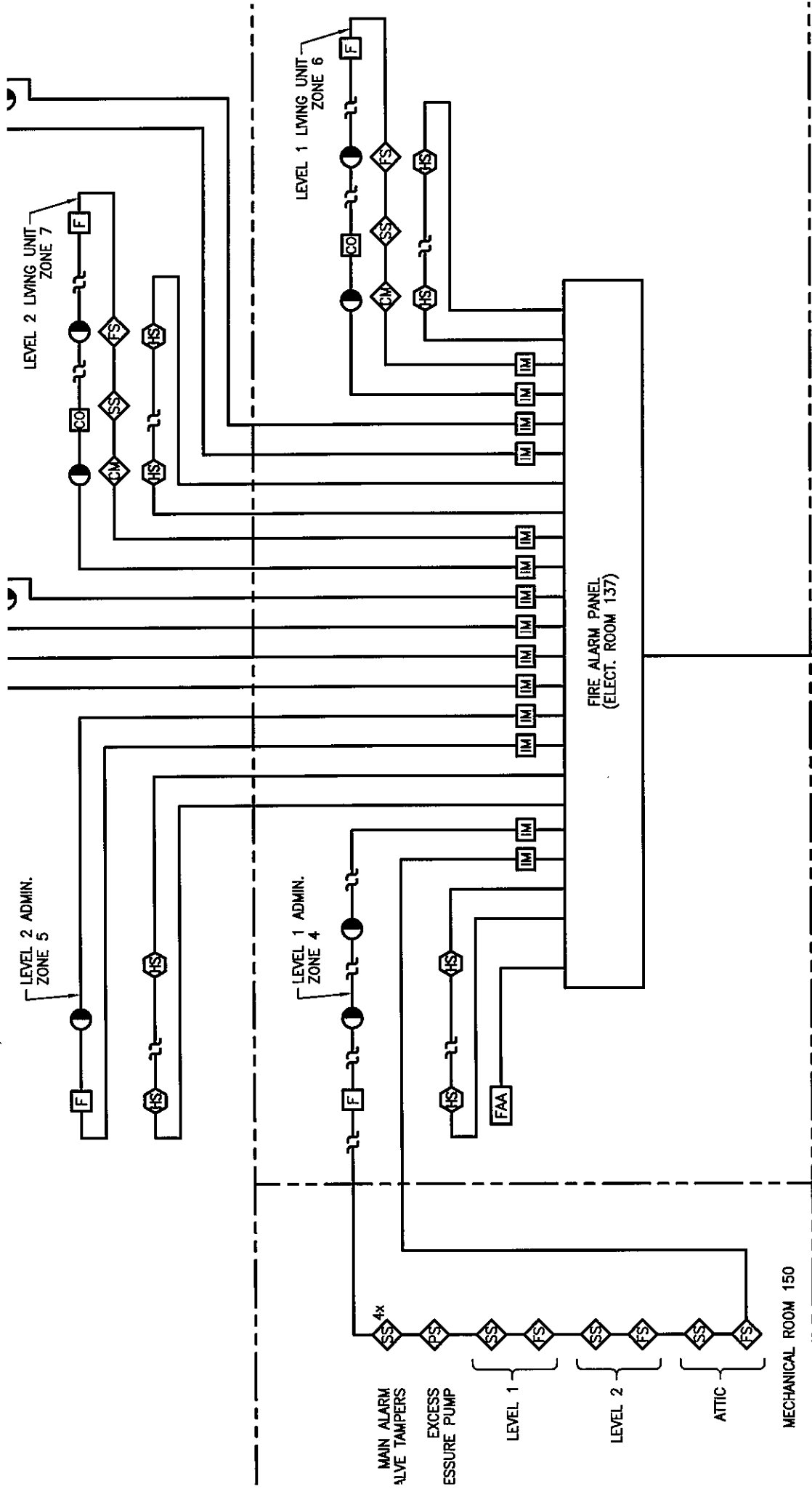
Appendix B

UNIT ID.	UNIT DESCRIPTION	UNIT LOCATION	HP	KW	MCA	VOLT	PH	STARTER TYPE	STARTER BY	DISC SW BY	FED FROM	PROTECTION	FEEDER	NOTES
AHU-1	Main Building Level 1 Air Handling Unit	Mechanical Room 150			15	600	3		M	E	DP-1	20A, 3P	21mmC, 3C #12 + G	1
AHU-2	Main Building Level 2 Air Handling Unit	Mechanical Room 150			15	600	3		M	E	DP-1	20A, 3P	21mmC, 3C #12 + G	1
AC-1	Comm Room Air Conditioning Unit	Comm Room 136											21mmC, 3C #12 + G	2
CU-1	Condensing Unit for AC-1	Site			20	120	1	G-2.4	E	E	Panel C	30A, 1P	21mmC, 2C #10 + G	
CU-2	Condensing Unit for AHU-2	Site				600	3		M	E	DP-1	30A, 3P	27mmC, 3C #10 + G	
FU-1	Living Unit Level 1 Furnace	Mechanical Room 112				120	1	G-2.4	E	E	Panel A	20A, 1P	21mmC, 2C #12 + G	
FU-2	Living Unit Level 2 Furnace	Mechanical Room 212				120	1	G-2.4	E	E	Panel B	20A, 1P	21mmC, 2C #12 + G	
HRV-1	Main Building Level 1 Heat Recovery	Mechanical Room 150	1/2			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
HRV-2	Main Building Level 2 Heat Recovery	Mechanical Room 150	1/2			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
HRV-3	Living Unit Level 1 Heat Recovery	Mechanical Room 112		0.5		120	1	G-2.4	E	E	Panel A	15A, 1P	21mmC, 2C #12 + G	
HRV-4	Living Unit Level 2 Heat Recovery	Mechanical Room 212		0.5		120	1	G-2.4	E	E	Panel B	15A, 1P	21mmC, 2C #12 + G	
EF-1	Electrical Room Exhaust Fan	Electrical Room 137		0.328		120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
EF-2	Smudging Exhaust Fan	Multipurpose 147		0.455		120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
EF-3	Mechanical Room Exhaust Fan	Mechanical Room 150		0.325		120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
EF-4	Attic Exhaust Fan	Admin. Area Attic		0.14		120	1	G-2.4	E	E	Panel D	15A, 1P	21mmC, 2C #12 + G	
EF-5	Attic Exhaust Fan	Living POD Attic		0.14		120	1	G-2.4	E	E	Panel D	15A, 1P	21mmC, 2C #12 + G	
RH-1	Living Unit Level 1 Kitchen Hood Fan	Kitchen 118			2.9	120	1	N/A			Panel A	15A, 1P	21mmC, 2C #12 + G	
RH-2	Living Unit Level 1 Kitchen Hood Fan	Kitchen 118			2.9	120	1	N/A			Panel A	15A, 1P	21mmC, 2C #12 + G	
RH-3	Living Unit Level 2 Kitchen Hood Fan	Kitchen 218			2.9	120	1	N/A			Panel B	15A, 1P	21mmC, 2C #12 + G	
RH-4	Living Unit Level 2 Kitchen Hood Fan	Kitchen 218			2.9	120	1	N/A			Panel B	15A, 1P	21mmC, 2C #12 + G	
B-1	Condensing Boiler	Boiler Room 150a			15	120	1	G-2.4	E	E	Panel C	20A, 1P	21mmC, 2C #12 + G	
B-2	Condensing Boiler	Boiler Room 150a			15	120	1	G-2.4	E	E	Panel C	20A, 1P	21mmC, 2C #12 + G	
P-1	Boiler 1 Circulator	Boiler Room 150a	1/2			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
P-2	Boiler 2 Circulator	Boiler Room 150a	1/2			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
P-3	Heating Water Pump	Boiler Room 150a	2			208	3	VFD	M	E	Panel C	15A, 3P	21mmC, 3C #12 + G	
P-4	Heating Water Pump	Boiler Room 150a	2			208	3	VFD	M	E	Panel C	15A, 3P	21mmC, 3C #12 + G	
P-5	Domestic Hot Water Circulator	Boiler Room 150a	1/5			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
P-6	Sprinkler Pressure Pump	Mechanical Room 150	1/2			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
FFH-1	Living Unit Level 1 Stair Heater	Stair B1		1.5		120	1	N/A	N/A	E	Panel C	20A, 1P	21mmC, 2C #12 + G	
CUH-1	Hot Water Cabinet Unit Heater	Vestibule 131	Frac.			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
CUH-2	Hot Water Cabinet Unit Heater	Vestibule 149	Frac.			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
CUH-3	Hot Water Cabinet Unit Heater	Stair A1	Frac.			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
UH-1	Hot Water Unit Heater	Mechanical Room 150	Frac.			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	
UH-2	Hot Water Unit Heater	Boiler Room 150a	Frac.			120	1	G-2.4	E	E	Panel C	15A, 1P	21mmC, 2C #12 + G	

[illegible]

## NOTES:

- 1 Single point power connection for supply and air fans
- 2 AC-1 interlocks with CU-1. Provide power wiring between AC-1 and CU-1. Coordinate work with Mechanical Contractor on site
- 3 Coordinate power connection with the Mechanical Contractor on site. Control power to individual dampers by others
- 4 Coordinate power connection with the Mechanical Contractor on site



**NOTES:**

1. FOR QUANTITY OF DEVICES REFER TO FLOOR PLANS.
2. WIRING FOR BOTH SIGNALING AND INITIATION TO BE CLASS A
3. REFER TO MECHANICAL DRAWINGS FOR ACTUAL LOCATIONS OF FLOW, TAMPER, SUPERVISION SWITCHES AND EXCESS PRESSURE PUMP.
4. CABLE TO BE PULLED VIA NEW MANHOLE C10 AND EXISTING MANHOLES C9, C AND INTO BUILDING 'A' PENTHOUSE IT ROOM. COORDINATE WORK WITH THE INS

4F, MM, 50/125, OM3, OSP  
TO BUILDING 'A' FIRE ALARM PANEL  
LOCATED IN PENTHOUSE IT ROOM

ADD ET

# **FIRE ALARM RISER DIAGRAM**

SCALE NONE







TELEPHONE: (604) 736-5421

Drawing No.:  
ESK-E003-01

Jan 03, 2013 - 7:07am  
M:\12\121-14\04-00 Fraser Valley Institution 20-40 Man Unit\DWG\Elect\Issued\011-AddE1 (13Jan03)\Drawings\Esk-E003-01-02 (SystemRiserDia)).dwg

#### EQUIPMENT:

- ① FLOOR MOUNTED COMMUNICATIONS CABINET
- ② REFER TO CONDUIT FILL TABLE FOR CONDUIT SIZE

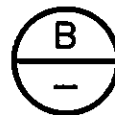
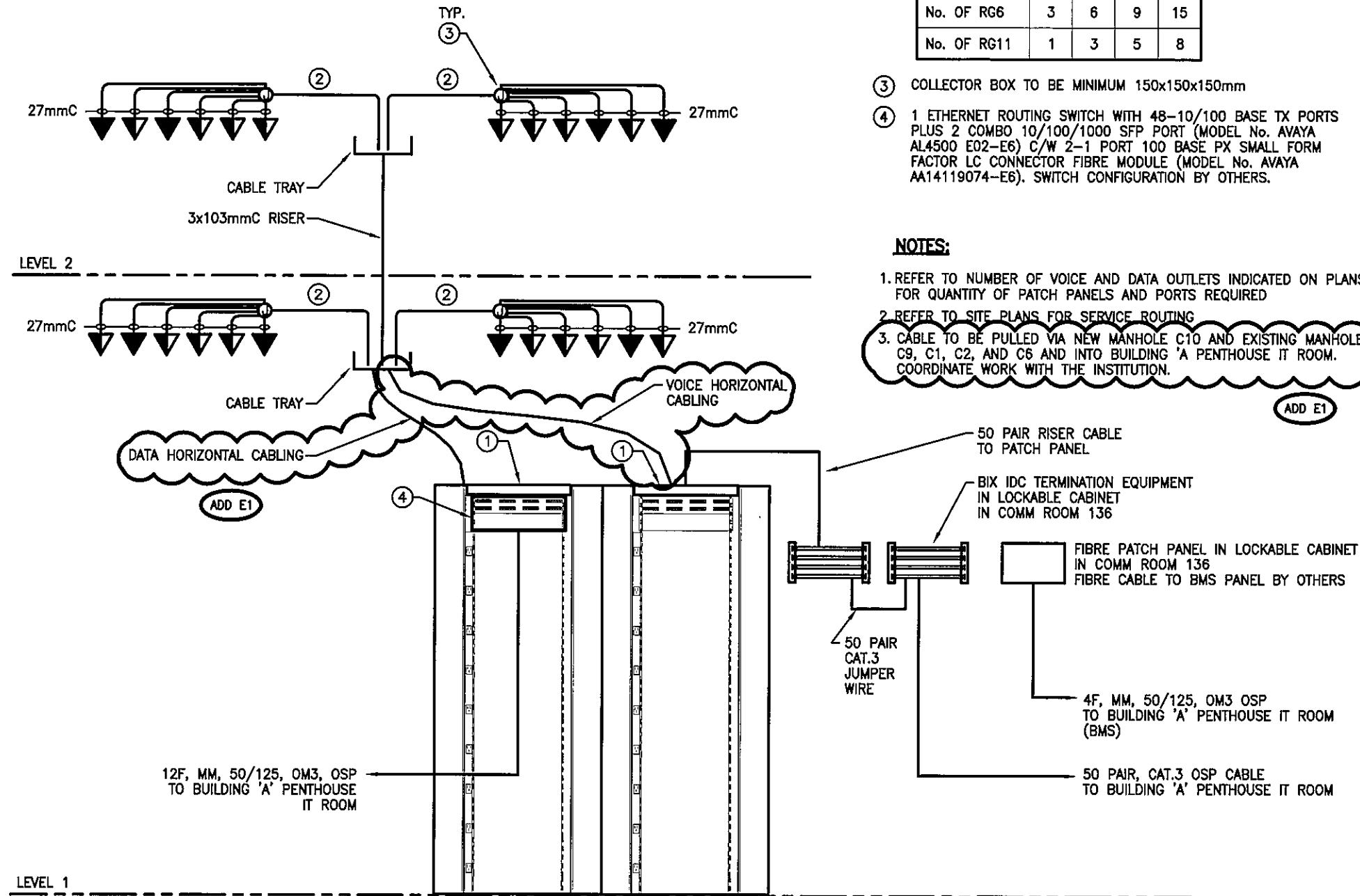
CONDUIT FILL TABLE COMM. WIRE				
CABLE TYPE \ CONDUIT	27	35	41	53
No. OF CAT.6	4	7	10	18
No. OF CAT.6A	2	5	7	13
No. OF RG6	3	6	9	15
No. OF RG11	1	3	5	8

- ③ COLLECTOR BOX TO BE MINIMUM 150x150x150mm
- ④ 1 ETHERNET ROUTING SWITCH WITH 48-10/100 BASE TX PORTS PLUS 2 COMBO 10/100/1000 SFP PORT (MODEL No. AVAYA AL4500 E02-E6) C/W 2-1 PORT 100 BASE PX SMALL FORM FACTOR LC CONNECTOR FIBRE MODULE (MODEL No. AVAYA AA14119074-E6). SWITCH CONFIGURATION BY OTHERS.

#### NOTES:

1. REFER TO NUMBER OF VOICE AND DATA OUTLETS INDICATED ON PLANS FOR QUANTITY OF PATCH PANELS AND PORTS REQUIRED
2. REFER TO SITE PLANS FOR SERVICE ROUTING
3. CABLE TO BE PULLED VIA NEW MANHOLE C10 AND EXISTING MANHOLES C9, C1, C2, AND C6 AND INTO BUILDING 'A' PENTHOUSE IT ROOM. COORDINATE WORK WITH THE INSTITUTION.

ADD E1



#### TELECOMMUNICATION RISER DIAGRAM

SCALE NONE



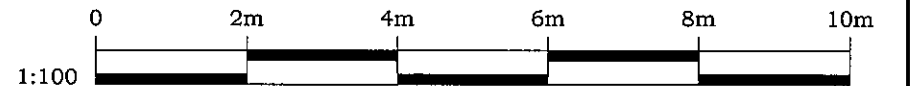
# GENIVAR

1985 WEST BROADWAY, SUITE 200  
VANCOUVER, BRITISH COLUMBIA, CANADA V6J 4Y3  
TELEPHONE: (604) 736-5421  
FAX: (604) 736-1519

CORRECTIONAL SERVICE OF CANADA - FRASER VALLEY INSTITUTION  
33344 KING ROAD, ABBOTSFORD, B.C. - TWENTY BED LIVING UNIT

PART DRAWING E003  
ISSUED FOR ADD-E1

Proj. No. R.052462.001	Scale: NONE	Date: 13 Jan 03	Designed: K.B.	Drawing No.: ESK-E003-02
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### KEY NOTES :

- 3 COORDINATE LIGHTING FIXTURE AND CEILING INSTALLATION WITH SHELLING. (ADD E1)



1985 WEST BROADWAY, SUITE 200  
VANCOUVER, BRITISH COLUMBIA, CANADA V6J 4Y3  
TELEPHONE: (604) 736-5421  
FAX: (604) 736-1519

CORRECTIONAL SERVICE OF CANADA - FRASER VALLEY INSTITUTION  
33344 KING ROAD, ABBOTSFORD, B.C. - TWENTY BED LIVING UNIT

PART DRAWING E201  
ISSUED FOR ADD-E1

Proj. No. R.052462.001
---------------------------

Scale:  
1 : 100

Date:  
13 Jan 03

Designed:  
K.B.

Drawing No.:  
ESK-E201-01

## Addendum No 2

The following changes in the tender documents are effective immediately. This addendum will form part of the contract documents.
--

DRAWING No. S201

- .1 Revise framing plan as per sketch AD-01.

DRAWING No. S202

- .1 Revise framing plan as per sketch AD-02.

DRAWING No. S401

- .1 Revise elevation details of shear wall as per sketches AD-03 & AD-04.

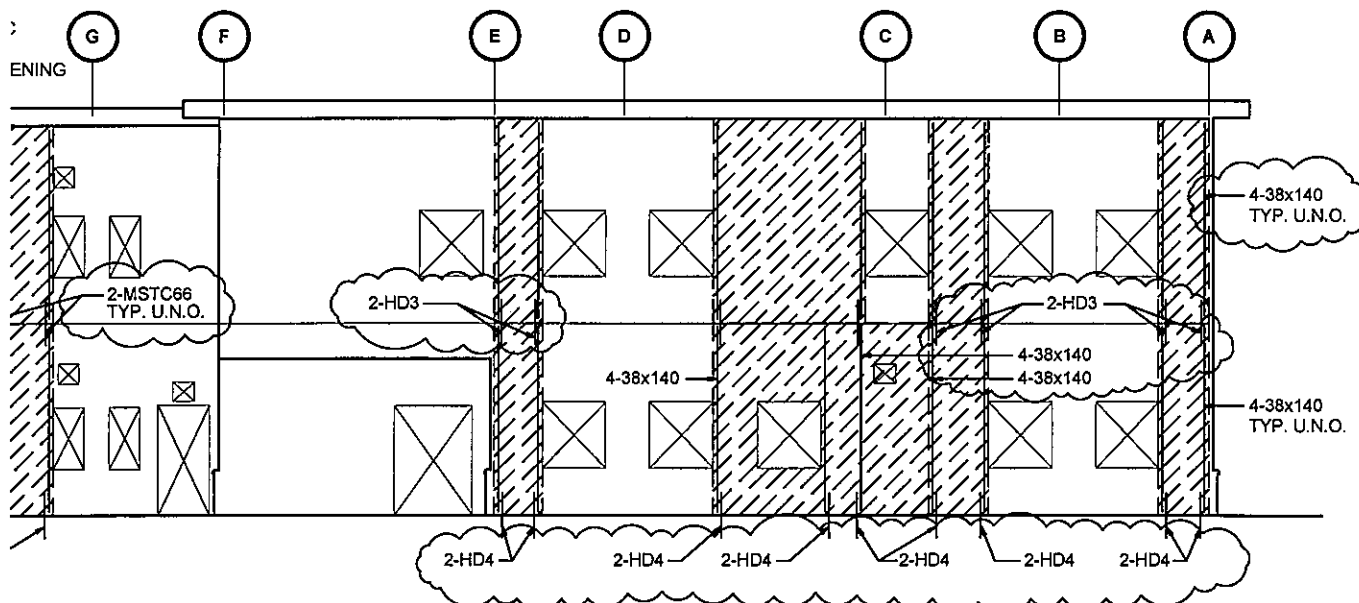
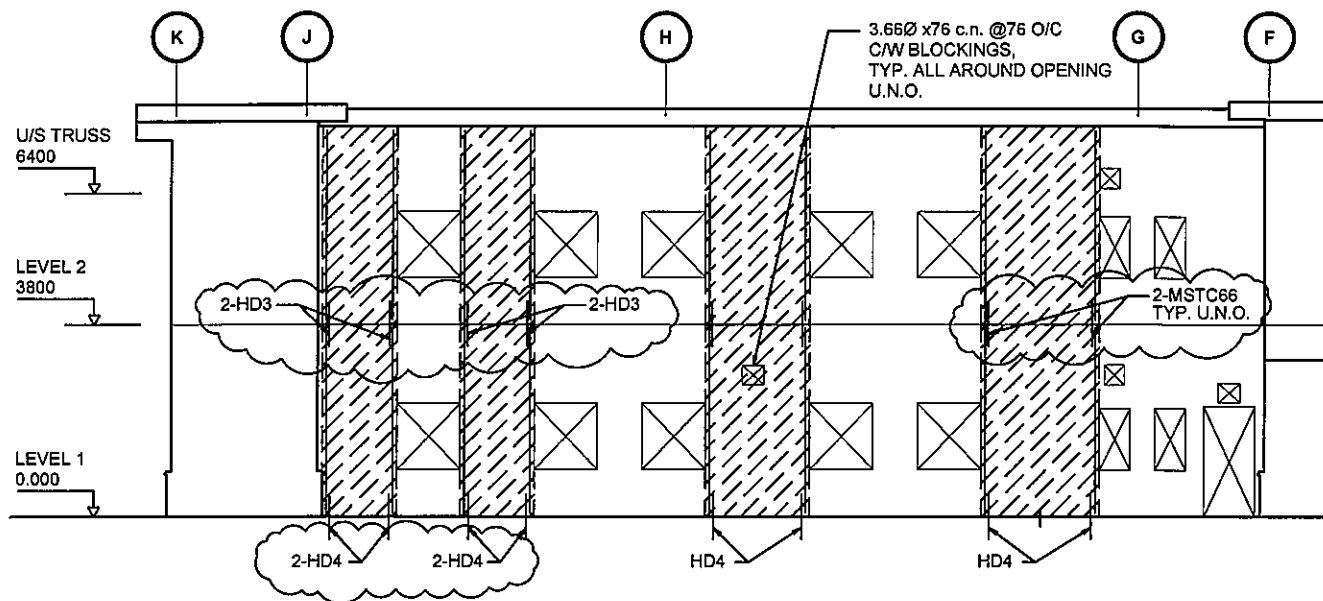
DRAWING No. S402

- .1 Revise shear wall schedule as per sketch AD-05.

**END OF ADDENDUM No. 2**






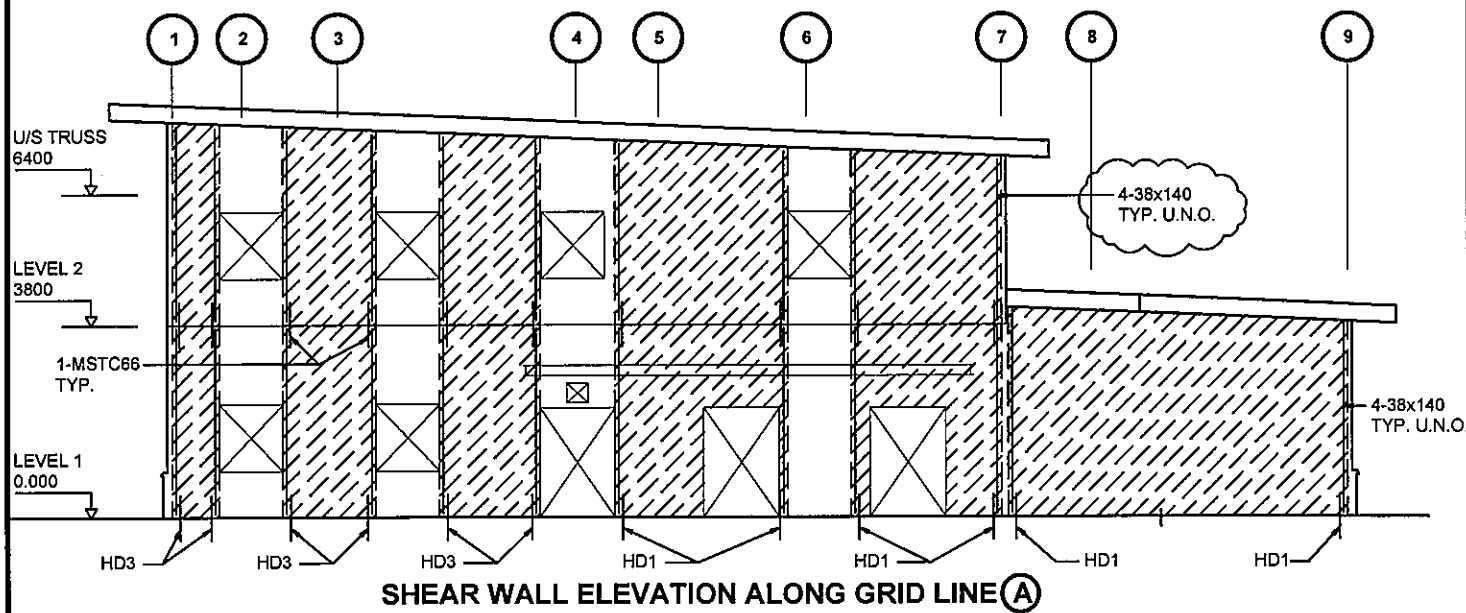


**SHEAR WALL ELEVATION ALONG GRID LINE ① & ③**


11704

project title		titre du projet		drawing title		titre du dessin						
FRASER VALLEY INSTITUTION 33344 KING ROAD, ABBOTSFORD, BC TWENTY BED LIVING UNIT				SHEAR WALL ELEVATION ALONG GRID LINE 1 & 3 REVISED (XREF. DWG. S401)								
	Public Works and Government Services Canada		Travaux publics et Services gouvernementaux Canada		designed by	conçu par	drawn by	dessiné par	scale	échelle	date	date
						LL		LH	AS SHOWN		2013-01-21	
					approved by	PL		approuvé par	project no.		projet no.	
					PWGSC Project Manager	Administrateur de Projets TPSGC			sheet	R.052462.001		feuille
REAL PROPERTY SERVICES Pacific Region				PATRICK TRUONG		AD-03						






11704

project title		titre du projet		drawing title		titre du dessin							
FRASER VALLEY INSTITUTION 33344 KING ROAD, ABBOTSFORD, BC TWENTY BED LIVING UNIT				SHEAR WALL ELEVATION ALONG GRID LINE A REVISED (XREF. DWG. S401)									
	Public Works and Government Services Canada		Travaux publics et Services gouvernementaux Canada		designed by	conçu par	drawn by	dessiné par	scale	échelle	date	date	
					LL		LH		AS SHOWN		2013-01-21		
					approved by		approuvé par		project no.		project no.		
					PL				R.052462.001				
REAL PROPERTY SERVICES Pacific Region				PWGSC Project Manager		Administrateur de Projets TPSGC		sheet		feuille		AD-04	
				PATRICK TRUONG									

# SHEARWALL SCHEDULE

TYPE	STUD SIZE		LEVEL 1 - LEVEL 2	LEVEL 2 - ROOF
SHEAR WALL ALONG GRID LINE ① & ③	38 x 140	SHEATHING	12.5mm PLYWOOD BOTH SIDES	12.5mm PLYWOOD BOTH SIDES
		NAILING @ PANEL EDGES	3.66Ø x 75 LG. NAILS @100 O/C	3.66Ø x 75 LG. NAILS @100 O/C
		BUILT-UP STUDS EA. END	4-38x140 U.N.O.	4-38x140
		HOLD DOWN EACH END	SEE ELEVATION	2-MSTC66 U.N.O.
		BLOCKING TO WALL TOP PLATE	3.66Ø x 75 LG. TOE NAILS @75 O/C E.S. STAGG.	3.66Ø x 75 LG. TOE NAILS @150 O/C E.S. STAGG.
		WALL BOTTOM PLATE	19Ø A.BOLTS @800 O/C	2-ROWS 3.66Ø x 75 LG. NAILS @100 O/C STAGG.
SHEAR WALL ALONG GRID LINE ⑦, ⑩ & ⑬	38 x 140	SHEATHING	12.5mm PLYWOOD BOTH SIDES	12.5mm PLYWOOD ONE SIDE
		NAILING @ PANEL EDGES	3.25Ø x 64 LG. NAILS @75 O/C	3.25Ø x 64 LG. NAILS @100 O/C
		BUILT-UP STUDS EA. END	4-38x140 U.N.O.	2-38x140
		HOLD DOWN EACH END	SEE ELEVATION	2-MSTC66
		BLOCKING TO WALL TOP PLATE	3.66Ø x 75 LG. TOE NAILS @100 O/C E.S. STAGG.	3.66Ø x 75 LG. TOE NAILS @100 O/C E.S. STAGG.
		WALL BOTTOM PLATE	19Ø A.BOLTS @800 O/C	2-ROWS 3.66Ø x 75 LG. NAILS @75 O/C STAGG.
SHEAR WALL ALONG GRID LINE ⑭	38 x 140	SHEATHING	12.5mm PLYWOOD BOTH SIDES	12.5mm PLYWOOD BOTH SIDES
		NAILING @ PANEL EDGES	3.25Ø x 64 LG. NAILS @100 O/C	3.25Ø x 64 LG. NAILS @100 O/C
		BUILT-UP STUDS EA. END	4-38x140 U.N.O.	4-38x140 U.N.O.
		HOLD DOWN EACH END	SEE ELEVATION	SEE ELEVATION
		BLOCKING TO WALL TOP PLATE	3.66Ø x 75 LG. TOE NAILS @75 O/C E.S. STAGG.	3.66Ø x 75 LG. TOE NAILS @100 O/C E.S. STAGG.
		WALL BOTTOM PLATE	19Ø A.BOLTS @800 O/C	2-ROWS 3.66Ø x 75 LG. NAILS @100 O/C STAGG.
SHEAR WALL ALONG GRID LINE ①	38 x 140	SHEATHING	12.5mm PLYWOOD BOTH SIDES	12.5mm PLYWOOD BOTH SIDES
		NAILING @ PANEL EDGES	3.66Ø x 75 LG. NAILS @75 O/C	3.66Ø x 75 LG. NAILS @100 O/C
		BUILT-UP STUDS EA. END	4-38x140	2-38x140
		HOLD DOWN EACH END	SEE ELEVATION	SEE ELEVATION
		BLOCKING TO WALL TOP PLATE	3.66Ø x 75 LG. TOE NAILS @64 O/C E.S. STAGG.	3.66Ø x 75 LG. TOE NAILS @75 O/C E.S. STAGG.
		WALL BOTTOM PLATE	19Ø A.BOLTS @800 O/C	2-ROWS 3.66Ø x 75 LG. NAILS @75 O/C STAGG.
ALONG GRID LINE ⑥ & ⑨		SHEATHING	12.5mm PLYWOOD ONE SIDE	
		NAILING @ PANEL EDGES	3.25Ø x 64 LG. NAILS @100 O/C	
		BUILT-UP STUDS EA. END	2-38x140	

11704

project title <b>FRASER VALLEY INSTITUTION</b> <b>33344 KING ROAD, ABBOTSFORD, BC</b> <b>TWENTY BED LIVING UNIT</b>		titre du projet <b>FRASER VALLEY INSTITUTION</b> <b>33344 KING ROAD, ABBOTSFORD, BC</b> <b>TWENTY BED LIVING UNIT</b>		drawing title <b>SHEAR WALL SCHEDULE</b> <b>REVISED</b> <b>(XREF. DWG. S402)</b>		titre du dessin <b>SHEAR WALL SCHEDULE</b> <b>REVISED</b> <b>(XREF. DWG. S402)</b>	
 Public Works and Government Services Canada  <b>REAL PROPERTY SERVICES</b> Pacific Region	Travaux publics et Services gouvernementaux Canada	designed by LL	drawn by LH	scale AS SHOWN	date 2013-01-21	sheet <b>AD-05</b>	feuille AD-05
		approved by PL		project no. R.052462.001			
		PWGSC Project Manager PATRICK TRUONG		Administrateur de Projets TPSGC			

### Addendum No 3

The following changes in the tender documents are effective immediately. This addendum will form part of the contract documents.

**DRAWING No. S201**

- .1 Add notes, "For elevator hoist way, provide waterproof concrete mix in a single continuous concrete pour for footing to Level 1 floor and in lifts thereafter with normal concrete."
- .2 To clarify P3 locations at A3 and A5/6 for misalignment near GL A, refer to sketches AD-06 & AD-07 For details.

**DRAWING No. S202**

- .1 Add details for the floor framing crosses the 190CMU wall (door face of the hoist way) as shown in sketches AD-08 & AD-09.
- .2 Add header detail with mechanical openings details along GL A7 to E7 as shown in sketches AD-10.
- .3 To clarify interior P2s (Staff Pod) creating structural diaphragm in 2nd floor, connection details in Floor framing, refer to sketches AD-11 & Elevation X-X/S304 for details.

**DRAWING No. S301**

- .1 Alternative option suggested is acceptable as shown in sketch AD-12 but ensure the field welds area where hot dipped galvanized coating was burned away shall be field painted & soaked with Galvacon or Equal.
- .2 Use HD3 in place of post base with post placed atop of bottom plate, typical whenever Post base interfere with holddown HD3 as shown in section 5/201 of S301.

**DRAWING No. S302**

- .1 Material for header 140 x 285 as shown in section A-A shall be D.Fir-L No. 2 or better and PSL header alternative is acceptable.

**DRAWING No. S304**

- .1 Provide 25mm Thick Non Shrink Grout (50MPa) to base plate for HSS columns P2 in Detail C/S304

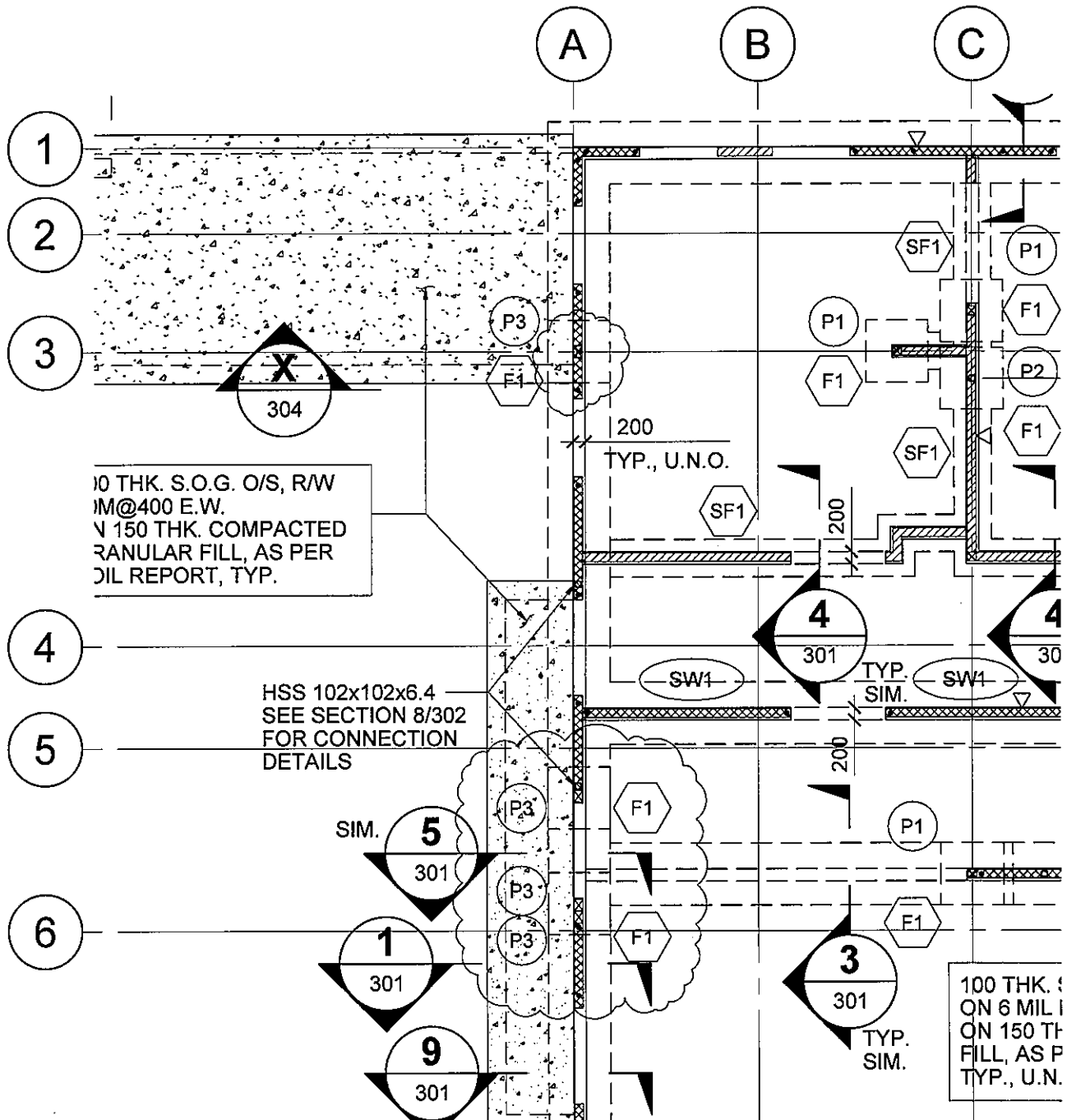
**DRAWING No. S401**

- .1 Revise HD8 to HD1 as noted in "Shear Wall Elevation Along Grid Line 'E' " detail.


**DRAWING No. S402**

- .1 For Shearwall Schedule - plywood on both side, where indicated, provide 12mm Dia. punch holes for inside sheet only with pattern as approved by Departmental Representatives.

**END OF ADDENDUM No. 3**



11704

project title		titre du projet		drawing title		titre du dessin			
FRASER VALLEY INSTITUTION 33344 KING ROAD, ABBOTSFORD, BC TWENTY BED LIVING UNIT				FOUNDATION AND LEVEL 1 FLOOR FRAMING PLAN REVISED (XREF. DWG. S201)					
	Public Works and Government Services Canada	Travaux publics et Services gouvernementaux Canada	designed by LL	concu par	drawn by LH	dessine par	scale 1:100	echelle	date 2013-02-08
	REAL PROPERTY SERVICES Pacific Region		approved by PL		approuve par		project no. R.052462.001		projet no.
			PWGSC Project Manager		Administrateur de Projets TPSCC		sheet AD-06		feuille
			PATRICK TRUONG						

11704



64x286 LEDGER C/W  
12Ø HILTI KWIK BOLTS  
@600 STAGG.  
EMB. MIN. 100, TYP.

38 THK. CONC.  
TOPPING

16m PLYWOOD

38x286 @406 JOIST

2-20M T&B (800 PAST  
OPENING)  
& 10M @406 TIES

900 LAP, TYP.

HEADER

EXTERIOR LOAD BEARING  
MASONRY H/15/A/M (25 MPA)  
W/ 20MPA GROUT  
- 1-20M VERT. @600  
- 1-20M VERT. @ E.S. OF OPENING  
- 3.8mm DIA. LADDER JOINT  
REINF. @400  
- 2-15M IN CONT. BOND BEAM  
W/ 1 BOND BEAM @ TOP WALL  
@ MID WALL  
- HORIZ. DOWELS INTO CONC.  
WALL W/ 6" MIN. EMBED.

SECTION

1:20

19

202

11704

project title

**FRASER VALLEY INSTITUTION  
33344 KING ROAD, ABBOTSFORD, BC  
TWENTY BED LIVING UNIT**

titre du projet

drawing title

**SECTION 19  
ADDED  
(XREF. DWG. S302)**

titre du dessin



Public Works and  
Government Services  
Canada

Travaux publics et  
Services gouvernementaux  
Canada

**REAL PROPERTY SERVICES  
Pacific Region**

designed by

conçu par

drawn by

dessiné par

scale

echelle

date

LL

LH

AS SHOWN

2013-02-08

approved by

approuvé par

project no.

projet no.

PL

**R.052462.001**

PWSC Project  
Manager

Administrateur de Projets  
TPSGC

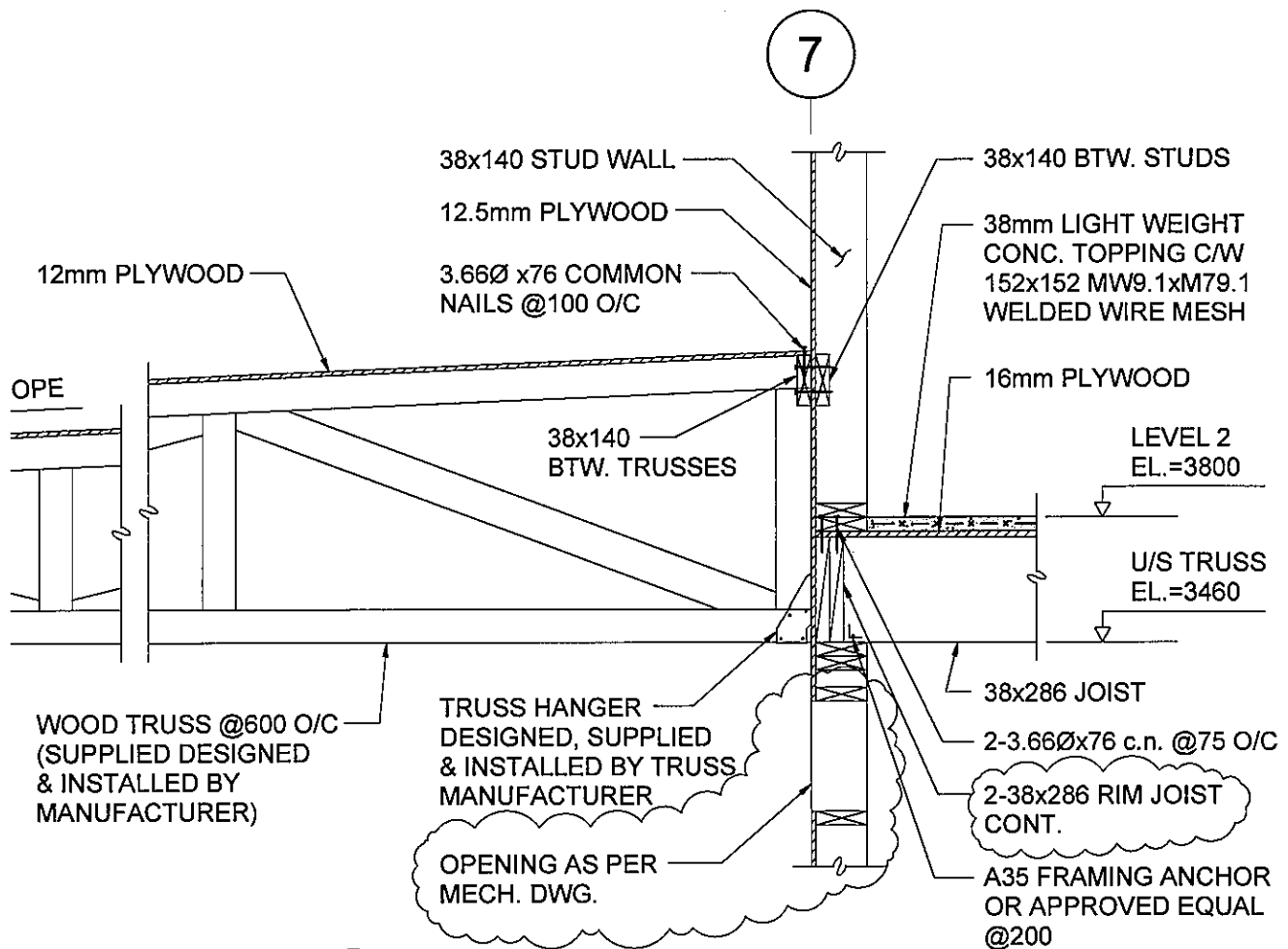
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feuille

**PATRICK TRUONG**

**AD-09**





SECTION

9

1:20

202

11704

project title

**FRASER VALLEY INSTITUTION**  
**33344 KING ROAD, ABBOTSFORD, BC**  
**TWENTY BED LIVING UNIT**

titre du projet

drawing title

**PARTIAL SECTION 9**  
**ADDED**  
**(XREF. DWG. S302)**

titre du dessin



Public Works and  
Government Services  
Canada

Travaux publics et  
Services gouvernementaux  
Canada

**REAL PROPERTY SERVICES**  
**Pacific Region**

designed by

conçu par

LL

drawn by

dessiné par

LH

scale

échelle

AS SHOWN

date

date

2013-02-08

approved by

approuvé par

PL

project no.

projet no.

**R.052462.001**

PWGC Project  
Manager

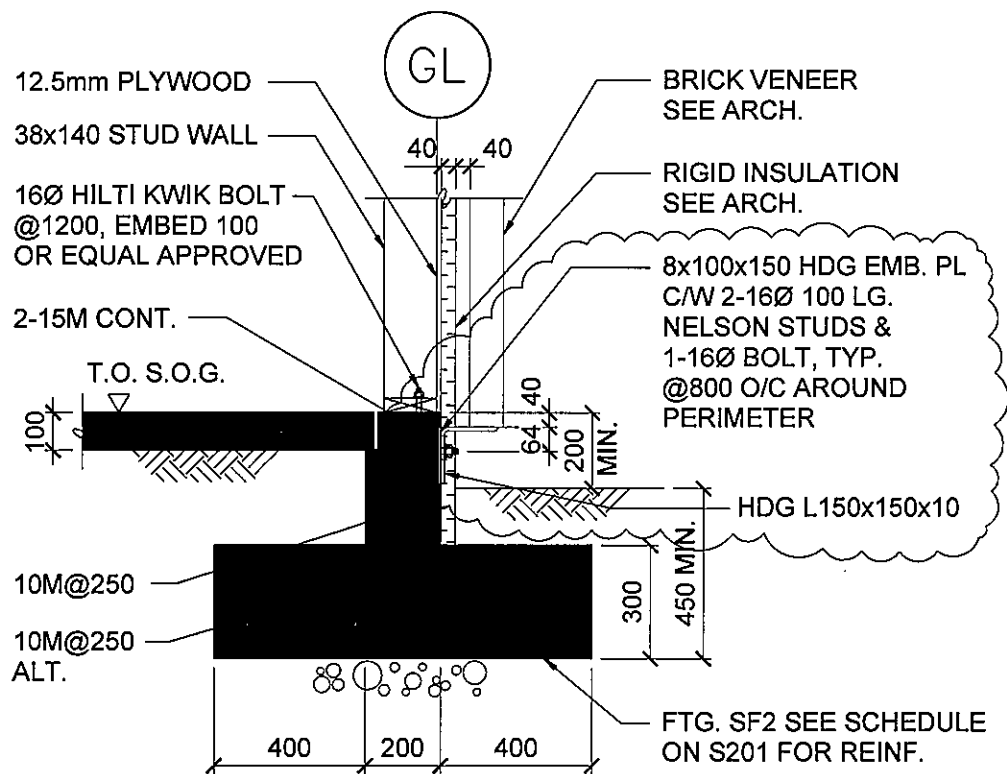
Administrateur de Projets  
TPSGC

**PATRICK TRUONG**

sheet

feuille

**AD-10**



SECTION

1

1:20

201

11704

project title

**FRASER VALLEY INSTITUTION**  
**33344 KING ROAD, ABBOTSFORD, BC**  
**TWENTY BED LIVING UNIT**

titre du projet

drawing title

**SECTION 1**  
**REVISED**  
**(XREF. DWG. S301)**

titre du dessin



Public Works and  
Government Services  
Canada

Travaux publics et  
Services gouvernementaux  
Canada

**REAL PROPERTY SERVICES**  
**Pacific Region**

designed by

conçu par

LL

drawn by

dessiné par

LH

scale

AS SHOWN

date

2013-02-08

approved by

PL

approuvé par

project no.

**R.052462.001**

project no.

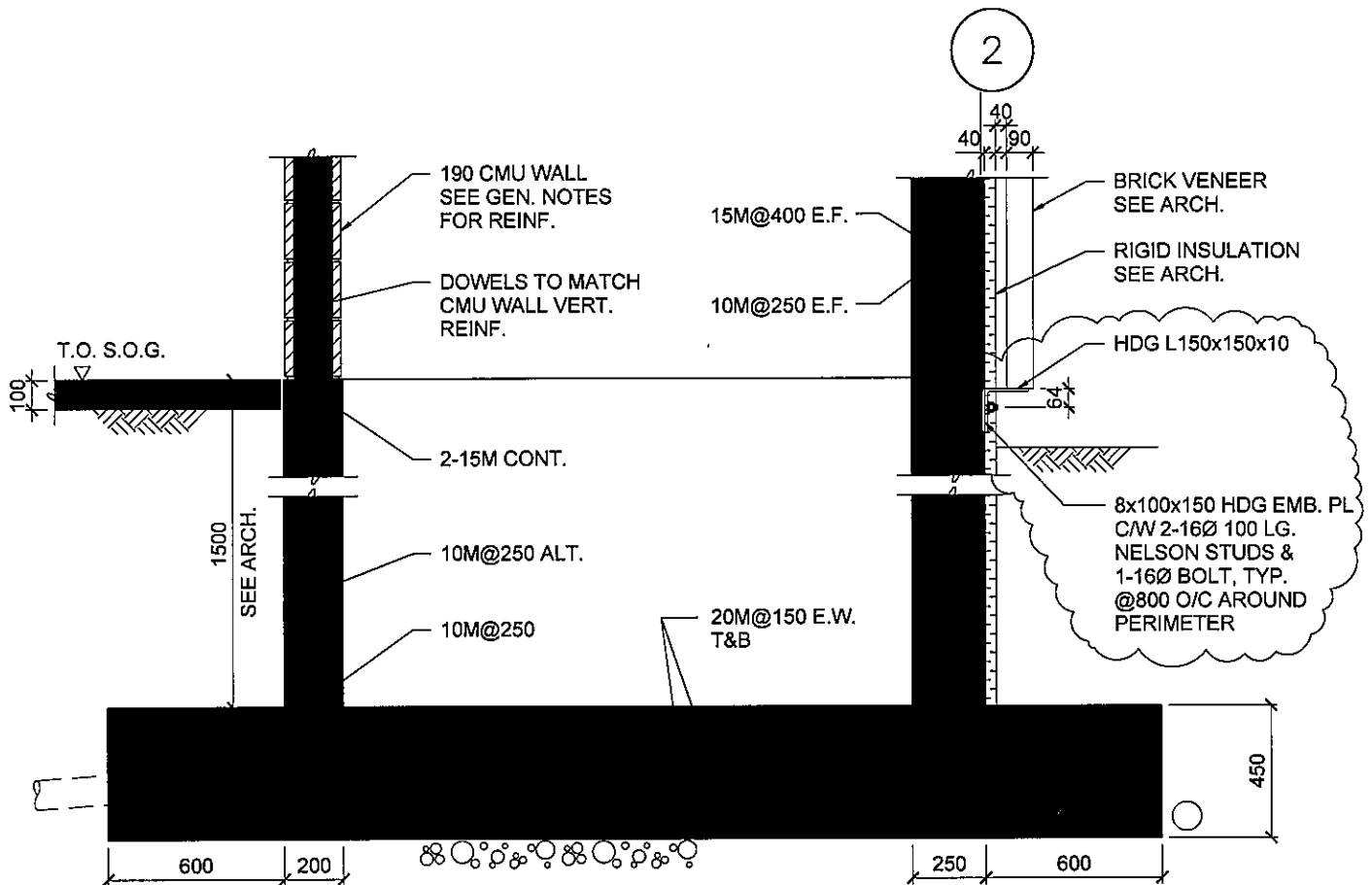
PWGSC Project  
Manager

Administrateur de Projets  
TPSGC  
**PATRICK TRUONG**

sheet

**AD-11**

feuille



PROVIDE WATERPROOF  
CONCRETE TO ELEVATOR  
PIT BELOW LEVEL 1 ELEV.

SECTION

6

1:20

201

11704

project title

**FRASER VALLEY INSTITUTION**  
**33344 KING ROAD, ABBOTSFORD, BC**  
**TWENTY BED LIVING UNIT**

titre du projet

drawing title

**SECTION 6**  
**REVISED**  
**(XREF. DWG. S301)**

titre du dessin



Public Works and  
Government Services  
Canada

Travaux publics et  
Services gouvernementaux  
Canada

**REAL PROPERTY SERVICES**  
Pacific Region

designed by

conçu par

drawn by

dessiné par

scale

échelle

date

LL

LH

N.T.S.

2013-02-08

approved by

approuvé par

project no.

projet no.

PL

**R.052462.001**

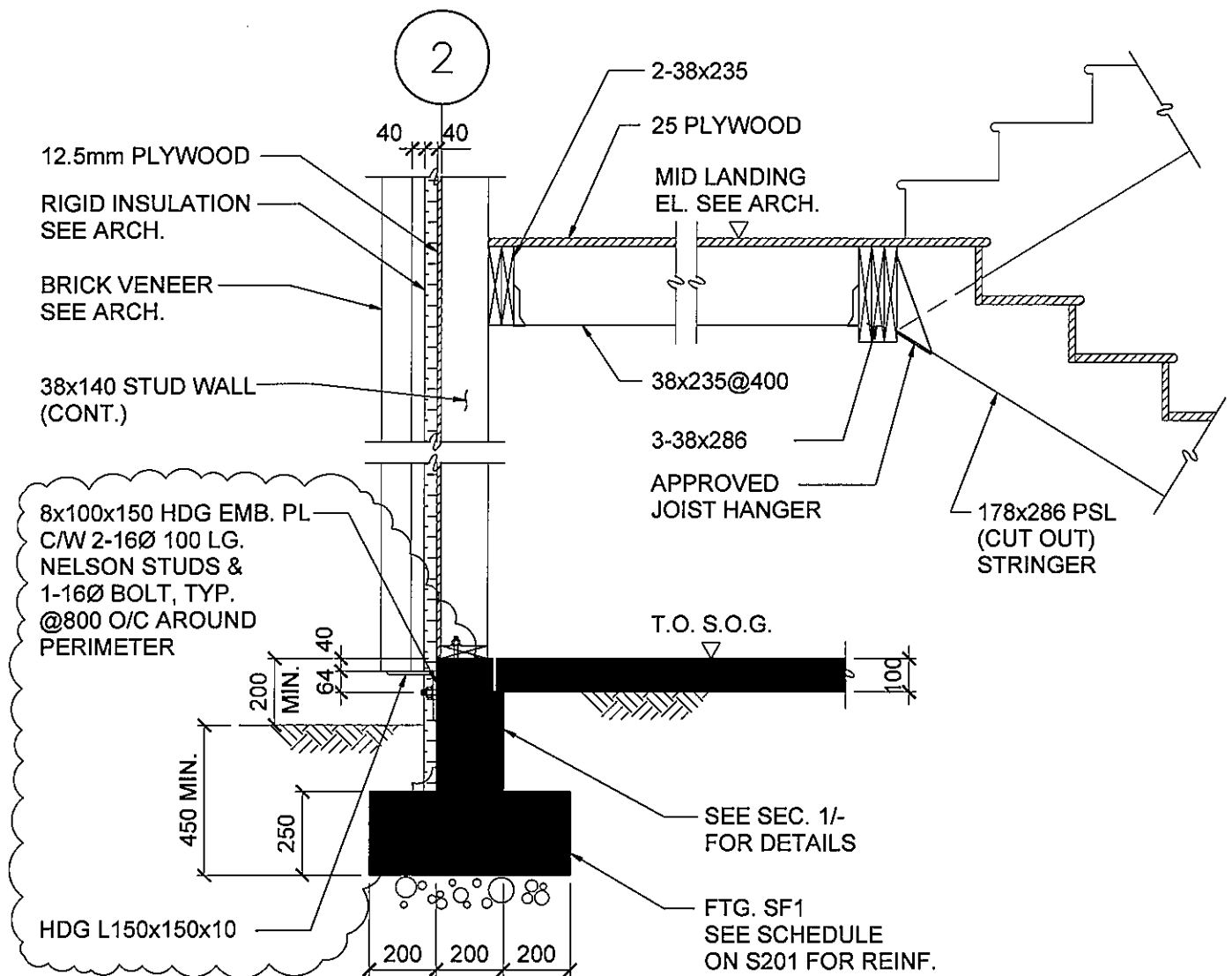
PWGSC Project  
Manager

Administrateur de Projets  
TPSGC  
**PATRICK TRUONG**

sheet

feuille

**AD-12**




SECTION

7

1:20

201

11704

project title		titre du projet		drawing title				titre du dessin				
FRASER VALLEY INSTITUTION 33344 KING ROAD, ABBOTSFORD, BC TWENTY BED LIVING UNIT				SECTION 7 REVISED (XREF. DWG. S301)								
	Public Works and Government Services Canada		Travaux publics et Services gouvernementaux Canada		designed by	conçu par	drawn by	dessiné par	scale	échelle	date	date
					LL		LH		AS SHOWN		2013-02-08	
					approved by		approuvé par		project no.		projet no.	
					PL				R.052462.001			
REAL PROPERTY SERVICES Pacific Region				PWGSC Project Manager		Administrateur de Projets TPSGC		sheet		feuille		
				PATRICK TRUONG				AD-13				

#### Addendum No 4

Twenty Bed Living Unit  
Abbotsford, BC – FVI Institution

Project No. R.052462.001  
Page 1 of 1

The following changes to the tender documents are effective immediately. These changes will form part of the tender/contract documents:

1. Refer to Mechanical Addendum #M1

End of Addendum

**Addendum .# M1**

The following changes to the tender documents are effective immediately. These changes will form part of the tender/contract documents:

**1. Specification Section 21 13 13 – Wet Pipe Sprinkler Systems**

- 1.1. DELETE clause 2.7 Water Gong.
- 1.2. ADD clause 3.9.4 Material and Test Certificates: Contractor shall submit the completion of Material and Test Certificates for above and below ground piping (sprinkler piping system) as per NFPA 13 to the Departmental Representatives and the Fire Commissioner.
- 1.3. CHANGE clause 3.2.2 from "Provide a High Density 3 tier racking..." to "Contractor's sprinkler engineer shall provide Letters of Assurance schedule B-1, B-2 and CB signed and sealed by a professional engineer licensed in the Province of British Columbia, to the Departmental Representatives and the Fire Commissioner."

**2. Specification Section 22 42 20 – Commercial Showers and Bathtubs**

- 2.1. CHANGE clause 2.1.8.1.1 to one piece heavy-duty acrylic domeless bath/shower, stain-resisting and non-slip surface. Size 1525 x 945 x 2000 mm. Unit equal to Hytec model Ashcroft. Colour and drain (left/right hand) location as per Architect"

**3. Specification Section 25 30 02 – EMCS: Field Control Devices**

- 3.1. CHANGE clause 2.16.3.1 to "Size/Capacity: refer to drawings for damper size. Coordinate damper location on site."
- 3.2. ADD clause 2.18.8 "Damper actuators shall be 24 V rated. Conduits and wiring shall be by EMCS contractor."
- 3.3. ADD clause 3.10: "Plastic Guard: Provide tamper resistance plastic guards to all thermostats, temperature sensors and control devices which are located at the public areas."

**4. Specification Section 25 90 01 – EMCS: Site Requirements**

- 4.1. ADD clause 1.1.9: "Electrical Contractor shall provide a fiber cable from the Building A Penthouse IT Room to the Communication Room 136. The EMCS contractor shall be responsible for the fiber connections from the patch panel to the EMCS panels along with any network equipment and control panels."

**5. Drawing M3 – Floor Plan- Main Level HVAC**

- 5.1. In the Communication Room 136, locate the AC-1 to close to grid line E and away from the electronic equipment. Coordinate with electrical drawings and trade.

**6. Drawing M6 – Floor Plan- Level 2 HVAC**

- 6.1. Locate the AHU override button in Room 249 at grid 3/E on the east wall with a temper resistance plastic guard. ---END---

## Addendum No 5



**Addendum #5**

The following changes to the tender documents are effective immediately. These changes will form part of the tender/contract documents:

1. Refer to revised Civil Drawings C00-C05.

End of Addendum