

**THE REGIONAL MUNICIPALITY OF YORK
CORPORATE SERVICES DEPARTMENT
PROPERTY SERVICES BRANCH**

CONTRACT NO. T-19-16

AMENDMENTS TO CCDC 2 STIPULATED PRICE CONTRACT 2008

The Standard Construction Document for Stipulated Price Contract (CCDC 2 - 2008), English version, consisting of the Agreement Between Owner and Contractor, Definitions, and General Conditions of the Stipulated Price Contract, Parts 1 to 12 inclusive, governing same is hereby made part of these Contract Documents, with the following amendments, modifications, deletions and additions.

In the event that a paragraph is deleted, the numbering of the remaining paragraphs shall remain unchanged, and the numbering of the deleted paragraph will be retained, unused.

AGREEMENT BETWEEN OWNER AND CONTRACTOR

The Agreement Between Owner and Contractor of the Stipulated Price Contract, CCDC-2 2008 is hereby amended as follows:

ARTICLE A-1 THE WORK

Article 1.1

Add the word “diligently” to the beginning of Article 1.1.

Article 1.3

Delete Article 1.3 and replace it with the following:

- 1.3 subject to potential adjustment pursuant to PART 6 – CHANGES IN THE WORK:
 - .1 attain Substantial Performance of the Work within 280 Working Days from the date that the Owner gives written notice to the Contractor to commence the Work; and
 - .2 attain Total Performance of the Work within 320 Working Days from the date that the Owner gives written notice to the Contractor to commence the Work.

New Article 1.4

Add new Article 1.4:

- 1.4 provide all the labour, materials, equipment, machinery, Products and work including, without limitation, all commissioning services required by the Contract Documents in order to fully complete and construct the Work and in accordance with, and satisfaction of, all applicable federal, provincial, municipal and local laws, regulations, rules, bylaws, guidelines, standards, permits, statutes, ordinances, and codes including, without limitation, those relating to occupational health and safety and any and all obligations, responsibilities and duties required by or set out in any site plan agreement or approval, attributable to the Place of the Work and/or the proposed development therein, and furnish efficient business and construction administration and superintendence consistent with the interests of the Owner.

ARTICLE A-3 CONTRACT DOCUMENTS

Article 3.1

Delete Article 3.1 and replace it with the following:

- 3.1 The following is a list of the Contract Documents referred to in ARTICLE A-1 – THE WORK and as defined in the DEFINITIONS. This list is subject to subsequent amendments in accordance with the provisions of the Contract. Unless otherwise indicated, terms used in the Contract Documents which are defined in the DEFINITIONS shall have the meanings designated in the DEFINITIONS.
 - Bid
 - CCDC 2 STIPULATED PRICE CONTRACT – 2008
 - Agreement between the Owner and Contractor
 - Definitions
 - The General Conditions of the Stipulated Price Contract (CCDC 2008)

- Amendments to CCDC 2 STIPULATED PRICE CONTRACT – 2008
 - Amendments to Agreement Between Owner and Contractor
 - Amendments to Definitions
 - Amendments to the General Conditions of the Stipulated Price Contract
 - Supplementary Conditions
 - EMS Shore Cord Assembly Instructions
- Abbreviations
- Contractor/Constructor Program & Safety Guideline
- Specifications
- Ontario Provincial Standard Specifications (OPSS) (most current edition and amendments in effect as of date of tender closing)
 - OPSS 212
 - OPSS 206
 - OPSS 310
 - OPSS 353
 - OPSS 410
 - OPSS 514
 - OPSS 904
 - OPSS 1001
 - OPSS 1004
 - OPSS 1010
 - OPSS 1101
 - OPSS 1103
 - OPSS 1301
 - OPSS 1302
 - OPSS 1303
 - OPSS 1305
 - OPSS 1306
 - OPSS 1308
 - OPSS 1315
 - OPSS 1350
 - OPSS 1860
- Contract Drawings
- Ontario Provincial Standard Drawings
 - OPSD 310.010
 - OPSD 400.010
 - OPSD 401.010
 - OPSD 701.010
 - OPSD 705.010
 - OPSD 708.020
 - OPSD 802.010
 - OPSD 802.013
 - OPSD 802.014
 - OPSD 802.020
 - OPSD 802.023
 - OPSD 802.024
 - OPSD 802.030
 - OPSD 802.031
 - OPSD 802.032
 - OPSD 802.033
 - OPSD 802.034
 - OPSD 802.050

OPSD 802.051
OPSD 802.052
OPSD 802.053
OPSD 802.054

- Addenda

ARTICLE A-5 PAYMENT

Delete Article A-5 in its entirety and replace it with the following:

ARTICLE A-5 PAYMENT

- 5.1 Provided the Contractor is not in default under the Contract, and subject to, and in accordance with, the provisions of the Contract Documents and the *Construction Act*, RSO 1990, c. C.30 (the “**Construction Act**”) the Owner shall:
- .1 make monthly progress payments to the Contractor on account of the Work performed, based upon the Contractor’s applications for payment as certified by the Consultant, together with such Value Added Taxes as may be applicable to such amount certified by the Consultant, subject to the 10% statutory holdback and a 3% maintenance security;
 - .2 pay the 10% basic holdback, together with such Value Added Taxes as may be applicable, to the Contractor no sooner than 60 Days after the date of publication of the Certificate of Substantial Performance of the Contract in the prescribed form “the “**Certificate of Substantial Performance**”), as certified by the Owner or the Consultant;
 - .3 pay the 10% holdback for finishing work, together with such Value Added Taxes as may be applicable, to the Contractor no sooner than 60 Days after the date of Total Performance of the Work, as certified by the Owner or the Consultant; and
 - .4 subject to any deductions made by the Owner in accordance with GC 5.12 – MAINTENANCE SECURITY, pay the 3% maintenance security, together with such Value Added Taxes as may be applicable, to the Contractor upon the expiration of the warranty period and the correction of all deficiencies and warranty issues to the satisfaction of the Consultant (whether they have occurred during the warranty period or thereafter).
- 5.2 In the case of a contractor who is a non-resident of Canada, the applicable provisions of the *Income Tax Act*, RSC 1985, c 1 shall apply.
- 5.3 As such payments become due, the Contractor shall, in accordance with the terms of its agreements with any Subcontractors, Suppliers and workmen, pay all of its Subcontractors, Suppliers and workmen in full on account of work properly performed or Products properly supplied, as applicable, less any holdback monies retained in compliance with the Construction Act. If requested, the Contractor shall promptly provide evidence of all such payments to the Owner and the Consultant.
- 5.4 In the event of loss or damage occurring where payment becomes due under the property and other required insurance policies, payments shall be made to the Contractor or the Owner, as the case may be, in accordance with the provisions of GC 11.2 - INSURANCE of the General Conditions.
- 5.5 The Contractor hereby agrees to reasonably substantiate to the Owner and the Consultant, if requested, the amounts of all accounts representing any portion of the Contract Price, including without limitation, providing back up documents evidencing accounts or payments due to employees, Subcontractors and Suppliers.

5.6 Interest

- .1 The Contractor shall not be entitled to claim, demand or receive any interest as a result of delays in approval or payment by the Owner, unless payment has not been made within 20 Days of receipt of an approved invoice, in which case interest will be payable at a rate of 2% per annum above the Bank of Canada Rate, from the 51st Day until the date that payment has been received by the Contractor.
- .2 Interest shall apply at the rate and in the manner prescribed by paragraph 5.6.1 of this Article on the amount of any claim advanced and for which the Contractor is thereafter entitled to payment, either pursuant to Part 8 of the General Conditions – DISPUTE RESOLUTION, or otherwise, from the date the amount would have been due and payable under the Contract, had it not been in dispute, until the date it is paid.

5.7 In the case of a contractor who is a non-resident of Canada, the applicable provisions of the *Income Tax Act* RSC 1985, c 1 shall apply.

NEW ARTICLES

Add the following new Articles to the Agreement Between Owner and Contractor:

ARTICLE A-9 TIME OF THE ESSENCE

9.1 Time shall be of the essence in this Agreement.

ARTICLE A-10 LAW OF THE AGREEMENT

- 10.1 The law of the Province of Ontario and the Laws of Canada applicable therein shall govern the interpretation of this Agreement.
- 10.2 The Contractor covenants and agrees to abide by and comply with all federal, provincial, municipal and local laws, regulations, rules, bylaws, standards, ordinances, and codes applicable or related to this Agreement.

ARTICLE A-11 CONFLICT OF INTEREST

- 11.1 The Contractor, all of the Subcontractors, and any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall not engage in any activity or provide any services where such activity or the provision of such services creates a conflict of interest (actually or potentially, in the sole opinion of the Owner) with the provision of the Work pursuant to the Contract.
- 11.2 The Contractor shall disclose to the Owner, in writing, without delay any actual or potential situation that may be reasonably interpreted as either a conflict of interest or a potential conflict of interest, including the retention of any Subcontractor or Supplier that is directly or indirectly affiliated with or related to the Contractor.
- 11.3 A breach of this Article by the Contractor, any of the Subcontractors, or any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall entitle the Owner to terminate the Contract, in addition to any other rights and remedies that the Owner has in the Contract, in law, or in equity.

ARTICLE A-12 SEVERABILITY

- 12.1 Each provision of the Contract shall be valid and enforceable to the fullest extent permitted by law. If any provision of the Contract or the application thereof to any person or circumstance is determined to be invalid or unenforceable to any extent:
 - .1 the remainder of the Contract or the application of such provision to any other person or circumstance shall not be affected thereby; and
 - .2 the parties shall negotiate in good faith to amend the Contract to implement the provisions set forth.

ARTICLE A-13 LIQUIDATED DAMAGES

- 13.1 For the purposes of GC 5.10 – LIQUIDATED DAMAGES, liquidated damages will be assessed in accordance with the following:
- .1 \$2,000.00 for each Day that the Contractor fails to achieve Substantial Performance of the Work beyond the 280 Working Days specified in Article A-1 of the Agreement – THE WORK, paragraph 1.3.1; and
 - .2 \$1,000.00 for each Day that the Contractor fails to achieve Total Performance of the Work beyond the 320 Working Days specified in Article A-1 of the Agreement – THE WORK, paragraph 1.3.2.

ARTICLE A-14 RIGHTS AND REMEDIES

- 14.1 The duties and obligations imposed by the Contract and the rights and remedies available thereunder shall be in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.
- 14.2 No action or failure to act by the Owner or the Consultant shall constitute a waiver of any right or duty afforded under the Contract or law, nor shall any such action or failure to act constitute an approval of, or acquiescence in, any breach, except as may be specifically agreed to in writing.

ARTICLE A-15 WARRANTY PERIOD

- 15.1 For the purpose of GC 12.3 - WARRANTY, the Warranty Period for Work completed under this Contract shall be as follows:
- .1 24 months from the date of Substantial Performance of the Work for all Work completed on, or before, the date of Substantial Performance of the Work; and
 - .2 24 months from the date of Total Performance of the Work for all Work completed after the date of Substantial Performance of the Work.

In addition to the warranty periods specified above, the Work may be subject to extended warranties pursuant to GC 12.3 – WARRANTY, paragraph 12.3.6.

ARTICLE A-16 ENTIRE AGREEMENT

- 16.1 This Contract represents the entire agreement between the Contractor and the Owner and supersedes any previous agreements, negotiations and understandings. There are no agreements, representations, warranties, terms, conditions or commitments regarding the subject matter of this agreement except as expressed in this Contract.

DEFINITIONS

The Definitions of the Stipulated Price Contract CCDC – 2008 are hereby amended as follows:

1. Change Directive

Delete the words “within the general scope of the Contract Documents”.

4. Consultant

Add the following sentence after the last sentence:

The words “Engineer”, “Architect” or “Consultant” wherever used in the Contract Documents shall be regarded as synonymous.

6. Contract Documents

Add the words “in writing” after the word “upon” in the second line.

8. Contract Time

Delete the words “Substantial Performance of the Work” and replace with “Total Performance of the Work”.

9. Contractor

Add the following sentence after the second sentence:

For the purpose of the Contract, the words “Contractor” or “General Contractor” shall be regarded as synonymous.

10. Drawings

Delete in its entirety and replace with the following:

Drawings means all plans, profiles, drawings, sketches or copies thereof, used or prepared for, or in connection with, the Work and are included in the Contract Documents. For the purpose of the Contract, the word “Contract Drawings” shall be regarded as synonymous.

13. Place of the Work

Add the following sentence after the first sentence:

The terms “Place of the Work” and “Site” wherever used in the Contract Documents shall be regarded as synonymous.

16. Provide

Add the following after “install”:

or supply, install and connect as applicable, complete and in place, including accessories, finishes, tests, and services required to render each item so specified complete and ready for use.

17. Shop Drawings

Delete “which the Contractor provides” and replace with “to be provided by the Contractor”.

18. Specifications

Add “and approved, in writing, by the Owner” after “issued,”.

19. Subcontractor

Delete in its entirety and replace with the following:

A Subcontractor is a person or entity not contracting with or employed directly by the Owner, but who performs a part or parts of the Work or supplies products under an agreement with the Contractor or under an agreement with another subcontractor.

20. Substantial Performance of the Work

Delete in its entirety and replace with the following:

Substantial Performance of the Work means when the Contract is substantially performed pursuant to the Construction Act. If such legislation is not in force or does not contain such term, Substantial Performance of the Work shall have been reached when the Work is ready for use or is being used for the purpose intended and is so certified by the Owner. The Contract may specify additional requirements which must be met in order to obtain Substantial Performance of the Work.

25. Work

Add “, Products, installation, commissioning, checkout, start-up, testing” after “total construction”.

26. Working Day

Delete in its entirety and replace with the following:

Working Day means any Day except Saturdays, Sundays and statutory holidays in the Province of Ontario.

NEW DEFINITIONS

Add the following new Definitions:

27. As-Built Drawings

As-Built Drawings means drawings prepared by the Contractor by marking on a copy of the Drawings the changes from the Drawings which occur during construction including, but not limited to, the exact location of major building components that were shown generally on the Drawings.

28. Authorities Having Jurisdiction

The phrase Authorities Having Jurisdiction or the term Authorities means those authorities having jurisdiction under law over the Work or parts thereof.

29. Bid

Bid means the Contractor’s response to the Request for Tender for this Contract.

30. Cash Allowance Disbursement Authorization (CADA)

A Cash Allowance Disbursement Authorization is an authorization to the Contractor to expend monies from Cash Allowances included in the Contract Price.

31. Commission

Commission means, and Commissioning refers to, the procedure which includes checking, testing, adjusting and measuring Work performed by the Contractor to demonstrate and verify the installation, operation and performance of all components and the entire system.

32. Commissioning Agent

Commissioning Agent shall mean the independent commissioning authority (CA) hired by the Owner to review and confirm all mechanical and electrical systems.

33. Constructor

Constructor is as defined pursuant to the *Occupational Health and Safety Act*, RSO 1990, c O.1. as amended.

34. Contract Completion

Contract Completion means when the entire Work except those items arising from the provisions of GC 12.3 – WARRANTY has been performed to the requirements of the Contract Documents and is so certified by the Consultant.

35. Contract Schedule

Contract Schedule means the schedule indicating the timing of major activities of the Work submitted by the Contractor and approved in writing by the Owner including attaining Substantial Performance of the Work by the Substantial Performance Date.

36. Day

Day means a calendar day.

37. Install

Install means completion of the following activities, including the associated labour, services, plant, construction machinery and equipment required to:

- .1 Remove Products from storage and locate for placement,
- .2 Position and adjust Products for final placement,
- .3 Affix and anchor Products in final placement, in accordance with manufacturers' instructions and Contract Documents,
- .4 Commission and adjust Products for proper operation.

38. Interim Milestone

Interim Milestone means a scheduled event signifying the completion of a major deliverable or a set of related deliverables.

39. Local Municipality

Local Municipality means the lower-tier municipality or municipalities, as defined in the *Municipal Act, 2001*, SO 2001, c 25, in which the Work will be undertaken.

40. Make Good

Make Good means repairing, restoring, refurbishing, rehabilitating, or performing filling operation on any existing components disturbed due to work of this Contract, to at least the condition existing at the commencement of the Work, in terms of construction integrity, finishes, alignment with existing adjoining surfaces, compatibility of materials, sound attenuation criteria, exfiltration/infiltration requirements, air/vapour barrier and thermal continuity.

41. Other Contractor

Other Contractor means a person, firm or corporation not employed by, or having a contract with, the Contractor and who is performing work at or near the Site directly or indirectly on behalf of the Owner, the Local Municipality or any other governmental agencies, property owners, developers or utility companies and their respective contractors.

42. Professional Engineer

Professional Engineer means a person, firm or corporation legally qualified to practice professional engineering in the Province of Ontario.

43. Region

Region means The Regional Municipality of York or its authorized agent or representative as designated to the Contractor but does not include the Consultant.

44. Reports

Reports means the Reports set out in Article A-3 of the Agreement – CONTRACT DOCUMENTS.

45. Site

Site shall have the same meaning as the Place of the Work as defined in the Definitions.

46. Submittals

Submittals are documents or items required by the Contract Documents to be provided by the Contractor, such as:

1. Shop Drawings, samples, models, mock-ups to indicate details or characteristics, before the portion of the Work that they represent can be incorporated into the Work; and
2. Record drawings and manuals that provide instructions for the operation and maintenance of the Work.

47. Supply

Supply means completion of the following activities, including the associated labour, services, plant, construction machinery and equipment required to:

- .1 Fabricate or purchase Products;
- .2 Deliver Products to the Place of the Work;
- .3 Unload Products; and
- .4 Store Products in accordance with manufacturers' instructions.

For the purpose of the Contract, the words "Supply" or "Furnish" shall be regarded as synonymous.

48. Total Performance of the Work

Total Performance of the Work means when the Contract is deemed to be completed pursuant to the Construction Act. If such legislation is not in force or does not contain such definition, Total Performance of the Work shall have been reached when the entire Work, except those items arising from the provisions of GC 12.3 - WARRANTY, has been performed to the requirements of the Contract as certified by the Owner,. The Contract may specify additional requirements which must be met in order to obtain Total Performance of the Work.

49. Unresolved Litigation

Any unresolved dispute between the Owner and any other party or related party adverse in interest, including third party and cross-claims, where a legal proceeding has been commenced for an injunction, a mandatory order, a declaration or the recovery of money.

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

The General Conditions of the Stipulated Price Contract CCDC 2 – 2008 are hereby amended as follows:

PART 1 GENERAL PROVISIONS

GC 1.1 CONTRACT DOCUMENTS

Paragraph 1.1.1

Delete the first sentence in paragraph 1.1.1 and replace it with the following:

The intent of the Contract Documents is to include the construction, labour, Products, Construction Equipment and other services necessary, complementary or ancillary, for the performance and completion of the Work by the Contractor in accordance with the Contract Documents or reasonably inferable from them.

Paragraph 1.1.6

Add the following to the end of paragraph 1.1.6:

or in establishing the extent of the work to be performed by a trade. The Specifications are divided into divisions and sections for convenience but shall be read as a whole and neither such division nor anything else contained in the Contract Documents will be construed to place responsibility on the Consultant to settle disputes among the Subcontractors and Suppliers or as between them and the Contractor with respect to such divisions.

Paragraphs 1.1.7 and 1.1.8

Delete paragraphs 1.1.7 and 1.1.8 and replace them with the following:

- 1.1.7 In the event of conflicts or inconsistencies between Contract Documents, the following shall apply:
- .1 figured dimensions shown on a drawing shall govern even though they may differ from dimensions scaled on the same drawing;
 - .2 drawings of larger scale shall govern over those of smaller scale of the same date;
 - .3 Specifications shall govern over drawings;
 - .4 Division 1 of the Specifications shall govern over all other Specifications;
 - .5 the Bid shall govern over the specifications;
 - .6 Definitions shall govern over the Bid;
 - .7 General Conditions shall govern over Definitions;
 - .8 Supplementary Conditions shall govern over General Conditions;
 - .9 the Agreement between the Owner and the Contractor shall govern over all other documents;
 - .10 executed amendments to specific parts of the Contract Documents shall govern over the executed specific parts in Contract Documents affected by the amendments;
 - .11 later dated documents shall govern over earlier documents of the same type; and
 - .12 in case of discrepancies, noted materials and annotations shall take precedence over graphic indications in the Contract Documents.
- 1.1.8 At the request of the Contractor, the Owner may provide printed copies of the Contract Documents at the Contractor's expense.

Paragraph 1.1.9

Delete “and shall remain the Consultant’s property” from the first sentence and replace it with “not the Contractor’s property”.

New Paragraphs 1.1.11 to 1.1.19

Add the following new paragraphs to GC 1.1:

- 1.1.11 All documents and data furnished by the Owner to the Contractor are and shall remain the property of the Owner, with the exception of the signed Contract sets belonging to each party to the Contract. The Contractor may, at its cost, copy, use and communicate any such documents for the sole purposes of the Contract. Such documents shall not, without the written authorization of the Owner, be used, copied or communicated to a third party by the Contractor except as necessary for the sole purposes of the Contract.
- 1.1.12 All documents developed in connection with the Work by the Contractor shall become the sole property of the Owner with full and absolute title thereto. The Contractor shall execute and deliver and shall cause the Subcontractors and Suppliers to execute and deliver for no additional consideration all such transfers, assignments, deeds and other conveyances as the Owner may require to give effect to the foregoing. The Owner shall provide or cause to be provided without royalty, fee or other costs to the Contractor all licenses necessary to enable the Contractor to use such documents in connection with the Work, including the correction of defects and deficiencies during the Warranty Period.
- 1.1.13 The Contractor shall review the Contract Documents and shall report promptly to the Owner and the Consultant any error, inconsistency, or omission the Contractor may discover. If the Contractor does discover any error, inconsistency, or omission in the Contract Documents, the Contractor shall not proceed with the Work affected until the error, inconsistency or omission has been addressed and in dealing with such error, inconsistency or omission the Contractor shall co-operate with the Owner in good faith to resolve such errors, inconsistency or omission so as to avoid any increase in the Contract Price or delay in the progress of the Work.
- 1.1.14 The Contractor declares and represents that in entering into the Contract with the Owner for the performance of the Work, it has reviewed the Contract Documents including, without limitation, the Reports provided by the Owner and has satisfied itself of the character of the Work to be done and all local conditions including, without limitation, the position of all pole lines, conduits, watermains, sewers and other underground and overground utilities and structures identified in or reasonably inferable from the Contract Documents, and the Contractor has assumed and does hereby assume all risk of conditions now existing or arising in the course of the Work which are identified in, or reasonably inferred from, the Contract Documents, which might or could make the Work, or any items thereof more expensive in character, or more onerous to fulfill, than was contemplated or known when the Contract was signed.
- 1.1.15 Headings of all General Conditions of the Stipulated Price Contract and of all sections of the specifications are inserted for reference convenience only and shall not affect the Work, nor the interpretation of the Contract Documents.
- 1.1.16 Syntax
 - .1 Where the words “accepted”, “reviewed”, “designated”, “directed”, “inspected”, “instructed”, “permitted”, “required”, and “selected” are used in Standards or in the Contract Documents, they are deemed to be followed by the words “by the Consultant and the Owner”, unless the context provides otherwise.

- .2 Where the words “acceptable”, “submit” and “satisfactory” are used in Standards or in the Contract Documents, they are deemed to be followed by the words “to the Consultant and the Owner”, unless the context provides otherwise.
 - .3 Where the masculine is used in the Contract Documents, it shall be read and interpreted as if the feminine or neuter had been used when the context of the statement so requires, and the rest of the sentence, clause, paragraph or item shall be interpreted as if all changes in grammar, gender or terminology thereby rendered necessary had been made.
 - .4 The words "include", "includes" or "including" mean "include without limitation", "includes without limitation" and "including without limitation", respectively, and the words following "include", "includes" or "including" shall not be considered to set forth an exhaustive list.
- 1.1.17 Unless otherwise expressly provided herein, whenever in the Contract any matter is subject to the consent, approval, determination, authorization, consideration or authority of the Owner or is to be acceptable or to the satisfaction of the Owner, such consent, approval, determination, authorization, consideration, authority or determination of acceptability or satisfaction shall be in the Sole Discretion of the Owner acting reasonably.
 - 1.1.18 No implied terms or obligations of any kind by or on behalf of the Owner shall arise from anything in the Contract and the express covenants and agreements therein contained and made by the Owner are the only covenants and agreements upon which any rights against the Owner are to be founded.
 - 1.1.19 Any notices, requests, demands, instructions, consents, authorizations, approvals, certificates, determinations or other communications, with the exception of applications for payment under PART 5 - PAYMENT (a "notice") shall be in writing and shall be given in the manner set forth in Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING, and unless a specific time period for the giving of such notice is specified in the Contract Documents, such notice shall not be unreasonably delayed.

GC 1.3 RIGHTS AND REMEDIES

Paragraph 1.3.2

Delete the word "No" from the beginning of the first sentence and replace it with the words “Except with respect to the notice requirements set out in GC 6.4 – CONCEALED OR UNKNOWN CONDITIONS, paragraph 6.4.1, GC 6.5 – DELAYS, paragraph 6.5.4, and GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE, paragraph 6.6.1, no”.

New Paragraph 1.3.3

Add the following new paragraph to GC 1.3:

- 1.3.3 Notwithstanding paragraph 1.3.1, the Owner shall not be liable, whether in contract, tort, or any other theory of law or statute, for any claim arising from any prior negotiation, representation, or agreement, whether written or oral, which is superseded by the Contract under Article A-2 of the Agreement - AGREEMENTS AND AMENDMENTS.

GC 1.4 ASSIGNMENT

Paragraph 1.4.1

Delete paragraph 1.4.1 and replace it with the following:

- 1.4.1 The Contract, or any part thereof, including, the Work to be performed thereunder or any monies payable thereunder shall not be transferred, assigned (including an assignment by way of security) or otherwise disposed of by the Contractor without the written consent of

the Owner. It is further agreed that the said written consent shall not, under any circumstances, relieve the Contractor of its liabilities and obligations under the Contract.

NEW GENERAL CONDITIONS GC 1.5 TO GC 1.7

Add new GC 1.5, GC 1.6 and GC 1.7 as follows:

NEW GC 1.5 CO-OPERATION, CONSULTATION AND CO-ORDINATION

Add new GC 1.5 as follows:

GC 1.5 CO-OPERATION, CONSULTATION AND CO-ORDINATION

- 1.5.1 The Contractor shall, at all times and as part of the Work, fully assist, co-operate, consult and co-ordinate with the Consultant and any other consultants or other entities retained or identified by the Owner which are related to the Project (collectively, the "Other Entities"). The objective of such assistance, co-operation, consultation and co-ordination is to make certain the Work is properly co-ordinated with and integrated with the work and services of the Other Entities.
- 1.5.2 Without limiting the generality of any other provision in the Contract, the Contractor shall attend all design, construction, general co-ordination and progress meetings relating to the Work between the Consultant, the Owner and Other Entities and any other meeting relating to the Project as requested by the Owner to discuss and resolve all matters and issues relating to the Project. The Contractor shall, on a timely basis, prepare and distribute detailed minutes to the Owner of the construction and progress meetings which it attends, if requested by the Owner.

GC 1.6 NON-RESIDENT

- 1.6.1 If the Contractor is non-resident in Ontario or Canada it shall obtain a GST/HST Registration Number prior to commencement of the Work.
- 1.6.2 The Contractor shall ensure that all Subcontractors whom it proposes to use for carrying out any of the Work and who are non-resident in Ontario or Canada have obtained a GST/HST Registration Number before they commence any Work under the Contract.

GC 1.7 REVIEW BY OWNER AND REVIEW BY CONSULTANT

- 1.7.1 Neither the Owner's and/or Consultant's receipt, review or approval of any documents or the Work nor the failure of the Owner and/or Consultant's to provide comment shall limit, waive or diminish the Contractor's obligations, responsibilities, duties or liabilities under the Contract. The review or approval by the Owner and/or Consultant is intended only to ascertain that the document or the performance of the Contractor's duties, liabilities, responsibilities or obligations under the Contract including, without limitation, the Work generally meets the intention of the Contract and is not an assurance or confirmation of the adequacy, quality, fitness, suitability or correctness of the Contractor's obligations, responsibilities, duties and liabilities under the Contract including, without limitation, the Work, for which the Contractor is solely responsible in accordance with the Contract.

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.1 AUTHORITY OF THE CONSULTANT

Paragraph 2.1.3

Delete "against whom the Contractor makes no reasonable objection and" from line 2.

GC 2.2 ROLE OF THE CONSULTANT

Paragraph 2.2.3

Add the following sentence to the end of paragraph 2.2.3:

The presence of such project representatives at the Place of the Work will not abrogate any of the Contractor's responsibility to perform the Work as required by the Contract Documents.

Paragraph 2.2.5

Add in line 2, after "under the Contract", ", subject to the Owner's approval and the conditions of the Contract,".

Paragraph 2.2.6

Insert the words "to the Contractor" after the words "the Consultant will not be responsible" in each of the first two sentences.

Paragraph 2.2.7

Delete the words "Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER, the" at the beginning of the first sentence and replace them with the word "The".

Paragraph 2.2.13

Add the following to the end of paragraph 2.2.13:

If, in the opinion of the Contractor, performance of the Supplemental Instruction will result in an increase in the Contract Price or to the Contract Time, the Contractor shall, within 10 Working Days of receipt of the Supplemental Instruction, provide the Consultant with Notice in Writing of the cause and duration of the delay and of any increase in Contract Price. Failure to provide the Notice in Writing shall be a deemed acceptance of the Supplemental Instruction by the Contractor without adjustment in the Contract Price or Contract Time.

Paragraph 2.2.14

Delete the word "submittals," and substitute the words "Submittals which are provided" after the word "Contractor's" in the first line, and insert the following at the end of the sentence:

"The Consultant's review of the Shop Drawings, samples and Submittals and on-site observation of the construction work is to determine if the Contractor's submittals and work appear to be in general conformance with the design set forth in the Contract Documents prepared by the Consultant."

Paragraph 2.2.17

Insert the words "to the Contractor" after the words "the Consultant does not guarantee".

New Paragraphs 2.2.19 to 2.2.22

Add the following new paragraphs to GC 2.2:

- 2.2.19 The Consultant will conduct reviews of the Work to determine the date of Total Performance of the Work as provided in GC 5.7 – FINAL PAYMENT, paragraph 5.7.2.
- 2.2.20 The Consultant shall not be required to decide on questions arising under agreements or Contracts between the Contractor and the Contractor's Subcontractors or Suppliers.
- 2.2.21 The Consultant's review shall not be considered to be complete in every detail or exhaustive and shall also not relieve any Contractor, Subcontractor, Supplier, manufacturer, fabricator, or other third party of responsibility for any deficiency that may exist or for any departures or deviations from the requirements of the Contract Documents or of the responsibility to co-ordinate the Work, or portion of the Work, of one trade with another.
- 2.2.22 The Consultant's services will be performed solely for the benefit of the Owner and no Contractor, Subcontractor, manufacturer, supplier, fabricator or other third party shall have any claim against the Consultant as a result of the Owner-Architect Agreement or the performance or non-performance of the Consultant's services. The Contractor shall bring

this provision to the attention of the parties with whom it Contracts and have them do the same with those with whom they Contract.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

Paragraph 2.3.1

Delete “the Consultant” and replace with “the Consultant and Owner” in the second sentence only.

Paragraph 2.3.2

Add “regulations, rules, bylaws, standards, guidelines, permits, statutes, codes,” before “laws or ordinances”.

Paragraph 2.3.6

Delete paragraph 2.3.6 and replace it with the following:

The Contractor shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is required, by the Contract Documents or the Consultant, to be performed by the Contractor, or if such test or inspection is required by the laws or ordinances applicable to the Place of the Work. The cost of the testing required by the Consultant will be payable by the Contractor only if the test results show that the specification requirements have not been met because of the Contractor’s negligence.

Paragraph 2.3.7

Replace “designated in” with “required by”.

New Paragraphs 2.3.8 to 2.3.10

Add the following new paragraphs to GC 2.3:

- 2.3.8 The Contractor shall immediately inform the Owner and the Consultant of any notices, warnings or asserted violations issued by any regulatory or government agencies having jurisdiction relating to the Work.
- 2.3.9 The Consultant’s and/or Owner’s review shall not be considered to be complete in every detail or exhaustive and shall also not relieve any Contractor, Subcontractor, Supplier, manufacturer, fabricator, or other third party of responsibility for any deficiency that may exist or for any departures or deviations from the requirements of the Contract Documents or of the responsibility to co-ordinate the Work, or portion of the Work, of one trade with another.
- 2.3.10 Where standards of performance are specified in the Contract Documents and the Work does not comply with the performance specified, such deficiency shall be corrected as directed by the Consultant. Any testing of work identified as defective in accordance with GC 2.4 – DEFECTIVE WORK, including retesting required by the Owner to verify performance, shall be done at the Contractor’s expense.

GC 2.4 DEFECTIVE WORK

Delete in GC 2.4 its entirety and replace it with the following:

GC 2.4 DEFECTIVE WORK

- 2.4.1 The Contractor shall promptly correct defective work that has been rejected by the Consultant and/or Owner as failing to conform to the Contract Documents, at the Contractor’s expense, whether or not the defective work has been incorporated in the Work and whether or not the defect is the result of poor workmanship, use of defective products or damage through carelessness or other act or omission of the Contractor.
- 2.4.2 The Contractor shall promptly correct, at its own expense, defects or deficiencies in the Work which appear prior to and during the warranty period(s) specified in the Contract Documents.

The Contractor shall rectify, at its own expense, in an acceptable manner all other defective work and like deficiencies throughout the Work whether or not they are specifically identified by the Owner or the Consultant.

- 2.4.3 The Contractor shall prioritize the correction of any defective work which, in the sole discretion of the Owner acting reasonably, adversely affects the day to day operation of the Owner.
- 2.4.4 The Contractor agrees to correct and pay for damage resulting from corrections made under the requirements of paragraphs 2.4.1 and 2.4.2.
- 2.4.5 The Contractor shall promptly pay the Owner for costs incurred by the Owner, the Owner's own forces or the Owner's Other Contractors, for work destroyed or damaged or any alterations necessitated by the Contractor's removal, replacement or re-execution of defective work. The Owner may appoint the Contractor to rectify any such deficiencies to Subcontractor' work, at the Contractor's expense.
- 2.4.6 If in the opinion of the Consultant or Owner it is not expedient to correct defective work or work not performed as provided in the Contract Documents, the Owner may deduct from the amount otherwise due to the Contractor the value of such work as is necessary to correct any non-compliance with the Contract Documents, the amount of which will be determined by the Owner acting reasonably.
- 2.4.7 The Contractor shall prioritize the correction of any defective work which, in the sole discretion of the Owner acting reasonably, adversely affects the day-to-day operations of the Owner.
- 2.4.8 The Consultant shall not have any power to waive any obligations of the Contractor for the furnishing by the Contractor of good materials and of its performing good work as herein described and in full accordance with the Contract Documents. No failure or omission of the Owner or the Consultant to condemn any defective work or material shall release the Contractor from the obligation to at once tear out, remove and properly replace the same at any time upon the discovery of said defective work or material, at the Contractor's expense. In case the Contractor should refuse or neglect to remove any rejected work or material within 48 hours after written notice from the Owner or, if the removal would reasonably require more than 48 hours to complete, the Contractor has failed to commence the removal work within 48 hours, such work or material may be removed by order of the Owner at the Contractor's expense and the Owner may deduct the cost of same from any monies otherwise due or that may become due to the Contractor.
- 2.4.9 The carrying out of replacement Work and making good of defects shall be executed at times convenient to the Owner and may require work outside of normal working hours at the Contractor's expense.
- 2.4.10 The remedies of the Owner set forth above shall not deprive the Owner of any action, right or remedy otherwise available to it for breach of any provisions of the Contract Documents.

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

Paragraph 3.1.2

Add the word "schedules" after the word "techniques" in the first line.

New Paragraphs 3.1.3 to 3.1.6

Add the following new paragraphs to GC 3.1:

- 3.1.3 Prior to commencing the Work and individual procurement, fabrication and construction activities, the Contractor shall verify, at the Place of the Work, all relevant measurements

and levels necessary for the proper fabrication, assembly, installation and completion of the Work and shall further carefully compare such field measurements and conditions with the requirements of the Contract Documents. Where dimensions are not included, or contradictions exist, or exact locations are not apparent in the Contract Documents, the Contractor shall immediately notify the Consultant in writing and obtain Supplemental Instructions from the Consultant before proceeding with any part of the affected work.

- 3.1.4 Without limiting the generality of the foregoing, the Contractor is responsible for the coordination of the various parts of the Work so that no part is left in an unfinished or incomplete condition.
- 3.1.5 The Contractor shall have the sole responsibility for the design, erection, operation, maintenance and removal of temporary structural and other temporary facilities and the design and execution of construction methods required in their use. The Contractor shall engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform these functions where required by law or by the Contract Documents and in all cases where such temporary facilities and their method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.
- 3.1.6 The Contractor is solely responsible for the quality of the Work and shall undertake any quality control activities specified in the Contract Documents.

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

Delete in GC 3.2 its entirety and replace it with the following:

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

- 3.2.1 The Owner reserves the right, at any time during the Contractor's performance of the Work or the warranty period, to request that the Contractor grant, to the Owner, its agents or Other Contractors, access to the Place of the Work for the purpose of constructing or installing collateral work as the Owner may deem necessary.
- 3.2.2 The Contractor shall co-ordinate the Work with the work of Other Contractors and, where applicable, prepare all connections as specified or shown in the Contract Documents.
- 3.2.3 The Contractor agrees not to interfere with, or prevent, the performance of such collateral work by the agents or Other Contractors of the Owner. In the event that the Contractor is delayed in the performance of a critical path activity on the Construction Schedule by the construction or installation of such collateral works, this shall be considered a delay event pursuant to paragraph 6.5.1.
- 3.2.4 Entry by the Owner, its agents or Other Contractors to the Place of the Work does not constitute acceptance of the Work and does not relieve the Contractor of its responsibilities under the Contract.
- 3.2.5 The placement, installation and connection of collateral work by the Owner, its agents or Other Contractors on, and to, the Contractor's Work does not relieve the Contractor of its responsibilities under the Contract including any warranty obligations.
- 3.2.6 In the event that the Work coincides with the work of the Owner, Other Contractors, utility companies and/or the Local Municipality, the Contractor shall cooperate with the Owner, Other Contractors, utility companies and the Local Municipality in order to facilitate free access to their work at all times. The Owner reserves the right to alter the method of operations on this Contract to avoid interference with other work. The Contractor shall also provide separations in time and/or space (a minimum of 50 metres from the Other Contractors' proposed work area) in order to avoid placing the Owner in the position of

"Constructor" within the meaning prescribed in the *Occupational Health and Safety Act*, RSO 1990, c O.1.

- 3.2.7 The Contractor shall have right to remove representatives of Other Contractors, the Consultant and the Owner from the Site for failure to adhere to reasonable safety instructions.

GC 3.3 TEMPORARY WORK

Delete the heading "TEMPORARY WORK" and replace it with "TEMPORARY SUPPORTS, STRUCTURES AND FACILITIES"

Paragraph 3.3.3

Delete paragraph 3.3.3 in its entirety.

GC 3.4 DOCUMENT REVIEW

Delete in GC 3.4 its entirety and replace it with the following:

GC 3.4 DOCUMENT REVIEW

- 3.4.1 The Contractor shall review the Contract Documents and shall report promptly to the Consultant any error, inconsistency, or omission the Contractor may discover. Such review by the Contractor shall be undertaken with the standard of care described in GC 3.14 – PERFORMANCE BY CONTRACTOR, paragraph 3.14.1. Except for its obligation to make such review and report the result, the Contractor does not assume any responsibility to the Owner or to the Consultant for the accuracy of the Contract Documents. The Contractor shall not be liable for damage or costs resulting from such errors, inconsistencies, or omissions in the Contract Documents, which the Contractor could not reasonably have discovered through the exercise of the required standard of care. If the Contractor does discover any error, inconsistency, or omission in the Contract Documents, the Contractor shall not proceed with the work affected until the Contractor has received corrected or missing information from the Consultant.
- 3.4.2 The lack of reference on a drawing or in a specification to labour or products that are required or normally recognized within the applicable trade practice as being necessary for the complete execution of the Work shall not constitute an error, inconsistency or omission.
- 3.4.3 The issuance of Requests for Information by the Contractor shall not entitle the Contractor to any increases to the Contract Price or Contract Time.
- 3.4.4 If, at any time, the Contractor finds errors, inconsistencies, or omissions in the Contract Documents or has any doubt as to the meaning or intent of any part thereof, the Contractor shall immediately notify the Consultant, and request a Supplemental Instruction, Change Order, or Change Directive, as the case may require. Neither the Owner nor the Consultant will be responsible for the consequences of any action of the Contractor based on oral instructions.

GC 3.5 CONSTRUCTION SCHEDULE

Delete in GC 3.5 its entirety and replace it with the following:

GC 3.5 CONSTRUCTION SCHEDULE

- 3.5.1 The Contractor shall:
- .1 prior to commencement of construction, prepare and submit to the Owner and the Consultant for their review and acceptance a construction schedule indicating the critical path for the Project, using "Microsoft Project" or equivalent, demonstrating that the Work will be performed in conformity with the Contract Time, and shall conform to the phasing and sequencing requirements for the Work as set out in the Contract Documents

or as otherwise required by the Consultant or the Owner including, without limitation, a Products delivery schedule with respect to the Products whose delivery is critical to the schedule of the Work. The Contractor shall provide the schedule information required by this paragraph 3.5.1.1 in both electronic format and hard copy. Once approved by the Owner and the Consultant, the construction schedule submitted by the Contractor under this paragraph 3.5.1.1, as updated by the Contractor and approved by the Owner, shall become the "Construction Schedule";

- .2 monitor the progress of the Work on a weekly basis relative to the Construction Schedule and update the Construction Schedule on a monthly basis;
 - .3 perform the Work in accordance with the Construction Schedule;
 - .4 advise the Consultant of any revisions required to the Construction Schedule as a result of extension of the Contract Time in accordance with PART 6 – CHANGES IN THE WORK; and
 - .5 identify potential variances between scheduling and scheduled completion dates and implement necessary adjustments in the Construction Schedule in order to meet the Substantial Performance Date.
- 3.5.2 On request of the Consultant, the Contractor shall provide information regarding the progress of the Work or any part of it, or, copies, schedules and orders covering materials, components and services. The Contractor shall cooperate fully with the Consultant, and shall ensure that all Subcontractors and Suppliers and anyone for whom the Subcontractors and Suppliers may be responsible also cooperate and make available on request the same documents.
- 3.5.3 Without limiting the other obligations of the Contractor under GC 3.5 – CONSTRUCTION SCHEDULE, the Contractor shall not amend the Construction Schedule (including, without limitation, any changes to the critical path) without the prior written approval of the Owner.
- 3.5.4 If, at any time, the Owner or the Consultant advise the Contractor that it appears that the actual progress of the Work is behind schedule or is likely to become behind schedule, or if the Contractor has given notice of such to the Owner or the Consultant, the Contractor shall take appropriate steps to cause the actual progress of the Work to conform to the schedule or minimize the resulting delay and shall produce and present to the Owner and the Consultant a recovery plan demonstrating how the Contractor will achieve the recovery of the schedule. If the Contractor intends to apply for a change in the Contract Price or claim compensation for delay in relation to a schedule recovery plan, then the Contractor shall proceed in accordance with GC 6.5 – DELAYS.

GC 3.6 SUPERVISION

Delete GC 3.6 - SUPERVISION in its entirety and replace it with the following:

GC 3.6 CONTRACTOR'S PERSONNEL COMMITMENT

- 3.6.1 The Contractor shall furnish competent and adequate staff, who shall be in attendance at the Place of the Work at all times, as necessary, for the proper administration, co-ordination, supervision and superintendence of the Work; organize the procurement of all materials and equipment so that they will be available at the time they are needed for the Work; and keep an adequate force of skilled workmen on the job to complete the Work in accordance with all requirements of the Contract Documents.
- 3.6.2 Prior to commencement of the Work, the Contractor shall select a competent and experienced full time project manager (the "**Project Manager**") who shall be engaged in the Work at all times, and a competent and experienced full time site supervisor (the "Site Supervisor") who shall be in attendance at the Place of the Work at all times. Both the Project Manager and Site Supervisor shall be Gold Seal Certified or equivalent. The Project Manager

shall have full responsibility for the prosecution of the Work, with full authority to act in all matters as may be necessary for the proper co-ordination, supervision, direction and technical administration of the Work, who shall attend site meetings in order to render reports on the progress of the Work and who shall have authority to bind the Contractor in all matters related to this Contract. The Project Manager and the Site Supervisor shall be satisfactory to the Owner and shall not be changed except for good reason and with the prior written approval of the Owner.

- 3.6.3 The Project Manager and Site Supervisor shall represent the Contractor at the Place of the Work and notices and instructions given to the Project Manager and/or the Site Supervisor shall be held to have been received by the Contractor.
- 3.6.4 The Contractor may not change its Project Manager or its Site Supervisor without the Owner's prior written approval which shall not be unreasonably withheld. Further, the Contractor shall not employ or continue to employ on the Work anyone to whom the Owner may reasonably object.
- 3.6.5 The Contractor shall provide the Owner and the Consultant with the names, addresses and telephone numbers of the Project Manager, the Site Supervisor and other responsible field persons who may be contacted for emergency and other reasons during non-working hours.

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

Paragraph 3.7.4

Delete paragraph 3.7.4.

New Paragraphs 3.7.7 to 3.7.10

Add the following new paragraphs to GC 3.7:

- 3.7.7 The Contractor acknowledges and agrees that it shall not retain the services of any Subcontractors not identified in the Schedule of Subcontractors in its Bid without the prior written authorization of the Owner and/or Consultant which consent shall not be unreasonably withheld. In no event will the Contract Time be extended or the Contract Price be increased in such a change.
- 3.7.8 In the event that the Contractor requires a change of, replacement to or addition of a named Subcontractor or Supplier, the Contractor shall advise the Owner in writing, giving reasons therefore, and shall obtain the prior written approval of the Owner to such change, replacement or addition. In no event will the Contract Price be increased or the Contract Time extended as a result of such change, replacement or addition.
- 3.7.9 Nothing contained in the Contract Documents shall create any Contractual relationship between the Owner, a Subcontractor, a Supplier or their respective agents, employees or any other Persons performing any part of the Work.
- 3.7.10 The Contractor shall, in the case of its Subcontractors, be responsible to ensure that they obtain all necessary permits, fees, licences, certifications and all insurance in connection with the Work as may be required by laws and regulations and that they comply with all laws and regulations and the Contract Documents.

GC 3.8 LABOUR AND PRODUCTS

Paragraph 3.8.1

Add new subparagraphs 3.8.1.1 to 3.8.1.5:

- 3.8.1.1 Without limiting any other obligation of the Contractor under the Contract Documents or any rights of the Owner, including the rights set out in GC 5.3 - PROGRESS PAYMENT, the Contractor shall remove all liens from title immediately upon notification that a lien or

liens have been registered or filed against title, provided that the lien or liens have been placed by a Subcontractor, Supplier, labourer, mechanic or any other lien claimant under the Contract, to the extent the Contractor has been paid for the applicable Work. To the extent that the cost of the Work to complete the Project exceeds the Contract Price ("Account Deficiency"), the Owner may demand the Contractor to pay such Account Deficiency without further payment from the Owner prior to additional payments being due to the Contractor; and, in addition, the Contractor's obligation to remove liens from title shall be bound without limitation for Account Deficiency.

- 3.8.1.2 If a lien is registered by a Subcontractor, Supplier, labourer, mechanic or any other lien claimant under the Contract, the Owner may, at its option require the Contractor to defend the Owner with respect to any action which may arise as a result of such lien or the Owner may assume carriage and control of such action and any costs which may result from such action, including any legal costs incurred in removing such registered lien may be deducted by the Owner from any monies otherwise due or that may become due to the Contractor.
- 3.8.1.3 If the Owner receives a written notice of a lien or claim for lien in respect of the Work, the Contractor shall pay to the Owner the amount of the lien plus an additional 25% of the lien amount, to be retained as a holdback until the Owner is satisfied that all accounts have been paid in full and any liens have been vacated, withdrawn or discharged, as applicable.
- 3.8.1.4 If the Contractor fails to vacate, withdraw or discharge such liens, the Owner may vacate the lien(s) and may, without limiting its other rights and remedies hereunder, deduct from the monies held pursuant to paragraph 3.8.1.2, the amount of such lien(s), together with all costs and expenses incurred by the Owner in connection therewith.
- 3.8.1.5 Unless otherwise specified, all materials existing at the Place of the Work at the time of execution of the Contract shall remain the property of the Owner. All Work, Products and materials delivered by the Contractor which form part of the Work shall be considered the property of the Owner but the Contractor shall remove all supplies or rejected materials as its property when notified in writing to do so by the Owner's Consultant. All such materials, Work and Products shall remain at the risk of the Contractor who shall be held responsible for the safe keeping of same.

Paragraphs 3.8.2 and 3.8.3

Delete paragraphs 3.8.2 and 3.8.3 and replace them with the following:

- 3.8.2 Unless otherwise specified in the Contract Documents, Products provided shall be new, free from defects, and as specified. The Contractor shall not provide substitutions for specified Products without the express written consent of the Consultant and the Owner. Products which are not specified should be of a quality best suited to the purpose required and their use shall be subject to the approval of the Consultant and/or Owner.
- 3.8.3 The Contractor shall maintain good order and discipline among its employees, agents, Subcontractors and Suppliers engaged on the Work and shall not employ on the Work anyone not skilled in the task assigned. The Contractor shall submit job site rules for the review and approval of the Owner. Any such job site rules prepared by the Contractor shall be consistent with the Contractor's duties and obligations under all applicable laws and regulations and shall also include provisions making consumption of alcohol or non-prescription drugs at the Place of the Work the subject of disciplinary proceedings and/or termination of employment at the Work. Whenever the Owner or the Consultant shall inform the Contractor in writing that any person performing the Work, in its opinion:
 - .1 is incompetent or disorderly;

- .2 interferes with the ability of the Contractor, Subcontractors or Subcontractor to perform the Work;
- .3 carries on an unlawful activity;
- .4 acts in a manner inconsistent with the timely completion of the Work;
- .5 injures or attempts to injure any person or causes any damage to any property;
- .6 is not using all reasonable efforts to work safely;
- .7 has failed to comply with a direction from the Owner, the Consultant or the Owner's Health and Safety Auditor, including a direction to stop Work; or
- .8 acts in a manner that is abusive or offensive to representatives of the Owner, the Consultant or any member of the public

such person or persons shall be discharged from the Work and shall not again be employed on this Contract without the Owner's prior written consent.

New Paragraphs 3.8.4 and 3.8.5:

Add the following new paragraphs to GC 3.8:

- 3.8.4 The Contractor is responsible for the safe on-site storage of Products and their protection (including Products supplied by the Owner and other contractors to be installed under the Contract) in such ways as to avoid dangerous conditions or contamination to the Products or other persons or property and in locations at the Place of the Work to the satisfaction of the Owner and the Consultant. The Owner shall provide all relevant information on the Products to be supplied by the Owner.
- 3.8.5 The Contractor represents and warrants that the Products provided for in accordance with the Contract are not subject to any conditional sales contract and are not subject to any security rights obtained by any third party which may subject any of the Products to seizure and/or removal from the Place of the Work.

GC 3.9 DOCUMENTS AT THE SITE

Paragraph 3.9.1

Add in line 1, following "Contract Documents," the words "Supplemental Instructions, Contemplated Change Orders, Change Orders, Change Directives, Cash Allowance Disbursement Authorizations, reviewed shop drawings,".

GC 3.10 SHOP DRAWINGS

Delete the heading "SHOP DRAWINGS" and replace it with "SHOP DRAWINGS AND OTHER SUBMITTALS"

Paragraphs 3.10.1, 3.10.2, 3.10.4, 3.10.7, 3.10.8, 3.10.8.2, 3.10.9, 3.10.10 and 3.10.11

Add the words "and Submittals" after the words "Shop Drawings".

Paragraph 3.10.1

Add the words "or as the Consultant may reasonably request" at the end of the paragraph.

Paragraph 3.10.3:

Delete paragraph 3.10.3 and replace it with the following:

- 3.10.3 Prior to the first application for payment, the Contractor and the Consultant shall jointly prepare a schedule of the dates for submission and return of Shop Drawings and any Submittals.

Paragraph 3.10.12:

Delete paragraph 3.10.12 and replace it with the following:

- 3.10.12 The Consultant will review and return Shop Drawings and Submittals in accordance with the schedule agreed upon in paragraph 3.10.3, or, in the absence of such schedule, within 10 Working Days or such longer period as may be reasonably required by the Consultant. If, for any reason, the Consultant cannot process them within the time periods specified herein, the Consultant shall notify the Contractor and they shall meet to review and arrive at an acceptable revised schedule for processing. The Contractor shall update the Shop Drawings and Submittals Schedule to correspond to changes in the construction schedule. Changes in the Contract Price or Contract Time may be made only as otherwise provided in the Contract.

GC 3.13 CLEAN UP

New Paragraph 3.13.4:

Add the following new paragraph to GC 3.13:

- 3.13.4 The Owner shall have the right to back charge cleaning to the Contractor if it is not done within 24 hours of written notice to clean and the Owner shall have the right to back charge cost of damage to the Place of the Work caused by Contractor's, Subcontractor's or Supplier's transportation in and out of the Place of the Work if not repaired within 5 Working Days of written notice to repair or before final payment, whichever is earlier.

NEW GENERAL CONDITIONS GC 3.14 TO GC 3.21

Add new GC 3.14, GC 3.15, GC 3.16, GC 3.17, GC 3.18, GC 3.19, GC 3.20 and GC 3.21 as follows:

GC 3.14 PERFORMANCE BY CONTRACTOR

- 3.14.1 In performing its services and obligations under the Contract, the Contractor shall exercise the standard of care, skill, and diligence that would normally be provided by an experienced and prudent contractor supplying similar services for similar projects. The Contractor acknowledges and agrees that throughout the Contract, the performance of the Contractor's obligations, duties, and responsibilities shall be judged against this standard. The Contractor shall exercise the same standard of care, skill, and diligence in respect of any Products, personnel, or procedures which it may recommend to the Owner.
- 3.14.2 The Contractor further represents, covenants and warrants to the Owner that:
- .1 the personnel it assigns to the Project are appropriately experienced;
 - .2 it has a sufficient staff of qualified and competent personnel to replace any of its appointed representatives, subject to the Owner's approval, in the event of death, incapacity, removal or resignation; and
 - .3 there are no pending, threatened or anticipated claims that would have a material effect on the financial ability of the Contractor to perform its work under the Contract.

GC 3.15 INTERFERENCE

- 3.15.1 If the Work, in whole or in part, involves the renovation of, or addition to, existing and occupied premises:
- .1 the Contractor shall maintain normal business operations and traffic flow, with a minimum of inconvenience to the tenants and occupants of the Place of the Work;
 - .2 subject to the provisions of the Contract Documents, the Contractor shall ensure that no essential services such as electric power, water supply or other public utilities are interrupted; and

- .3 in every case where an interruption to existing services or utilities is to occur during execution of the Work, the Contractor shall give the Owner five Working Days prior written notice. The Contractor shall reschedule any such interruption, at no additional cost to the Owner, if requested to do so in writing by the Owner.

GC 3.16 RIGHT OF ENTRY

- 3.16.1 The Owner shall have the right to enter or occupy the Place of the Work in whole or in part for the purpose of placing materials, fittings and equipment or for other uses at any time before Substantial Performance of the Work, if, in the reasonable opinion of the Consultant, such entry or occupation does not prevent or substantially interfere with the Contractor's completion of the Contract or achieving Substantial Performance of the Work within the Contract Time. Such entry or occupation or use of equipment or systems shall not be considered as acceptance of the Work in whole or in part, or in any way relieve the Contractor from its responsibility as constructor under the *Occupational Health and Safety Act*, RSO 1990, c O.1 or to complete the Contract.

GC 3.17 OPERATIONAL RISKS

- 3.17.1 The position of all pole lines, conduits, water mains, sewers and other underground and overground utilities and structures is not necessarily shown on the Contract Drawings, and, where shown, the accuracy of the position of such utilities and structures is not guaranteed. Before starting Work, the Contractor shall inform itself of the exact locations of such utilities and structures, and shall be liable for damages to any utilities identified or which reasonably should have been identified, as a result of any negligent act or omission of the Contractor and/or those for whom the Contractor is responsible. Unless otherwise specified, the Contractor shall temporarily support or relocate such utilities and structures, or temporarily remove them, and restore them, to the satisfaction of the owners of the utilities and structures. The Contractor waives any claim and releases the Owner and the agents of the Owner from all liability for damages suffered as a result of such Contract Drawings or any operation required under this paragraph.
- 3.17.2 The Consultant will provide the Contractor in writing with bench marks and points of reference to be used by him in setting out the Work. The Owner will be responsible only for the correctness of the information so supplied. From these bench marks and points of reference the Contractor will do his own setting out. The setting out by the Contractor shall include but shall not be limited to the preparation of grade sheets, the installation of centre lines stakes, grade stakes, offsets and site rails.

GC 3.18 OWNERSHIP OF MATERIALS

- 3.18.1 All Work and Products delivered to the Place of the Work by the Contractor shall be the property of the Owner. The Contractor shall remove all surplus or rejected materials when notified in writing to do so by the Consultant.

GC 3.19 PROJECT RECORDS

- 3.19.1 The Contractor shall maintain and keep accurate Project records (which means all tangible records, daily reports, daily logs, documents, computer printouts, electronic information, books, plans, Drawings, Specifications, accounts or other information relating to the Work) in its office in Ontario in accordance with requirements of law, but in any event for not less than 6 years from Substantial Performance of the Work or until all claims have been settled. The records shall include detailed records of all actions taken by the Contractor related to security and health and safety legislation in the Place of the Work. During this time, the Contractor shall allow the Owner access to the Project records during normal business hours upon the giving of reasonable notice. The Contractor shall ensure that equivalent provisions to those provided herein are made in each subcontract and shall require the Subcontractors

and Suppliers to incorporate them into every level of contract thereunder for any part of the Work.

GC 3.20 CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS

- 3.20.1 With the prior written approval of the Owner, the Contractor may make use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the Work for the purpose of providing heat or power to the Project during the final stages of construction. In such event, before making its written application for Substantial Performance of the Work, and again, immediately prior to final takeover by the Owner of such systems and equipment, the Contractor shall clean and make good, to the satisfaction of the Consultant, such systems and equipment as it had been permitted to use. The Contractor shall pay any and all costs associated with such use, cleaning and making good.

GC 3.21 USE AND/OR OCCUPATION OF COMPLETED PORTIONS OF THE WORK

- 3.21.1 Upon the Owner's request, the Owner shall, at any time or times, have the right of occupying and/or using any part or parts of the Work (including, without limitation, for the purposes of installing and testing fittings and equipment), whether partially performed or entirely complete, or whether completed on schedule or not, before the completion of the Work.
- 3.21.2 In the event the Owner desires to exercise the privilege of occupancy and/or use of the Work as provided above, the Contractor shall co-operate with the Owner throughout in making available for the Owner's use such building services as heating, ventilation, cooling, water, lighting and telephone for the space or spaces to be occupied and/or used, and if the equipment required to furnish such services is not entirely completed at the time the Owner desires to occupy and/or use the aforesaid space or spaces, the Contractor shall make every reasonable effort to complete same as soon as possible to the extent that the necessary equipment can be put into operation and use and any extra cost beyond that originally required to complete the Work arising from such early occupancy and/or use shall be borne by the Owner.
- 3.21.3 In the event that the Owner exercises the privilege of occupancy and/or use of the Work as provided above, it agrees to do so, so as not to materially interfere with the respective work of the Contractor, Subcontractors or Suppliers and under the understanding that the Owner will be occupying premises within a construction site which will require compliance with all normal construction site requirements including, without limitation, health and safety requirements.
- 3.21.4 It shall be understood, however, that the Owner's occupancy and/or use of such space or spaces of the Work shall not constitute the Owner's acceptance of any Work, materials or equipment which are not in accordance with the requirements of the Contract Documents, nor affect the warranty period under the Contract, nor relieve the Contractor from his obligations, duties, responsibilities, and liabilities to complete the Work, nor for responsibility for loss or damage due to or arising out of defects in, or malfunctioning of, any Work, material or equipment, nor from any other unfulfilled duties, liabilities, obligations or responsibilities under the Contract nor from any other duty, liability, obligation or responsibility under the Contract including, without limitation, the Contractor's warranty obligations. If, however, damage results from any act by the Owner, the Owner shall assume its share of the responsibility for such damage.

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

Delete GC 4.1 in its entirety and replace it with the following:

GC 4.1 CASH ALLOWANCES

- 4.1.1 The Contract Price includes the cash allowances, if any, stated in the Contract Documents. The scope of work or costs included in such cash allowances shall be as described in the Contract Documents.
- 4.1.2 The Contract Price, and not the cash allowances, includes the Contractor's overhead and profit in connection with such cash allowances.
- 4.1.3 Expenditures under cash allowances shall be authorized by the Owner through the Consultant.
- 4.1.4 Where the actual cost of the Work under any cash allowance exceeds the amount of the allowance, any unexpended amounts from other cash allowances shall be reallocated, at the Consultant's direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the Contract Price for overhead and profit. Only where the actual cost of the Work under all cash allowances exceeds the total amount of all cash allowances shall the Contractor be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the Contract Documents.
- 4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the Contract Price by Change Order without any adjustment for the Contractor's overhead and profit on such amount.
- 4.1.6 The value of the work performed under a cash allowance is eligible to be included in progress payments.
- 4.1.7 At the commencement of the Work, the Contractor shall prepare for the review and acceptance of the Owner and the Consultant, a schedule indicating the times, within the construction schedule referred to in GC 3.5 – CONSTRUCTION SCHEDULE, that items called for under cash allowances and items that are specified to be Owner purchased and Contractor installed or hooked up are required at the site to avoid delaying the progress of the Work.
- 4.1.8 The Owner reserves the right to call, or to have the Contractor call, competitive bids for portions of the Work, to be paid for, out of cash allowances.
- 4.1.9 Purchases from cash allowances must be authorized by written instructions issued by the Consultant and the form and methods of accounting for costs shall be agreed to by the Consultant and the Contractor before proceeding with the purchase.

GC 4.2 CONTINGENCY ALLOWANCE

Delete GC 4.2 in its entirety.

PART 5 PAYMENT

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

Delete in GC 5.1 in its entirety and replace it with the following:

GC 5.1 FINANCING INFORMATION REQUIRED

- 5.1.1 The Owner and Contractor shall provide each other with timely Notice in Writing of any material change in their financial ability to fulfil their respective obligations under the Contract.

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

Paragraph 5.2.2

Add the following to the end of paragraph 5.2.2:

The Contractor shall review with the Consultant and the Owner, at a scheduled time, the percentage of work completed for each item indicated in the schedule of values. This procedure

shall be complied with for each application for payment prior to submitting the formal application for payment.

Paragraph 5.2.4

Add “the Owner and” before “the Consultant”.

Paragraph 5.2.7

Add the following to the end of paragraph 5.2.7:

Any Products delivered to the Place of the Work but not yet incorporated into the Work shall remain at the risk of the Contractor notwithstanding that title has passed to the Owner pursuant to GC 3.18 - OWNERSHIP OF MATERIALS.

New Paragraphs 5.2.8 to 5.2.14

Add the following new paragraphs to GC 5.2:

- 5.2.8 Prior to each application for payment, the Contractor and Consultant shall jointly check the progress of the Work.
- 5.2.9 The Contractor shall submit, with each application for payment after the first, a Statutory Declaration, in a form satisfactory to the Owner, stating that payments in connection with the Work, as noted in the Statutory Declaration, have been made to the end of the period immediately preceding that covered by the current application and, if requested by the Owner, a Statutory Declaration from any Subcontractor, as may be identified by the Owner in a form satisfactory to the Owner. The Statutory Declarations shall be dated the same date as the Contractor’s application for payment.
- 5.2.10 Each Contractor’s application for payment shall be accompanied by a current Workplace Safety and Insurance Board Certificate stating that the Contractor is in good standing with the Workplace Safety and Insurance Board and that all assessments have been paid by the Contractor to the date of such application and, in the event that any insurance policy required to be maintained by the Contractor under the Contract Documents has either lapsed or the Owner or the Consultant has received notice from the insurer of cancellation of coverage thereunder, an up-to-date certificate of insurance with respect to such policy evidencing that same is in full force and effect and fully paid for.
- 5.2.11 The Contractor shall submit with each application for payment, payment receipts for products and materials purchased under conditional sales contracts. Authorization for payment of products and materials purchased under conditional sales contracts shall not be made by the Owner until evidence of payment is submitted.
- 5.2.12 The Contractor shall prepare current As-Built Drawings during the course of the Work, which current As-Built Drawings shall be maintained by the Contractor and made available to the Consultant for review with each application for payment. The Consultant may retain an amount reasonably determined by the Consultant from any progress payment for the value of the As-Built Drawings not presented for review until the As-Built Drawings are presented for review.
- 5.2.13 Payment by the Owner pursuant to the Contract shall not preclude the Owner from thereafter disputing any of the items involved and shall not be construed as acceptance of any part of the Work.
- 5.2.14 The Contractor shall utilize and submit to the Consultant and the Owner one hard copy, and one electronic copy (in a pdf. format) of the “Contractor’s Application for Payment”, in a form satisfactory to the Owner, when submitting its formal application for payment. In addition, a breakdown of approved Change Orders and percentage completed of each shall be included, in a form satisfactory to the Owner. Deviation or incomplete submissions

with respect to the approved breakdown will require resubmission of the application for payment.

GC 5.3 PROGRESS PAYMENT

Subparagraph 5.3.1.3

Delete subparagraph 5.3.1.3 and replace it with the following:

- 5.3.1.3 The Owner shall make payment to the Contractor on account as provided in Article A-5 of the Agreement – PAYMENT no later than 20 calendar days after the date of issuance by the Consultant of a certificate for payment.

New Paragraphs 5.3.2 to 5.3.5

Add the following new paragraphs to GC 5.3:

- 5.3.2 Certificates for payment may provide for retention of amounts as determined by the Consultant to ensure correction of deficient work done or unacceptable Products provided.
- 5.3.3 If the Contractor fails to comply with GC 5.2 – APPLICATIONS FOR PROGRESS PAYMENT or GC 10.4 – WORKERS COMPENSATION, the Owner shall not be required to make payments to the Contractor until the obligation has been complied with.”
- 5.3.4 Without limiting any other remedy available to the Owner, the Owner may withhold all, or any part, of any payment, or revise any previous payment certificate(s) made because of subsequently discovered evidence or the results of subsequent inspections or tests, but only to the extent that is necessary to protect the Owner from loss because:
- .1 the Work does not conform to the requirements of the Contract Documents or completed Work has been damaged requiring correction or replacement; or
 - .2 the Contract Price has been reduced by Change Order; or
 - .3 the Owner has been required to correct non-conforming Work or complete Work in accordance with GC 2.4 – DEFECTIVE WORK, or
 - .4 the Owner has actual knowledge of the occurrence of any of the events enumerated in GC 7.1 – OWNER’S RIGHT TO PERFORM THE WORK OR STOP THE WORK OR TERMINATE THE CONTRACT, justifying termination; or
 - .5 claims have been made against the Owner on account of the Contractor’s performance or furnishing of the Work; or
 - .6 written notice of a lien or a claim for lien under the Construction Act has been received by the Owner or a lien has been registered or filed, in either case, in connection with the Work, except where the Contractor has delivered a bond, acceptable to the Owner, to secure the satisfaction and discharge, vacation or withdrawal of such lien;
 - .7 there are other items entitling the Owner to a set-off against the amount for which application is made in accordance with the provisions of the Contract Documents; or
 - .8 the Contractor has not delivered all of the documentation required with its application for payment.
- 5.3.5 If the Owner fails to pay any amount owing to the Contractor because of a good faith dispute, no default by the Owner under the Contract Documents shall be deemed to exist because of such failure of payment, provided the Owner pays the amount the parties agree is owing to the Contractor within 21 Days following the resolution of such dispute.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

Delete GC 5.4 in its entirety and replace it with the following:

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

- 5.4.1 When the Contractor considers that the Work is substantially performed, and the Contractor has supplied all documentation required to be provided prior to the granting of Substantial Performance as specified in the Contract Documents, the Contractor shall notify the Owner and the Consultant in writing, providing a comprehensive list of items remaining to be completed or corrected, and request that the Consultant issue a Certificate of Substantial Performance. Failure to include an item on the list will not alter the responsibility of the Contractor to complete the Work.
- 5.4.2 No later than 10 Working Days after the receipt of the Contractor's notification, the Consultant will review the Work to verify its completion status. If the Consultant does not consider the Work substantially performed, it will communicate its reasons in writing to the Owner and the Contractor. Where the Consultant finds that the Work has been substantially performed, subject to receipt by the Consultant of all documentation specified in the Contract Documents and the satisfaction by the Contractor of all other requirements set out in the Contract Documents, the Consultant will issue a Certificate of Substantial Performance. The date of Substantial Performance of the Work shall be as stated in the certificate.
- 5.4.3 The following are conditions precedent to the issuance of the Certificate of Substantial Performance referred to in paragraph 5.4.2:
- .1 the Work has satisfactorily passed the required inspection and performance testing;
 - .2 contact information for the written warranties and guarantees required by the Contract Documents shall have been received by the Consultant and the Owner;
 - .3 all record drawings, records, and related data as required by the Contract Documents shall have been received by the Consultant;
 - .4 all maintenance manuals, training manuals, operating instructions, equipment calibration sheets, maintenance and operating tools, and replacement/spare parts and materials, as specified in the Contract Documents, shall have been received by the Consultant;
 - .5 all test results shall have been received by the Consultant;
 - .6 where applicable, the Consultant shall have received permits, licenses, approvals, certificates and authorizations required by any authority having jurisdiction over the Work or the Place of the Work;
 - .7 all training required under the Contract shall have been provided;
 - .8 where applicable, each item of mechanical, electrical, instrumentation, piping and HVAC equipment installed under this Contract shall have been tested to demonstrate compliance with the performance requirements of this Contract;
 - .9 where applicable, each mechanical, electrical, instrumentation, piping and HVAC system installed or modified under this Contract shall have been tested in accordance with the specified requirements; and
 - .10 where applicable, all instructions shall have been received by the Owner's staff to enable the Owner to operate the facility.
- 5.4.4 The Contractor, at its expense, shall cause the Certificate of Substantial Performance of the Work to be published, in a form satisfactory to the Owner, in a construction trade paper and shall provide proof of publication to the Consultant and the Owner.
- 5.4.5 The publication by the Contractor of the Certificate of Substantial Performance shall constitute a waiver by the Contractor of all claims whatsoever against the Owner under this Contract up to the date of Substantial Performance of the Work whether, for a change in the Contract Price, extension of Contract Time or otherwise, except those made in writing, prior

to the Contractor's application for payment upon Substantial Performance of the Work, and still unsettled.

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

Delete GC 5.5 in its entirety and replace it with the following:

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

- 5.5.1 No later than 15 Days after the issuance of the Certificate of *Substantial Performance*, the *Contractor* shall submit an application for payment of the basic holdback to the Owner and the Consultant.
- 5.5.2 The Contractor's application for the payment of the basic holdback shall indicate the name, title, telephone number and mailing address of the person to whom payment is to be sent and contain the following documentation, at a minimum:
 - .1 an application for payment covering Work performed up to the date of Substantial Performance of the Work;
 - .2 an application for payment of the basic holdback amount;
 - .3 proof of publication of the Certificate of Substantial Performance;
 - .4 a statutory declaration in a form satisfactory to the Owner stating that all accounts for materials, labour, subcontracts, *Products*, *Construction Equipment*, and other indebtedness which may have been incurred by the *Contractor or by any Subcontractor, or Supplier* in the *Substantial Performance of the Work* and for which the *Owner* might in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified amount in dispute,
 - .5 a written request for release of holdback including a declaration that no written notices of lien have been received by it,
 - .6 a valid Workplace Safety & Insurance Board Clearance Certificate, and
 - .7 a release from the Contractor in form satisfactory to the Owner releasing the Owner from all further claims relating to the Contract except for claims for work performed after the date of Substantial Performance of the Work and claims pursuant to PART 8 – DISPUTE RESOLUTION made prior to Substantial Performance of the Work and still unsettled.
- 5.5.3 After the receipt of an application for payment from the *Contractor* and the documents as provided in paragraph 5.5.2:
 - .1 the Owner and the Consultant shall review the application for payment of the basic holdback and advise the Contractor of any disputed amounts; and.
 - .2 the Consultant will issue a certificate for payment of the undisputed amount of the basic holdback.
- 5.5.4 In the event that the Owner or the Consultant dispute any amounts in the Contractor's application for the payment of basic holdback, the Owner or the Consultant shall arrange for the publication of a Notice of Non-Payment of Holdback in the prescribed form in a construction trade newspaper.
- 5.5.5 The Owner and the Consultant shall be under no obligation to process the application for payment of the basic holdback unless the documents identified in paragraph 5.5.2 are provided in a form acceptable to the Owner.

- 5.5.6 Provided the Owner has not received a claim for lien or written notice of a lien under the Construction Act, the Owner shall pay all undisputed amounts to the Contractor in accordance with the provisions of Article A-5 of the Agreement – PAYMENT.

GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

Delete GC 5.6 in its entirety and replace it with the following:

GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

- 5.6.1 When the Contractor considers a subcontract (the “**Subcontract**”) to be complete, including all required inspection and testing, the Contractor may submit an application for certification of completion of the Subcontract to the Owner and the Consultant.
- 5.6.2 The application for certification of completion of the Subcontract shall include the following information and documentation with supporting particulars, at a minimum:
- .1 the final Subcontract price;
 - .2 a Declaration of Last Supply under subsection 31(5) of the Construction Act from the Subcontractor;
 - .3 valid WSIB Certificates of Clearance from the Contractor and the Subcontractor;
 - .4 a statutory declaration from the Subcontractor, in a form satisfactory to the Owner, that all accounts for labour, subcontracts, Products, construction machinery and equipment and other indebtedness which may have been incurred by the Subcontractor in performing the work under the Subcontract, and for which the Owner might in any way be held responsible, have been paid in full except for statutory holdback monies properly retained
 - .5 a release from the Contractor and the Subcontractor, in a form satisfactory to the Owner, releasing the Owner from all further claims relating to the Subcontract.
- 5.6.3 Upon receipt of the application for certification of completion of the Subcontract, the Owner and the Consultant may, at their sole discretion, review the application to determine whether the Subcontract is complete.
- 5.6.4 Provided the Subcontract is complete, the Owner may issue a Certificate of Completion of Subcontract, in the prescribed form, to the Contractor specifying the date of the Subcontract.
- 5.6.5 The Contractor shall arrange, at its own expense, for the publication of the Certificate of Completion of Subcontract in a construction trade newspaper.
- 5.6.6 No later than 15 Days following the issuance of the Certificate of Completion of Subcontract, the Contractor shall submit an Application for Holdback Release with Respect to a Completed Subcontract (the “**Application**”) to the Owner and the Consultant.
- 5.6.7 The Application shall indicate the name, title, telephone number and mailing address of the person to whom payment is to be sent and contain the following documentation, at a minimum:
- .1 an application for payment of the holdback with respect to the completed Subcontract; and
 - .2 proof of publication of the Certificate of Completion of Subcontract.
- 5.6.8 After receipt of the Application:
- .1 the Owner and the Consultant shall review the Application and advise the Contractor of any disputed amounts; and

- .2 the Consultant shall issue a certificate for payment of the undisputed amount of the holdback in relation to the Subcontract.
- 5.6.9 In the event that the Owner or the Consultant dispute any amounts in the Contractor's Application, the Owner or the Consultant shall arrange for the publication of a Notice of Non-Payment of Holdback in the prescribed form in a construction trade newspaper.
- 5.6.10 The Owner and the Consultant will be under no obligation to process the Application unless the documents identified in paragraph 5.6.7 are provided in a form satisfactory to the Owner.
- 5.6.11 Provided the Owner has not received a claim for lien or written notice of a lien under the Construction Act, the Owner shall pay all undisputed amounts to the Contractor in accordance with the provisions of **Error! Reference source not found.** Article A-5 of the Agreement - PAYMENT.
- 5.6.12 Immediately upon receipt of the statutory holdback funds the Contractor shall give to the Subcontractor the payment due under the Subcontract.
- 5.6.13 Release of the statutory holdback shall not relieve the Contractor, or its surety, from any obligations hereunder.

GC 5.7 FINAL PAYMENT

Delete GC 5.7 in its entirety and replace it with the following:

GC 5.7 FINAL PAYMENT

- 5.7.1 When the Contractor considers the Contract to be complete, the Contractor shall submit an application for Total Performance of the Work to the Owner and the Consultant. The Contractor's application for Total Performance of the Work shall be accompanied by any documents or materials not yet delivered pursuant to GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK, paragraph 5.4.3 together with complete As-Built Drawings.
- 5.7.2 The *Consultant* will, no later than 10 Working Days after the receipt of the Contractor's application for Total Performance of the Work, review the *Work* to verify the validity of the application. If the Consultant does not consider the Contract to be complete, it will communicate its reasons in writing to the Owner and the Contractor.
- 5.7.3 Where the Consultant and the Owner find that Total Performance of the Work has been reached, the Consultant will, subject to receipt of all documentation specified in the Contract Documents and the satisfaction by the Contractor of all other requirements set out in the Contract Documents, including the requirements set out in paragraph 5.7.4, issue a Certificate of Total Performance. The date of Total Performance of the Work shall be as stated in the certificate.
- 5.7.4 The following are conditions precedent to the issuance of the Certificate of Total Performance referred to in paragraph 5.7.3:
- .1 the completion of all Work, including patching and the furnishing of missing material and acceptance thereof by the Consultant; and
- .2 where applicable, the Owner shall have received proof that all claims, including taxes, arising from or in respect of the Work and any liens arising from the same which shall have been claimed, filed or recorded have been finally and conclusively satisfied and released, all of which shall be in form and substance satisfactory to the Owner.
- 5.7.5 No later than 15 Days following the issuance of the Certificate of Total Performance, the Contractor shall submit an application for the release of the holdback for finishing work to the Consultant and the Owner.

- 5.7.6 The Contractor's application for the release of the holdback for finishing work shall indicate the name, title, telephone number and mailing address of the person to whom payment is to be sent and contain the following documentation, at a minimum:
- .1 an application for payment covering Work performed up to the date of Total Performance of the Work;
 - .2 an application for payment of the holdback for finishing work;
 - .3 a signed copy of the Certificate of Total Performance;
 - .4 a written request for release of holdback, including a declaration that no written notices of lien have been received by it.
 - .5 a statutory declaration in a form acceptable to the Owner stating that all accounts for materials, labour, subcontracts, *Products, Construction Equipment*, and other indebtedness which may have been incurred by the *Contractor or by any Subcontractor, or Supplier* in completing the Contract and for which the *Owner* might in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified amount in dispute,
 - .6 a valid Workplace Safety & Insurance Board Clearance Certificate;
 - .7 a certificate of search of title from a solicitor testifying there are no liens registered relative to the Work;
 - .8 a written statement that the Work has been performed to the requirements of the Contract Documents, itemizing approved changes in the Work, the Consultant's written instructions and modifications required by authorities having jurisdiction; and
 - .9 a release from the Contractor in form satisfactory to the Owner releasing the Owner from all further claims relating to the Contract except for claims pursuant to PART 8 – DISPUTE RESOLUTION made prior to Total Performance of the Work and still unsettled.
- 5.7.7 After receipt of an application for payment from the Contractor and the documents as provided in paragraph 5.7.6:
- .1 the Owner and the Consultant shall review the application for payment of the holdback for finishing work and advise the Contractor of any disputed amounts; and
 - .2 the Consultant shall issue a certificate for payment of the undisputed amount of the holdback for finishing work.
- 5.7.8 In the event that the Owner or the Consultant dispute any amounts in the Contractor's application for the payment of basic holdback, the Owner or the Consultant shall arrange for the publication of a Notice of Non-Payment of Holdback in the prescribed form in a construction trade newspaper.
- 5.7.9 The Owner and the Consultant will be under no obligation to process the application for payment of the holdback for finishing work unless the documents identified in paragraph 5.7.6 are provided in a form satisfactory to the Owner.
- 5.7.10 Provided the Owner has not received a claim for lien or written notice of a lien under the Construction Act, the Owner shall pay all undisputed amounts to the Contractor in accordance with the provisions of Article A-5 of the Agreement - PAYMENT.

- 5.7.11 All certificates issued by the Owner or the Consultant shall be to the best of their knowledge, information and belief. By issuing any certificate the Owner or the Consultant do not confirm the correctness or completeness of the Work.
- 5.7.12 Subject to the Construction Act, and without limiting the rights of set-off granted to the Owner under the Contract Documents, all monies payable to the Owner by the Contractor under any stipulation herein may be retained out of any monies due or which may become due from the Owner to the Contractor under the Contract or, if the Contractor becomes insolvent, under any other contract between the Contractor and the Owner, and may be recovered from the Contractor or its sureties, or any or either of them, as a debt due to the Owner. In addition, the Owner shall have full power to retain monies or withhold any certificate if circumstances arise which may indicate the advisability of so doing, though the sum to be retained may be unascertained.

GC 5.8 WITHHOLDING OF PAYMENT

Paragraph 5.8.1

Delete the word “If” and replace it with “Subject to the Construction Act, if”

New Paragraph 5.8.2

Add the following new paragraph to GC 5.8:

- 5.8.2 In the event that any portion of the Work is defective or is not performed in accordance with the Contract Documents, the Owner may retain as a holdback an amount equal to the cost which the Owner or the Consultant estimates will be incurred to correct the Work until the Work has been corrected to the satisfaction of the Owner.

NEW GENERAL CONDITIONS GC 5.10 TO GC 5.11

Add new GC 5.10 and GC 5.11 as follows:

GC 5.10 LIQUIDATED DAMAGES

- 5.10.1 Without prejudice to any other remedy available to the owner, If the Contractor:
- .1 fails to complete the Work within the Contract Time, the Contractor shall pay to the owner the amount per Day specified in Article A-13 of the Agreement - LIQUIDATED DAMAGES until the Work is complete; and/or
 - .2 fails to meet any of the Interim Milestone(s) stipulated in the Contract Documents, the Contractor shall pay to the Owner the amount(s) per day specified in Article A-13 of the Agreement – LIQUIDATED DAMAGES until the Interim Milestone(s) has been met.
- 5.10.2 The Contractor acknowledges and agrees that the liquidated damages amounts specified in Article A-13 of the Agreement - LIQUIDATED DAMAGES are a genuine estimate of the actual costs/damages that will be incurred by the Owner as a result of the failure of the Contractor to complete the Work, including any Interim Milestone(s), within the allotted time and is not a penalty.

GC 5.11 SET-OFF

- 5.11.1 Without limiting the specific rights of set-off in favour of the Owner provided for in this Contract, the Owner shall have the right to set-off against any and all monies due, or which may become due, to the Contractor under this Contract, any reasonable and substantiated amounts due or to become due from the Contractor to the Owner under the Contract and in the event of an insolvency of the Contractor, in relation to any other contracts between the Contractor and the Owner.

GC 5.12 MAINTENANCE SECURITY

- 5.12.1 The Owner may deduct from the maintenance security, if any, any amounts owing to the Owner under this Contract, or in the event the Contractor becomes insolvent, any other contract between the Owner and the Contractor, whether the amounts relate to outstanding or deficient Work, or any other claims which the Owner may have including, but not limited to, outstanding claims under GC 12.1 and GC 3.8.
- 5.12.2 The balance of the maintenance security, if any, shall be eligible for release to the Contractor upon the expiration of the warranty period and only after all deficiencies and all other warranty issues have been resolved to the satisfaction of the Owner (whether they have occurred during the Warranty Period or thereafter).

PART 6 CHANGES IN THE WORK

GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

Delete GC 6.1 in its entirety and replace it with the following:

GC 6.1 CHANGES IN THE WORK

- 6.1.1 The Owner, without invalidating the Contract, may make changes in the Work by providing the Contractor with a Change Order or Change Directive. The Contractor shall provide an updated schedule in the event that the Change Order or Change Directive affects the progress of the Work.
- 6.1.2 The Contractor shall not proceed with any changes in the Work until it has received a copy of the Change Order or Change Directive. No claims for changes in the Contract Price or Contract Time shall be valid unless provided for by the Owner in the Change Order.
- 6.1.3 Any Change Order executed by the parties shall be deemed to include any and all direct and indirect costs incurred by the Contractor as a result of the change in the Work including, but not limited to, labour, materials, equipment, bonding, insurance, overhead, profits, and delay costs, and the Contractor shall not be entitled to claim any additional compensation for these items.
- 6.1.4 The Contractor shall not be entitled to receive any additional compensation arising out of changes to the Work other than the amounts determined and agreed to under GC 6.2 – CHANGE ORDER, or as provided in GC 6.3 – CHANGE DIRECTIVE.
- 6.1.5 The Contractor acknowledges that the total Contract Time includes a built in 'float' of approximately 10% of the Contract Time to account for schedule delays resulting from changes in the Work which would normally be expected to arise on projects of a similar scope, size and complexity and as contemplated by GC 6.1 – CHANGES IN THE WORK. As a result, subject to paragraphs 6.1.6 and 6.1.7, no extensions of the Contract Time and/or compensation for schedule delays, shall be granted by the Owner to the Contractor for any changes in the Work reflected in Change Orders or Change Directives issued under GC 6.2 – CHANGE ORDER or GC 6.3 - CHANGE DIRECTIVE respectively, until the cumulative value of all Change Orders and Change Directives under the Contract exceeds 10% of the original Contract Price. If and only once the total cumulative value of all Change Orders and Change Directives exceeds 10% of the original Contract Price (excluding those related to "substantial changes" as defined in paragraph 6.1.6 below), shall the Contractor be entitled to any extensions of Contract Time and/or compensation for schedule delays, in relation to any subsequent change in the Work, as reflected as part of any Change Orders or Change Directives issued thereafter, and provided that such change in the Work adversely affects the critical path schedule.
- 6.1.6 Paragraph 6.1.5 shall not apply when an extension of the Contract Time is made necessary due to a "substantial change" in the Work. A "substantial change" means a change in the Work under GC 6.1 – CHANGES IN THE WORK which results in either:

- .1 actual direct additional costs to the Contractor equal to, or greater than, \$500,000; or
 - .2 a delay to the critical path of the construction schedule for the Project of greater than 10 Working Days;
- or both.

- 6.1.7 Should a substantial change arise, the Contractor shall be entitled to an extension of Contract Time in accordance with the Contract, and the value of any Change Order or Change Directive issued in relation to the substantial change shall be excluded from the 10% calculation referred to in paragraph 6.1.6.

GC 6.2 CHANGE ORDER

Delete GC 6.2 in its entirety and replace it with the following:

GC 6.2 CHANGE ORDER

- 6.2.1 When a Change in the Work is proposed or requested, the Owner shall prepare a Contemplated Change Order (CCO) describing the proposed change(s) and submit the CCO to the Contractor for consideration. The Contractor shall propose, with the appropriate supporting documentation, its proposed method of adjustment and the amount of adjustment to the Contract Price, if any, and the proposed adjustment in the Contract Time, for the work included in the CCO.
- 6.2.2 The Owner and/or the Consultant will assess the merits of the proposed adjustments to the Contract Price and/or the Contract Time in accordance with the process outlined in this General Condition.
- 6.2.3 If the Owner and the Contractor agree to the adjustments in the Contract Price and/or Contract Time or the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a Change Order.
- 6.2.4 The value of a change shall be determined in one or more of the following methods as directed by the Consultant or the Owner:
- .1 By quotation and acceptance of a lump sum. Any quotations submitted by the Contractor, in support of the CCO shall meet the requirements specified below in order to ensure that the quotation can be properly evaluated by the Consultant. The Contractor shall also require Subcontractors and suppliers to supply similar information to the Consultant.
 - (1) Quotations from the Subcontractors shall be on the Subcontractor's letterhead.
 - (2) Quotations submitted by Subcontractors and the Contractor shall have a complete breakdown for all items of material, a total number of hours for labour, and a dollar rate applied against individual material items and labour quantities.
 - (3) Quotations shall stipulate any adjustment in the Contract Time, if any, for the proposed change in the Work.
 - (4) Quotations shall indicate correct percentage values for overhead and profit by the Contractor and the Subcontractors as stated in paragraph 6.2.4.3(3). If the quotation is paid for under a Cash Allowance Disbursement Authorization, refer to GC 4.1 – CASH ALLOWANCES for overhead and profit requirements.
 - (5) Mark-up fee shall be applied as set out in the table below.
 - (6) Ensure all mathematical calculations are complete.
- Quotations submitted with any of the above items missing or incorrect will be returned for revision.

- .2 By unit prices established in the Contract or subsequently agreed upon in writing by the parties. Unit prices shall include materials, labour, equipment, delivery, freight, handling, disposal, statutory charges, supervisions, testing, all applicable duties, brokerage charges, import charges, taxes, bonding, overhead, profit and all relative charges and expenses including, but not limited to, office administration charges such as disbursements, travel costs, printing and incidentals to the Contractor, and shall be the total cost to the Owner. Adjustment to the Contract Price shall be based on a net quantity difference from the original quantity.
- .3 By the amount, net of all credits, of time, materials, Construction Equipment and Products expended:
 - (1) by a Subcontractor applying its labour charge out rates, together with the actual costs, without mark-up, of materials, Construction Equipment and Products utilized in the change, plus the Subcontractor's mark-up fee set out in the table below, which shall be applied to material and Product costs only;
 - (2) by the Contractor applying its labour charge out rates, together with the actual costs, without Contractor's mark-up, of materials, Construction Equipment and Products plus the mark-up fee set out in the table below which shall be applied to material, Construction Equipment and Product costs only;
 - (3) the Contractor shall be entitled to the Contractor mark-up fee in the table below on the value of Subcontractor work even where the Subcontractor is not entitled to a mark-up fee on its labour charge out rates pursuant to paragraph 6.2.4.3(1).

Costs*	Subcontractor and Contractor's Own Forces Mark-Up (%) (includes overhead and profit)	Contractor Mark-Up (%) on Subcontractor Work (includes overhead and profit)
\$1.00 to \$10,000.00	10	5.0
\$10,000.01 to \$50,000	8	5.0
Over \$50,000	5	3.0

*each percentage specified in the table above is not cumulative but is applied to the costs only

- .4 The aforesaid Subcontractor and Contractor's percentage fee mark-ups include all necessary supervision, general account items, general clean-up, small tools, as-built drawings and job safety necessary to perform the change.

GC 6.3 CHANGE DIRECTIVE

Delete GC 6.3 in its entirety and replace it with the following:

GC 6.3 CHANGE DIRECTIVE

- 6.3.1 If the Owner requires the Contractor to proceed with a Change in the Work prior to the Owner and the Contractor agreeing upon the adjustments to the Contract Price and/or the Contract Time, the Owner or the Consultant shall issue a Change Directive. Upon receipt of the Change Directive, the Contractor shall promptly proceed to execute the Work described in the Change Directive.
- 6.3.2 The adjustment in the Contract Price for a change carried out by way of a Change Directive shall be determined in one of the following methods:
 - .1 Estimate and acceptance in a lump sum;

- .2 Unit prices set out in the Contract or subsequently agreed upon;
 - .3 Actual cost of expenditures and savings to perform the work attributable to the change plus markup as specified in GC 6.2 – CHANGE ORDER, paragraph 6.2.4.3.
- 6.3.3 In the case of a change in the Work to be valued in accordance with the method prescribed in paragraph 6.3.2.1, the Contractor shall present to the Consultant and the Owner, for approval, a detailed estimate of the costs of the Contractor and the involved Subcontractors including Products, labour itemized by man hours, labour burden and the overhead and profit of each of the involved Subcontractors shown separately.
- 6.3.4 In the case of a change to be valued under methods prescribed in paragraphs 6.3.2.2 and 6.3.2.3, the form of presentation of costs and methods of measurement shall be agreed to by the Owner, through the Consultant, and the Contractor, before proceeding with the change.
- 6.3.5 When the method prescribed in paragraph 6.3.2.3 is used to determine the value of a change in the Work, the Contractor shall keep and present, in such form as the Consultant may require, an itemized accounting of the actual cost of expenditures and savings together with supporting data. The cost of performing the work attributable to the Change Directive shall be limited to the actual cost of the items contained in paragraphs 6.3.6.1 to 6.3.6.17 below.
- 6.3.6 The cost of performing the work attributable to the Change Directive shall be limited to the actual cost of the following:
- .1 salaries, wages and benefits paid to personnel in the direct employ of the Contractor under a salary or wage schedule agreed upon by the Owner and the Contractor, or in the absence of such a schedule, actual salaries, wages and benefits paid under applicable bargaining agreement, and in the absence of a salary or wage schedule and bargaining agreement, actual salaries, wages and benefits paid by the Contractor, for personnel:
 - (1) carrying out the work, including necessary supervisory services;
 - (2) engaged in the preparation of Shop Drawings, fabrication drawings, coordination drawings and As-Built Drawings; or
 - (3) engaged in the processing of changes in the Work.
 - .2 contributions, assessments or taxes incurred for such items as employment insurance, provincial or territorial health insurance, workers' compensation, and Canada or Quebec Pension Plan, insofar as such cost is based on wages, salaries or other remuneration paid to employees of the Contractor and included in the cost of the Work as provided in paragraph 6.3.6.1;
 - .3 travel and subsistence expenses of the Contractor's personnel described in paragraph 6.3.6.1;
 - .4 all Products including cost of transportation thereof;
 - .5 materials, supplies, Construction Equipment, temporary work, and hand tools not owned by the workers, including transportation and maintenance thereof, which are consumed in the performance of the Work; and cost less salvage value on such items used but not consumed, which remain the property of the Contractor;
 - .6 all tools and Construction Equipment, exclusive of hand tools used in the performance of the Work, whether rented from or provided by the Contractor or others, including installation, minor repairs and replacements, dismantling, removal, transportation, and delivery cost thereof;
 - .7 all equipment and services required for the Contractor's field office;
 - .8 deposits lost;

- .9 the amounts of all subcontracts;
 - .10 quality assurance such as independent inspection and testing services;
 - .11 charges levied by authorities having jurisdiction at the Place of the Work;
 - .12 royalties, patent licence fees and damages for infringement of patents and cost of defending suits therefor subject always to the Contractor's obligations to indemnify the Owner as provided in GC 10.3 - PATENT FEES;
 - .13 any adjustment in premiums for all bonds and insurance which the Contractor is required, by the Contract Documents, to purchase and maintain;
 - .14 any adjustment in taxes, other than Harmonized Sales Taxes, and duties for which the Contractor is liable;
 - .15 charges for long distance telephone and facsimile communications, courier services, expressage, and petty cash items incurred in relation to the performance of the Work;
 - .16 removal and disposal of waste products and debris; and
 - .17 any additional safety measures and requirements.
- 6.3.7 Notwithstanding any other provisions contained in the General Conditions of the Contract, it is the intention of the parties that the cost of any item under any cost element referred to in paragraph 6.3.6 shall cover and include any and all costs or liabilities attributable to the Change Directive other than those which are the result of or occasioned by any failure on the part of the Contractor to exercise reasonable care and diligence in the Contractor's attention to the Work. Any cost due to failure on the part of the Contractor to exercise reasonable care and diligence in the Contractor's attention to the Work shall be borne by the Contractor.
- 6.3.8 For the purpose of valuing Change Directives, the Owner shall be afforded reasonable access to all of the Contractor's pertinent documents related to the cost of performing the Work attributable to the Change Directive.
- 6.3.9 Pending determination of the final amount of a Change Directive, the undisputed value of the Work performed as the result of a Change Directive is eligible to be included in progress payments.
- 6.3.10 If the Owner and the Contractor do not agree on the proposed adjustment in the Contract Time attributable to the change in the Work, or the method of determining it, the adjustment shall be referred to the Consultant for determination.
- 6.3.11 If the Owner and the Contractor agree to the adjustments in the Contract Price and/or Contract Time or the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a Change Order.

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

Paragraphs 6.4.1.1 and 6.4.1.2

Add the words "or the Reports" after "Contract Documents".

Paragraph 6.4.2

Add the words "Having regard to and subject to the liabilities and responsibilities assumed by the Contractor pursuant to GC 3.17 – OPERATIONAL RISKS," at the beginning of the first and second sentences.

New Paragraphs 6.4.5 to 6.4.8

Add the following new paragraphs to GC 6.4:

- 6.4.5 The Contractor confirms that it carefully reviewed the Contract Documents, including the Reports and that it has satisfied itself as to the nature and extent of the Work, the Contract Documents and the Contract and as to the facilities and difficulties in attending and completing the execution of the Work. The Contractor confirms that it has applied to its review the degree of care and skill required by GC 3.14 – PERFORMANCE BY CONTRACTOR, paragraph 3.14.1. In those circumstances, notwithstanding the provisions of paragraph 6.4.2, the Contractor is not entitled to an adjustment to the Contract Price or to an extension of the Contract Time for conditions which could reasonably have been ascertained by the Contractor by such careful review, or which could have been reasonably inferred from the material provided with the Contract Documents. In those circumstances, should a claim arise, the Contractor will have the burden of establishing that it could not have discovered the materially different conditions from a careful review of the Contract Documents.
- 6.4.6 To the extent the Contractor has not reviewed the Contract Documents as referenced in paragraph 6.4.5, the Contractor willingly assumes responsibility for all losses, damages, costs, expenses (including all legal costs on a full indemnity basis), liabilities, claims, actions, and demands, whether arising under statute, contract or at common law, which such review might have avoided or reduced and shall indemnify and save harmless the Owner from all risk which might make it more onerous and more expensive to fulfill or perform the Work than was contemplated or known when the Contract was signed, and for any and all liability, responsibility and obligations which the Owner may have to any third parties resulting from any failure to review.
- 6.4.7 If the finding made pursuant to paragraph 6.4.2 is that the subsurface or otherwise concealed physical conditions differ materially and this would cause an increase or decrease in the Contractor's cost or time to perform the Work, and if the said conditions were otherwise discoverable by the Contractor in the proper performance of its duties and obligations under the Contract, all costs and expenses resulting from any delay (excluding, for clarity, the direct cost of remediating the said conditions) in the completion of the Work that is caused, or contributed to, as a result of the said conditions, will be borne by the Contractor.
- 6.4.8 Without limiting the generality of any other provision in the Contract Documents, during the performance of the Work, the Contractor shall, as a part of the Contract Price and Work, perform any additional geotechnical and subsurface and other investigations, tests and studies beyond those being provided by the Owner, which a reasonable and prudent contractor would conduct to ascertain the nature and extent of subsurface or otherwise concealed physical conditions at the Place of the Work.

GC 6.5 DELAYS

Paragraphs 6.5.1, 6.5.2, 6.5.3 and 6.5.4

Delete paragraphs 6.5.1, 6.5.2, 6.5.3 and 6.5.4 and replace them with the following:

- 6.5.1 If the Contractor is delayed in the performance of a critical path activity on the Construction Schedule by an action or omission of the Owner, Consultant or anyone employed or engaged by them directly or indirectly, contrary to the provisions of the Contract Documents, then the Contract Time shall be extended for such reasonable time as the Consultant may recommend in consultation with the Contractor. The Contractor shall also be reimbursed by the Owner for only the actual additional costs incurred as a result of the delay, excluding markup for profit, head office overhead or payments to staff not employed full time at the Site.
- 6.5.2 If the Contractor is delayed in the performance of a critical path activity on the Construction Schedule by a stop work order issued by a court or other public authority and

provided that such order was not issued as a result of an act or fault of the Contractor or any person employed or engaged by the Contractor directly or indirectly, then the Contract Time shall be extended for such reasonable time as the Consultant may recommend in consultation with the Contractor. The Contractor shall also be reimbursed by the Owner for only the actual additional costs incurred as a result of the delay, excluding markup for profit, head office overhead or payments to staff not employed full time at the Site.

6.5.3 If the Contractor is delayed in the performance of a critical path activity on the Construction Schedule by:

- .1 any labour disputes, strikes or lock-outs affecting the Work or the Project.
- .2 fire or unusual delay by common carriers,
- .3 abnormally adverse weather conditions, or
- .4 any other cause which could not be reasonably anticipated to occur during the course of a construction project, which the Owner deems to be beyond the Contractor's (including any Subcontractors) reasonable control (other than financial incapacity) other than one resulting from a default or breach of Contract by the Contractor. For the purpose of this provision, delays in the supply and/or delivery of materials, Products and/or equipment, or arising from the breakdown of equipment, do not constitute causes which are beyond the Contractor's control.

then the Contract Time shall be extended for such reasonable time as the Consultant may recommend in consultation with the Contractor. The extension of time shall not be less than the time lost as the result of the event causing the delay, unless the Contractor agrees to a shorter extension. The Contractor shall not be entitled to payment for costs incurred by such delays, unless such delays result from the actions of the Owner, Consultant or anyone employed or engaged by them directly or indirectly. Notwithstanding the foregoing, the Contractor shall use its best efforts to minimize the impact of such event upon the performance of the Work and Contract Time.

6.5.4 No compensation for delay shall be paid to the Contractor, and no extension shall be made for delay unless Notice in Writing of the cause of delay is given to the Consultant and Owner not later than 10 Working Days after the commencement of the delay. In the case of a continuing cause of delay only one Notice in Writing shall be necessary. Without limiting the generality of the foregoing, the following shall also apply to the event of delay dealt with by paragraphs 6.5.1, 6.5.2 or 6.5.3:

- .1 the notice provided by the Contractor as set out in this paragraph 6.5.4 shall include, without limitation, sufficient and adequate information and documentation to allow the Consultant and Owner to properly consider the claim of the Contractor.
- .2 the Contractor shall take all reasonable steps to minimize the impact of the delay event upon the performance of the Work, the Contract Time and the Contract Price, resume performance of all its obligations under the Contract affected by the delay as soon as practicable and use all reasonable endeavours to remedy any failure to perform.

Failure to adhere strictly to these notice provisions shall constitute a waiver and release of any obligation of the Owner to extend the Contract Time as a result of such delay and of any claim by the Contractor for costs as a result of such delay.

New Paragraph 6.5.6

Add the following new paragraph to GC 6.5:

6.5.6 If the Contractor is delayed in the performance of the Work by an act or omission of the Contractor, any Subcontractor or Supplier, or anyone employed or engaged by them,

directly or indirectly, or by any cause within the Contractor's control, the Contractor shall devote such additional resources and take all steps necessary, all at the Contractor's own cost and expense, to ensure that the dates for attaining Substantial Performance of the Work and Total Performance of the Work under the Contract as may have been amended in accordance with the provisions of PART 6 – CHANGES IN THE WORK, are met. If the Contractor fails to attain Substantial Performance of the Work or Total Performance of the Work as aforesaid, the Owner shall be entitled to assess liquidated damages in accordance with Article A-13 of the Agreement – LIQUIDATED DAMAGES. Such liquidated damages shall be the Owner's sole and exclusive remedy for delays.

NEW GENERAL CONDITION GC 6.7

Add new GC 6.7 as follows:

GC 6.7 NO CLAIMS FOR CHANGE IN SCOPE OF WORK

- 6.7.1 If any change, deviation or omission from the Work is made by which the amount of Work to be done is decreased, including any of the quantities specified in Contract Documents, or if the whole or any portion of the Work is deleted from the scope of Work or otherwise dispensed with, no compensation shall be claimed by the Contractor or any Subcontractors for any such changes including any claims for loss of anticipated profits.

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

Delete GC 7.1 in its entirety and replace it with the following:

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK OR STOP THE WORK OR TERMINATE THE CONTRACT

- 7.1.1 If:
- .1 the Contractor should become bankrupt or insolvent or make a general assignment for the benefit of creditors because of its insolvency; or
 - .2 a receiver is appointed because of its insolvency; or
 - .3 the Contractor commits a criminal act; or
 - .4 the Contractor transfers, assigns or otherwise disposes of its interest in the Contract or any part thereof without the written authority of the Owner; or
 - .5 the Contractor ceases the Work for a period of 30 Days or more (other than for delays for which an extension of Contract Time is granted by the Owner pursuant to GC 6.5 - DELAYS); or
 - .6 the Owner deems, in its sole discretion, acting reasonably, that the progress of the Work has fallen behind schedule to such an extent that the Contractor will not be able to meet one or more of the Interim Milestone dates specified in the Contract and/or complete the Work within the Contract Time, provided that the Contractor has first been given the opportunity to rectify this breach pursuant to the process outlined in paragraphs 7.1.2, 7.1.3 and 7.1.4; or
 - .7 the Contractor fails to maintain adequate insurance as stipulated in GC 11.2 – INSURANCE; or
 - .8 the Contractor fails to comply immediately with a direction of the Owner under the Contract including, but not limited to, any directions under GC 9.4 – CONSTRUCTION SAFETY; or

- .9 the Contractor fails to comply immediately with a stop work order issued by the Owner or the Consultant under the Contract; or
 - .10 the Contractor fails to comply with a written direction from the Owner under PART 8 – DISPUTE RESOLUTION; or
 - .11 the Contractor commits any other breach of Contract which the Owner deems material the Owner, without prejudice to any other right or remedy it may have, may by giving the Contractor or receiver or trustee in bankruptcy written notice:
 - .12 terminate the Contract; or
 - .13 take all or any part of the Work out of the Contractor's hands and may employ such means as it may see fit to complete the Work and may deduct the costs thereof from any payment due to the Contractor and, in the event the costs thereof exceed the sum payable to the Contractor had the Contractor completed that part of the Work, the Contractor shall pay such excess amount to the Owner forthwith upon notice from the Owner; or
 - .14 issue a Stop Work Order on the Contract.
- 7.1.2 If the Contractor should neglect to perform the Work in compliance with the requirements of the Contract, of which the Consultant shall be the sole judge, the Owner may notify the Contractor in writing that it is in default of its contractual obligations and instruct it to correct the default in the 5 Working Days immediately following the receipt of such notice or, where immediate action is required, in such lesser time as specified in the notice.
- 7.1.3 If the correction of the default cannot be completed in the 5 Working Days specified, or the lesser time specified where immediate action is required, the Contractor shall be in compliance with the Owner's instructions if it:
- .1 commences the correction of the default within the specified time; and
 - .2 provides the Owner with a schedule acceptable to the Owner for such correction; and
 - .3 completes the correction in accordance with such schedule.
- 7.1.4 If the Contractor fails to correct the default within the time specified, the Owner may, without prejudice to any other right or remedy it may have:
- .1 correct such default and charge the cost thereof to the Contractor; or
 - .2 terminate the Contractor's right to continue with the Work in whole or in part; or
 - .3 terminate the Contract.
- 7.1.5 If the Owner terminates the Contractor's right to continue with the Work or terminates the Contract pursuant to paragraph 7.1.1 or paragraph 7.1.4, the Owner shall be entitled to:
- .1 take possession of the premises and Products, utilize the construction machinery and equipment and finish the Work by whatever method it may see fit; and
 - .2 receive an assignment or transfer forthwith from the Contractor of any permit or approval obtained by the Contractor for the performance of the Work; and
 - .3 withhold further payments to the Contractor until the Work is finished; and
 - .4 deduct the following costs from the unpaid balance of the Contract Price:
 - (1) the full cost of finishing the Work, as certified by the Consultant; and
 - (2) any additional compensation payable to the Consultant for additional services; and

- (3) a reasonable allowance, as determined by the Consultant, to cover the cost of corrections to work performed by the Contractor as may be required under GC 12.3 - WARRANTY

and

- .5 upon expiry of the warranty period, charge the Contractor the amount by which the cost of corrections to its work under GC 12.3 - WARRANTY exceeds the allowance provided for such corrections.

If the costs referred to in paragraphs 7.1.5.4 and 7.1.5.5 are less than the unpaid balance of the Contract Price, the Owner shall pay the Contractor the difference.

7.1.6 The Contractor acknowledges that the performance of the Work may require the following:

- .1 approval of the local conservation authority and/or other applicable government agencies in respect of watercourses, wetlands, floodplain, and hazard lands;
- .2 approval of the Ministry of Natural Resources and Forestry, the Department of Fisheries and Oceans and/or the local conservation authority in respect of its authority under the *Fisheries Act*, RSC 1985, c F-14;
- .3 approval of the Ministry of the Environment and Climate Change, the local conservation authority and/or other applicable government agencies in respect of any water taking;
- .4 approval of the Ministry of the Environment and Climate Change in respect of any discharge, emission, waste, waste disposal site, waste management system, water works, sewage works, storm water works and/or drinking water systems;
- .5 approval of the Ministry of Natural Resources and Forestry, the Department of Fisheries and Oceans and/or Environment Canada in respect of the protection of any species at risk and/or the respective habitat of any species at risk;
- .6 approval of Transport Canada in respect of navigable waterbodies;
- .7 approval of the Ministry of Labour and Ministry of the Environment and Climate Change, as applicable, in respect of any new equipment specified by the Owner;
- .8 approval of Regional Committee/Council and/or other governmental or municipal authorities or utilities; and
- .9 land acquisitions, easements or utility relocations.

If at any time any one or more of these requirements have not been satisfied, the Owner may terminate the Contract by providing written notice to the Contractor to such effect and the Contractor shall be entitled to be paid for the Work performed up to and including the date of service of the notice terminating the Contract, as determined by the Consultant and the Owner. In no event will the Contractor be entitled to claim any amount for profit or loss sustained or any other damages as a result of the termination of the Contract.

7.1.7 If at any time during the course of the Contract, the Owner exhausts or exceeds the allocated budget for the Contract, or if the allocated budget for the Contract is withdrawn, reduced or cancelled by Regional Council for any reason whatsoever, the Owner may terminate the Contract by providing written notice to the Contractor to such effect and the Contractor shall be entitled to be paid for the Work performed up to and including the date of service of the notice terminating the Contract, as determined by the Consultant. In no event will the Contractor be entitled to claim any amount for profit or loss sustained or any other damages as a result of the termination of the Contract.

- 7.1.8 The Contractor's obligation under the Contract as to quality, correction and warranty of the Work performed by it up to the time of termination shall continue in force after such termination.

GC7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

Paragraph 7.2.2

Delete the number "20" and replace it with "60 consecutive".

Paragraph 7.2.3

Delete the work "if" before the colon and replace it with "and instruct the Owner to correct the default in the five (5) Working Days immediately following the receipt of such notice if".

Subparagraph 7.2.3.1

Delete subparagraph 7.2.3.1 in its entirety.

Subparagraph 7.2.3.2

Add the words "subject to the other terms and conditions of the Contract," before "the Consultant".

Subparagraph 7.2.3.3

Add the words "subject to the other terms and conditions of the Contract," before "the Owner".

Subparagraph 7.2.3.4

Delete the words ", except for General Condition 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER,"

Paragraphs 7.2.4 and 7.2.5

Delete paragraphs 7.2.4 and 7.2.5 in their entirety, and replace them with the following:

- 7.2.4 If the default cannot be corrected in the 5 Working Days specified, the Owner shall be in compliance with the Contractor's instructions if the Owner:
- .1 commences the correction of the default within the specified time; and
 - .2 provides the Contractor with an acceptable schedule for such correction, and
 - .3 corrects the default in accordance with such schedule.
- 7.2.5 If the Owner fails to correct the default in the time specified or subsequently agreed upon, without prejudice to any other right or remedy the Contractor may have, the Contractor may suspend the Work for not more than 90 Days or terminate the Contract."

New Paragraphs 7.2.6 to 7.2.8

Add the following new paragraphs to GC 7.2:

- 7.2.6 If the Contractor terminates the Contract under the conditions set out above, the Contractor shall be entitled to be paid for all work performed to the date of termination. The Contractor shall also be entitled to recover the direct costs associated with termination, including the costs of demobilization, and losses sustained on Products and Construction Equipment. The Contractor shall not be entitled to any additional reimbursement on account of any such termination including, without limitation, indirect, incidental, special, consequential or other damages, including loss of profits, notwithstanding any other provision of the Contract Documents.
- 7.2.7 The Owner's withholding of a progress payment, holdback payment or final payment due to the Contractor's failure to pay a Subcontractor or Supplier, to protect the Owner's interest in the event of the preservation of a lien or receipt of notice of lien, or otherwise pursuant to the terms of the Contract, shall not constitute a default under paragraph 7.2.3 which would

permit the Contractor to stop the Work or terminate the Contract. In such circumstances, the Contractor shall continue with the Work.

- 7.2.8 If the Contractor stops the Work or terminates the Contract as provided in this GC 7.2 – CONTRACTOR’S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, it shall ensure that the Place of the Work is left in a secure and safe condition as required by all authorities having jurisdiction and the Contract Documents.

PART 8 DISPUTE RESOLUTION

GC 8.1 AUTHORITY OF THE CONSULTANT

Delete the heading “AUTHORITY OF THE CONSULTANT” and replace it with “DISPUTES”.

Paragraph 8.1.1

Add the words “other than a failure to agree on the method of valuation, measurement and change of the Contract Price,” after the words “is called for,”.

Add the words “interpretation and the” prior to “findings”.

Paragraphs 8.1.2 and 8.1.3

Delete paragraphs 8.1.2 and 8.1.3 in their entirety and replace them with the following:

- 8.1.2 The Contractor shall give oral notice of any dispute to the Owner immediately becoming aware of the situation giving rise to such dispute.
- 8.1.3 The Contractor will provide written notice of any dispute within 7 Days after the commencement of the work giving rise to the dispute to the Owner. Such notice shall include particulars of the matter in dispute, the extent and value of the claim and the relevant provisions of the Contract Documents.

New Paragraphs 8.1.4 to 8.1.9

Add the following new paragraphs to GC 8.1:

- 8.1.4 If the matter in dispute is not resolved promptly, the Consultant will give such instructions as, in its opinion, are necessary for the proper performance of the Work and to minimize delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim it may have.
- 8.1.5 As time is of the essence, if so directed by the Owner, the Contractor will continue to perform the Work in accordance with the instructions of the Owner, notwithstanding any such dispute. Accordingly, in the event of a dispute, any work stoppage by the Contractor will constitute a breach of the Contract entitling the Owner to claim damages on account of any delay affecting the as-planned schedule of the Work.
- 8.1.6 The Contractor shall submit to the Owner a detailed statement of its claims not later than 30 Days after completion of the Work which is the subject of the dispute, identifying the item or items in respect of which the dispute has arisen, the grounds upon which a claim is made and all records substantiating such claim.
- 8.1.7 The Contractor shall promptly submit, at the request of the Owner, such further and other information and documentation as the Owner or the Consultant considers necessary to assess the claim.
- 8.1.8 If the Contractor fails to comply with the provisions for notices and claims within the times stipulated in respect of any dispute, the Contractor will not be entitled to proceed with any claim in respect of such dispute and this provision shall act as a bar to any such claims.

- 8.1.9 If the Contractor has complied with all of the provisions of this General Condition and the Owner and the Contractor cannot resolve the dispute, and if both parties do not agree to settle the dispute in accordance with GC 8.2 - NEGOTIATION, MEDIATION AND ARBITRATION, then either party may refer the dispute to a court of competent jurisdiction.

GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

Paragraph 8.2.1

Add the words “(the “Rules””, subject to amendments, if any, required by virtue of the applicability of the *Municipal Arbitrations Act*, RSO 1990, c M.48,” after the words “CCDC 40”.

Subparagraph 8.2.1.2

Delete the words “either party by Notice in Writing requests” and replace them with “both parties agree”.

Paragraph 8.2.4

Add the words “subject to any amendments to the Rules made as described in paragraph 8.2.1”, after the words “CCDC 40”.

Paragraph 8.2.6

Delete paragraph 8.2.6 in its entirety and replace it with the following:

- 8.2.6 By giving notice in writing to the other party, not later than 20 Working Days after the date of termination of the mediated negotiations under paragraph 8.2.5, either party may refer the dispute to be finally resolved by arbitration under the latest edition of the Rules, subject to any amendments to the Rules made as described in paragraph 8.2.1 (the “Notice of Arbitration”). The arbitration shall be conducted pursuant to the *Municipal Arbitrations Act*, RSO 1990, c M.48, as amended. Unless either party gives the notice contemplated by this paragraph 8.2.6, there shall be no arbitration of any such dispute.

Paragraph 8.2.7

Delete the number “10” and replace it with the number “20”.

New Paragraphs 8.2.9 to 8.2.11

Add the following new paragraphs to GC 8.2:

- 8.2.9 - Within five Working Days of receipt of a Notice of Arbitration given pursuant to paragraph 8.2.6, the Owner shall give the Consultant a written notice containing:
- .1 a copy of the Notice of Arbitration; and
 - .2 any claims or issues which the Contractor or the Owner, as the case may be, wishes to raise in relation to the Consultant arising out of the issues in dispute in the arbitration.
- 8.2.10 For purposes of the Rules for Mediation and Arbitration of Construction Disputes CCDC 40, the term “neutral appointing authority”, as used in the Rules for Mediation of CCDC2 Construction Disputes shall mean the head of the construction section of the ADR Institute of Ontario, Inc. presiding at the time notice of the dispute is given pursuant to the Contract.
- 8.2.11 Notwithstanding any other provision of this Contract, the provisions set out in paragraphs 8.2.1 and 8.2.3 to 8.2.10 shall only apply if the parties agree in writing to submit a dispute to all, or any part of, those alternate dispute resolution procedures. If the parties do not agree as aforesaid, the Courts shall have exclusive jurisdiction to determine any dispute relating to the Work or to the Contract.

GC 8.3 RETENTION OF RIGHTS

Delete GC 8.3 in its entirety.

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.1 PROTECTION OF WORK AND PROPERTY

Paragraphs 9.1.1, 9.1.2 and 9.1.3

Delete paragraphs 9.1.1, 9.1.2 and 9.1.3 in their entirety and replace them with the following:

- 9.1.1 The Contractor shall protect the Work and the Owner's property and property adjacent to, in the vicinity of, or proximate to, the Place of the Work from damage and shall be responsible for damage which may arise as the result of its performance or failure to perform under the Contract.
- 9.1.2 Should the performance or non-performance by the Contractor under the Contract result in damage to the Work, the Owner's property or property adjacent to, in the vicinity of, or proximate to, the Place of the Work, the Contractor shall be responsible for the making good of such damage at its expense."
- 9.1.3 Before commencing any Work, the Contractor shall determine the location of all underground utilities and structures indicated in or reasonably inferable from the Contract Documents by a contractor exercising the degree of care and skill described in GC 3.14 – PERFORMANCE BY CONTRACTOR, paragraph 3.14.1.

New Paragraphs 9.1.5 and 9.1.6

Add the following new paragraphs to GC 9.1:

- 9.1.5 With respect to any damage to which paragraph 9.1.4 applies, the Contractor shall neither undertake to repair or replace any damage whatsoever to the work of other contractors, or to adjoining property, nor acknowledge that the same was caused or occasioned by the Contractor, without first consulting the Owner and receiving written instructions as to the course of action to be followed from either the Owner or the Consultant.
- 9.1.6 The Contractor shall be responsible for securing the Place of the Work at all times and shall take all reasonable precautions necessary to protect the Place of the Work, its contents, materials (including Owner-supplied materials) and the public from loss or damage during and after working hours.

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

Paragraph 9.2.4

Delete paragraph 9.2.4 and replace it with the following:

- 9.2.4 Unless the Contract Documents expressly provide otherwise, the Contractor shall be responsible for taking all necessary steps in accordance with legal requirements and the Contract Documents to dispose of, store or otherwise render harmless, toxic or hazardous substances or materials encountered at the Place of the Work in the course of the completion of the Work."

Paragraph 9.2.5

Add the following new subparagraph to paragraph 9.2.5:

- 9.2.5.5 Take all reasonable steps to mitigate the impact on Contract Time and Contract Price and any further steps it deems necessary to mitigate or stabilize any conditions resulting from encountering toxic or hazardous substances or materials.

Subparagraph 9.2.8.3

Add the words "and as a result of the delay" before the semicolon at the end of the subparagraph.

New Paragraphs 9.2.10, 9.2.11 and 9.2.12

Add the following new paragraphs to GC 9.2:

9.2.10 If the Contractor causes or permits

- .1 any toxic or hazardous substances or materials to be brought by the Contractor, its Subcontractors, Suppliers or anyone else for whom the Contractor is responsible at law, to the Place of the Work, or
- .2 any toxic or hazardous substances or materials which were already at the Place of the Work (but which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements), to be dealt with in a manner which does not comply with legal and regulatory requirements or which threatens human health and safety or the environment or causes material damage to the property of the Owner or others,

the Contractor shall

- .3 take all reasonable steps, including stopping the Work, to ensure that no person suffers injury, sickness or death and that no property is injured or destroyed as a result of exposure to or the presence of the substances or materials, and
- .4 immediately report the circumstances to the Consultant and the Owner by telephone, confirmed in writing.

9.2.11 In the case of any circumstances contemplated in paragraph 9.2.10, the Contractor shall be responsible, at the Contractor's sole expense, for cleaning up, removing, containing, storing, or otherwise dealing with the toxic or hazardous substances or materials and any damage caused thereby in a manner which the authorities having jurisdiction determine will:

- .1 meet all applicable legal and regulatory requirements and ensure compliance with any applicable permits or other authorizations.
- .2 remove any threat to human health and safety or the environment, and
- .3 rectify all material damage to the property of the Owner and others.

9.2.12 For the purposes of this GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES, the term "toxic and hazardous substances" shall be taken to mean, and shall be limited to, substances as currently defined by applicable statutory and regulatory requirements.

GC 9.4 CONSTRUCTION SAFETY

Delete GC 9.4 in its entirety and replace it with the following:

GC 9.4 CONSTRUCTION SAFETY

- 9.4.1 The Contractor acknowledges that it is aware of the provisions of the *Occupational Health and Safety Act*, RSO 1990, c O.1 (the "OHSA") and the regulations, policies and guidelines thereunder. The Contractor agrees to comply with, and cause to be complied with, the provisions thereof as such statutes, regulations, policies and guidelines may be amended or replaced from time to time including, without limiting the generality of the foregoing, all of the obligations of the constructor and employer under the OHSA and regulations, as applicable, in respect of the Work.
- 9.4.2 The Contractor shall execute all required documents under the Owner's Contractor/Constructor Guidelines at the pre-construction meeting.

- 9.4.3 The Contractor shall do, cause to be done, or refrain from doing any act or thing as directed by the Owner or the Consultant, including stopping the Work if, at any time, the Owner or the Consultant considers that any situation or condition is unsafe or contrary to the provisions of the OHSA, or any other applicable statutes, regulations, policies or guidelines. If the Contractor fails to comply with such direction, the Owner may:
- .1 take action to remedy the situation or condition and the cost thereof shall be payable by the Contractor on demand and, failing payment thereof, the Owner may deduct the costs from monies which are due or may become due to the Contractor; or
 - .2 terminate the Contract pursuant to GC 7.1 – OWNER’S RIGHT TO PERFORM THE WORK OR STOP THE WORK OR TERMINATE THE CONTRACT, paragraph 7.1.1.
- 9.4.4 Notwithstanding the foregoing, any act or failure to act by the Owner shall not in any way derogate from the responsibility of the Contractor under the Contract including its obligations under GC 9.4 – CONSTRUCTION SAFETY.
- 9.4.5 The Contractor shall indemnify and hold harmless the Owner, the Consultant, the Local Municipality and their respective directors, officers, council members, partners, agents and employees from and against all claims, demands, losses, costs including legal costs, damages, actions, suits or proceedings (including by any government agency) arising as a result of any violation or alleged violation of the OHSA or the regulations, policies and guidelines thereunder, as such statutes, regulations, policies and guidelines may be amended or replaced from time to time.
- 9.4.6 The Contractor acknowledges that the Owner may employ the services of an Occupational Health and Safety Auditor for the purpose of conducting inspections of the Place of the Work. The Contractor shall grant the Auditor full and unimpeded access to the Site, at all times, and shall immediately comply with any direction issued by the Auditor to stop work. The parties acknowledge that the authority of the Auditor to stop work is limited to circumstances where there is an immediate threat to the health and safety of Regional staff and/or to members of the public.
- 9.4.7 This Contract is deemed to be an individual project for the purposes of the OHSA and the regulations made thereunder and the Contractor acknowledges that it is the “Constructor” as defined in the said Act on this project and that it shall carry out all of the obligations, and shall bear all of the responsibilities, of the Constructor as set out in the said Act and regulations including, but not limited to, the following:
- .1 ensuring that the measures and procedures prescribed by the said Act are carried out;
 - .2 ensuring that every employer and every worker performing work on the project complies with the said Act and regulations, and;
 - .3 ensuring that the health and safety of workers on the project is protected.
- 9.4.8 If the Owner is designated as the “Constructor” as a result of the Contractor’s actions, all of the increases in costs to the Owner to carry out the duties and obligations of the “Constructor” shall be borne by the Contractor.
- 9.4.9 All OHSA Regulations for construction projects are to be strictly adhered to.

GC 9.5 MOULD

Subparagraph 9.5.2.3

Add the words "and as a result of the delay" before the comma at the end of the subparagraph.

NEW GENERAL CONDITIONS GC 9.6 TO GC 9.7

Add new GC 9.6 and GC 9.7 as follows:

GC 9.6 COMPLIANCE WITH ENVIRONMENTAL LEGISLATION

9.6.1 The Contractor acknowledges that it is aware of the provisions of federal and provincial legislation applicable to the Work and the environment including, but not limited to:

- the *Clean Water Act, 2006*, SO 2006, c 22;
- the *Conservation Authorities Act*, RSO 1990, c C.27;
- the *Dangerous Goods Transportation Act*, RSO 1990, c D.1;
- the *Endangered Species Act, 2007*, SO 2007, c 6;
- the *Environmental Protection Act*, RSO 1990, c E.19;
- the *Fisheries Act*, RSC 1985, c F-14;
- the *Navigation Protection Act*, RSC 1985, c N-22
- the *Ontario Water Resources Act*, RSO 1990, c O.40;
- the *Safe Drinking Water Act, 2002*, SO 2002, c 32;
- the *Species at Risk Act*, SC 2002, c 29;
- the *Technical Standards and Safety Act, 2000*, SO 2000, c 16; and
- the *Transportation of Dangerous Goods Act, 1992*, SC 1992, c 34

and the regulations, permits, approvals, orders, directions, policies and guidelines issued thereunder. The Contractor agrees to comply with, and cause to be complied with, the provisions thereof as such statutes, regulations, permits, approvals, orders, directions, policies and guidelines may be amended or replaced from time to time including, without limiting the generality of the foregoing, any obligation to obtain, and any terms and conditions of, any approval, permit or other instrument required under the applicable Acts, regulations, policies and guidelines thereunder in respect of the Work and further agrees to discharge, release, handle, transport, manage, store and dispose of all materials in accordance with such legislation.

9.6.2 The Contractor shall do, cause to be done, or refrain from doing any act or thing as directed by the Owner or the Consultant, including stopping the Work if, at any time, the Owner or the Consultant considers that any situation or condition is unsafe, damaging to the environment or contrary to the provisions of the applicable Acts, regulations, policies or guidelines thereunder, or any term or condition of a permit, approval order, directive or other instrument issued thereunder. If the Contractor fails to comply with such direction, the Owner may:

- .1 take action to remedy the situation or condition and the cost thereof shall be payable by the Contractor on demand and, failing payment thereof, the Owner may deduct the costs from monies which are due or may become due to the Contractor; or
- .2 terminate the Contract pursuant to GC 7.1 – OWNER’S RIGHT TO PERFORM THE WORK OR STOP THE WORK OR TERMINATE THE CONTRACT.

9.6.3 Notwithstanding the foregoing, any act or failure to act by the Owner shall not in any way derogate from the responsibility of the Contractor under the Contract including its obligations under GC 9.6.1.

9.6.4 The Contractor shall indemnify and hold harmless the Owner, the Consultant, the Local Municipality and their respective directors, officers, council members, partners, agents, employees and authorized representatives from and against all claims, demands, losses, expenses, costs including legal and professional costs, damages, actions, suits or proceedings (including by any government agency) arising as a result of the Contractor’s violation of any applicable laws, regulations, bylaws and the common law relating to the environment, including permits, approvals, orders, directions, instructions, authorizations and instruments

issued thereunder as such may be amended, replaced or superseded from time to time as it relates to the Contractor's performance of the Work.

- 9.6.5 The Contractor acknowledges that the Owner may employ the services of an Environmental Inspector for the purpose of conducting inspections of the Place of the Work. The Contractor shall grant the Environmental Inspector full and unimpeded access to the Site, at all times, and shall immediately comply with any direction issued by the Environmental Inspector, the Consultant, or the Owner, including any direction to stop Work.

GC 9.7 SPILLS REPORTING

- 9.7.1 Prior to commencing construction, the Contractor shall:

- .1 submit to the Owner a Spill Action Plan in a form acceptable to the Owner, which outlines procedures for the reporting, interception, rapid clean-up, restoration of the affected area, treatment and disposal of the pollutant or substance spilled or discharged and impacted materials including without limitation, soil, groundwater and vegetation; and
- .2 post at the Place of the Work, in a clearly visible and accessible location, a notice containing the following information:
 - (1) the names and the telephone numbers of the representatives of the Owner and Local Municipality to be notified in the event of a spill or discharge;
 - (2) the telephone number of the Spills Action Centre 1-800-268-6060;
 - (3) the names and the telephone numbers of the representatives of the fire, police and health and public works departments of the Local Municipality to be notified in the event of a spill or discharge;
 - (4) the names and the telephone numbers of companies experienced in the control and clean-up of hazardous and non-hazardous materials and substances that would be called upon by the Contractor in the event of a spill or discharge; and
 - (5) the name and the telephone number of the Contractor's representative responsible for preparing, implementing, directing and supervising the clean-up of a spill or discharge.

- 9.7.2 In the event of a spill or discharge into the natural environment, the Contractor must comply, at all times, with the requirements of the *Classification and Exemption of Spills and Reporting of Discharges*, O. Reg. 675/98.

- 9.7.3 In the event of a spill or other discharge of a pollutant into the natural environment, every person responsible for the emission, or who causes or permits it, must forthwith notify all relevant parties of the spill or discharge. Information reported to the Ministry of the Environment and Climate Change Spills Action Centre must comply with the reporting requirements stated within *Classification and Exemption of Spills and Reporting of Discharges*, O. Reg. 675/98, and may include the nature of the spill or discharge, the circumstances surrounding the spill or discharge, and the action taken or intended to be taken with respect to the spill or discharge.

Relevant parties to be notified in the event of a spill or discharge may include, but are not limited to:

- the Ministry of the Environment and Climate Change Spills Action Centre – tel: 1-800-268-6060;
- the Owner – tel. (905) 895-1200 (24 hours per day);
- the Local Municipality;
- the owner of the pollutant or substance, if known;

- the person having control of the pollutant or substance, if known; and
- the Consultant

PART 10 GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

New Paragraphs 10.1.3 to 10.1.7

Add the following new paragraphs to GC 10.1:

- 10.1.3 Where the Owner is entitled to an exemption or a recovery of sales taxes, customs duties, excise taxes or Value Added Taxes applicable to the Contract, the Contractor shall, at the request of the Owner, assist with application for any exemption, recovery or refund of all such taxes and duties and all amounts recovered or exemptions obtained shall be for the sole benefit of the Owner. The Contractor agrees to endorse over to the Owner any cheques received from the federal or provincial governments, or any other taxing authority, as may be required to give effect to this paragraph.
- 10.1.4 The Contractor shall maintain accurate records tabulating equipment, material and component costs reflecting the taxes, customs duties, excise taxes and Value Added Taxes paid.
- 10.1.5 Any refund of taxes, including without limitation, any government sales tax, customs duty, excise tax or Value Added Tax, whether or not paid, which is found to be inapplicable or for which exemption may be obtained, is the sole and exclusive property of the Owner.
- 10.1.6 The Contractor agrees to cooperate with the Owner and to obtain from all Subcontractors and Suppliers cooperation with the Owner in the application for any rebates, incentives or refund or exemption of any taxes, which cooperation shall include, but not be limited to, making or concurring in the making of an application for any such rebates, incentives, refund or exemption and providing to the Owner copies, or where required, originals of records, invoices, purchase orders and other documentation necessary to support such applications. All such rebates, incentives or refunds shall either be paid to the Owner, or shall be a credit to the Owner against the Contract Price, in the Owner's discretion.
- 10.1.7 Customs duties, penalties, or any other penalty, fine or assessment levied against the Contractor shall not be treated as a tax or customs duty for purposes of this GC 10.1 – TAXES AND DUTIES.

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

Paragraphs 10.2.2, 10.2.3 and 10.2.4

Delete paragraphs 10.2.2, 10.2.3 and 10.2.4 in their entirety and replace them with the following:

- 10.2.2. The Owner shall obtain and pay for development approvals, building permit, site plan approval and environmental approvals. Without limiting the generality of any other provision in the Contract, the Contractor shall obtain and pay for, at its sole expense and cost, all other permits, approvals, licences, certificates, charges and refundable deposits, including, without limitation, water and sanitary sewer permits, water and sewer connection charges, site alteration permits, curb cut and road cut permits, sign permits, hydro approvals, and occupancy permit necessary for the performance of the Work and the use and occupation of the Work by the Owner in accordance with the Contract Documents, the cost of which shall all be included in the Contract Price.
- 10.2.3 The Contractor shall comply, and shall require its employees, agents, Subcontractors, Suppliers and anyone for whom they are responsible to comply, with all laws, ordinances, guidelines, standards, permits, statutes, bylaws, rules, regulations, or codes and all of the Owner's policies and procedures which are or become in force and are applicable to the

performance of the Work including, without limitation, all those relating to the preservation of the public health, occupational health and safety and to construction safety.

10.2.4 The Contractor shall give the required notices and comply with the laws, ordinances, rules, regulations, or codes, and industry best practices and guidelines which are or become in force during the performance of the Work and which relate to the Work, to the environment, to the preservation of public health and to construction safety. The Contractor shall provide the Owner with copies of all such required notices and related health and safety documents. The Contractor shall notify the Chief Building Official or the registered code agency, where applicable, of the readiness, substantial completion, and completion of the stages of construction set out in the Ontario Building Code. The Contractor shall be present at each site inspection by an inspector or registered code agency. If any laws, ordinances, rules, regulations, or codes conflict, the more stringent shall govern.

Paragraph 10.2.5:

Delete the word “The” from the beginning of the first sentence and replace it with the words “Subject to GC 3.4 – DOCUMENT REVIEW, paragraph 3.4.1, the”.

Add “and no further work on the affected components of the Contract shall proceed until these changes to the Contract Documents have been obtained by the Contractor from the Consultant” to the end of the second sentence.

Paragraph 10.2.6:

Delete paragraph 10.2.6 in its entirety and replace it with the following:

10.2.6 If the Contractor fails to notify the Owner and the Consultant in writing, fails to obtain direction as required in paragraph 10.2.5, and/or performs work that it knows or ought to have known that contravenes any laws, ordinances, guidelines, standards, permits, statutes, bylaws, rules, regulations, or codes, the Contractor shall be responsible for and shall correct the violations thereof, and shall bear the costs, expenses, and damages attributable to the failure to comply with the provisions of such laws, ordinances, guidelines, standards, permits, statutes, bylaws, rules, regulations, or codes.

New Paragraph 10.2.8

Add the following new paragraph to GC 10.2:

10.2.8 Without limiting the generality of any other provision in the Contract Documents, the Contractor shall cause all certificates to be furnished that are required or given by the appropriate governmental or quasi-governmental Authorities as evidence that the Work as installed conforms with the laws and regulations of Authorities Having Jurisdiction, including, without limitation, certificates of compliance for the Owner’s occupancy or partial occupancy. The certificates are to be final certificates giving complete clearance of the Work, in the event that such governmental or quasi-governmental Authorities furnish such certificates.”

GC 10.3 PATENT FEES

Paragraph 10.3.1

Add the words “indemnify and” before the words “hold the” in the second line.

Paragraph 10.3.2

Add the words “by the Owner” after the words “supplied to the Contractor.”

GC 10.4 WORKERS' COMPENSATION

Paragraph 10.4.1

Delete paragraph 10.4.1 and replace it with the following:

- 10.4.1 Upon execution and delivery of the Contract, prior to commencing the Work, with each application for payment, at Substantial Performance of the Work, and at the issuance of the final certificate for payment, the Contractor shall provide evidence of compliance with workers' compensation legislation at the Place of the Work, including payments due thereunder.

Paragraph 10.4.2

Add the following to the beginning of paragraph 10.4.2:

The Contractor shall ensure that each Subcontractor complies with the workers' compensation legislation at the Place of the Work.

New Paragraphs 10.4.3 and 10.4.4

Add the following new paragraphs to GC 10.4:

- 10.4.3 Where a Subcontractor is not required to participate in the insurance plan provided for under the workers' compensation legislation, the Contractor shall require the Subcontractor to provide a sworn declaration of its exemption as a condition of the Subcontractor's admission to the Place of Work. When requested by the Owner, the Contractor shall require the Subcontractor to provide a letter of exemption under the workers' compensation legislation.
- 10.4.4 If the Contractor at any time fails to pay any assessment or compensation required to be paid with respect to workplace safety and insurance, the Owner may pay such assessment or compensation and deduct the cost thereof from monies due or that may become due to the Contractor."

PART 11 INSURANCE AND CONTRACT SECURITY

Delete GC 11.1 and GC 11.2 in their entirety and replace them with the following:

GC 11.1 BONDS

- 11.1.1 On or before the execution and delivery of the Contract, the Contractor shall provide to the Owner:
- .1 a performance bond in the amount of 100% of the Contract Price in the form called for in the Bid Documents; and
 - .2 a labour and material payment bond in the amount of 50% of the Contract Price in the form called for in the Bid Documents
- 11.1.2 Such bonds shall be issued by a surety company licensed under the *Insurance Act*, RSO 1990, c. I.8, as amended, and approved by the Owner, and shall be maintained in good standing until the fulfillment of the Contract..

GC 11.2 INSURANCE

- 11.2.1 Without restricting the generality of GC 12.1 – INDEMNIFICATION AND CLAIMS HANDLING, the Contractor shall obtain, maintain, pay the premium(s) and any deductibles for, and provide evidence of, insurance coverage as listed in Schedule A.1. The insurance shall be taken out with insurance companies licensed to transact business in the Province of Ontario and who are not otherwise excluded by the Owner's Risk Manager.

- 11.2.2 The forms of the insurance policies shall in all respects be satisfactory to the Owner's Risk Manager and shall be maintained continuously from the commencement of the Work until the Work has been completed to the satisfaction of the Owner.
- 11.2.3 The policies shall be endorsed to provide the Owner with not less than 30 Days written notice in advance of any cancellation, change or amendment which restricts coverage such that the Contract requirements are no longer met.
- 11.2.4 The Contractor shall provide the Owner with proof of insurance, by submitting an original Certificate of Insurance on the Owner's standard "Certificate of Insurance" form, upon execution and delivery of the Contract, prior to commencement of the Work and thereafter upon request by the Owner. In lieu of an original Certificate of Insurance, the Owner may accept an electronic copy provided it is e-mailed or faxed by the Contractor's insurance broker directly to the Owner.
- 11.2.5 If the Contractor fails to provide or maintain insurance as required in this General Condition or elsewhere in the Contract, then the Owner shall have the right to provide and maintain such insurance and give evidence thereof to the Contractor, the Consultant and the Local Municipality, as applicable, and all such costs, including administration costs, shall be payable by the Contractor to the Owner on demand.

PART 12 INDEMNIFICATION, WAIVER OF CLAIMS AND WARRANTY

GC 12.1 INDEMNIFICATION

Delete GC 12.1 in its entirety and replace it with the following:

GC 12.1 INDEMNIFICATION AND CLAIMS HANDLING

- 12.1.1 The Contractor shall indemnify, hold harmless and defend the Owner, the Local Municipality and their respective directors, officers, council members, partners, agents and employees from and against all claims, demands, losses, costs (including all legal costs), damages, actions, suits or proceedings that arise directly or indirectly out of, or are attributable to, the Contractor's performance of, or failure to perform, the Contract or out of the condition of the Work, the Place of the Work, adjoining lands or highways used in connection with the performance of the Work, including any act or omission of the Contractor or its agents, any Subcontractors, employees, workers or other persons for whom the Contractor is in law responsible provided that such claims are caused by the negligent acts or omissions of the Contractor or its agents, any Subcontractors, employees, workers or other persons for whom the Contractor is in law responsible and only to the extent caused by the Contractor's negligence. This indemnification shall include any legal costs incurred by the Owner on a substantial indemnity basis, including those incurred to defend any criminal or quasi-criminal prosecutions against the Owner resulting from the actions of the Contractor.
- 12.1.2 The indemnification obligations in GC 12.1 – INDEMNIFICATION AND CLAIMS HANDLING shall apply provided that such claims are made by notice in writing within a period of two years from the date of Total Performance of the Work, or within such shorter period of time as may be prescribed by any limitation statute of the province or territory of the Place of the Work.
- 12.1.3 The Contractor shall respond to, and deal with, all third-party claims in a prompt, courteous and efficient manner. The Contractor shall contact all third-party claimants and acknowledge receipt of all third-party claims by telephone within 1 Working Day and in writing within 3 Working Days upon being notified in writing of the third-party claim. The Contractor shall immediately, upon receipt of any third-party claim, provide the Owner's Controllership Office with notice of the third-party claim. The Contractor shall also provide the Owner's Controllership Office with copies of all correspondence between the Contractor or its agents and the third-party claimant.

- 12.1.4 The Contractor shall not advise the third-party claimant that the Owner is responsible for their claim.
- 12.1.5 If, in the sole discretion of the Owner's Controllershship Office, acting reasonably, a claim is not being dealt with in a manner consistent with the provisions of this Contract, which includes, without limiting the generality of the foregoing:
- .1 failure of the Contractor to acknowledge receipt of the third-party claim in the manner set out in paragraph 12.1.3; and
 - .2 failure to resolve the third-party claim to the satisfaction of the Owner within 90 Days of the receipt of the third-party claim;
- the Owner may appoint an insurance adjuster or other person to settle any third-party claims arising from this Contract. Any money paid by the Owner in satisfaction of any third-party claim determined to be the Contractor's responsibility, plus all associated costs incurred by the Owner, shall be deducted from monies owing to the Contractor by the Owner.
- 12.1.6 Notwithstanding paragraph 12.1.5 the Owner may withhold funds in the amount of any third-party claim received plus the greater of \$1,000.00 or 25% of the amount claimed, from monies owing to the Contractor by the Owner under this Contract or, in the event the Contractor becomes insolvent, any other contract between the Owner and the Contractor.
- 12.1.7 The Contractor shall indemnify and hold harmless the Consultant, its agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings by third parties that arise out of, or are attributable to, the Contractor's performance of the Contract, provided such claims are attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, and caused by negligent acts or omissions of the Contractor or anyone for whose acts the Contractor may be liable, and made in writing within a period of six years from the date of Substantial Performance of the Work as set out in the certificate of Substantial Performance of the Work, or within such shorter period as may be prescribed by any limitation statute of the province or territory of the Place of the Work.
- 12.1.8 The Contractor and Owner mutually waive all consequential damages against each other relating to this Contract. Consequential damages are defined herein as indirect, incidental, special or consequential damages whatsoever arising out of or in connection with the Contract (including without limitation: lost profits, anticipated or lost revenue, loss of product, loss of use of any systems, networks, rental expenses, income, financing, business and reputation, loss of management or employee productivity or the services of such persons, principal office expenses, compensation of personnel stationed at principal office, failure to realize expected savings or any other commercial or economic loss, or any third party claim), whether arising in negligence, tort, statute, equity or common law, or any other cause of action or legal theory even if the party has been advised of the possibility of those damages. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with GC 7.1 – OWNER'S RIGHT TO PERFORM THE WORK OR STOP THE WORK OR TERMINATE THE CONTRACT or remedies under GC 12.1 – INDEMNIFICATION AND CLAIMS HANDLING. Nothing contained in this paragraph 12.1.8 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract.

GC 12.2 WAIVER OF CLAIMS

Delete GC 12.2 in its entirety and replace it with the following:

GC 12.2 WAIVER OF CLAIMS

- 12.2.1 Subject to any rights or remedies provided by the Construction Act, as of the date of the final certificate for payment, the Contractor expressly waives and releases the Owner from all

claims against the Owner including, without limitation, those that might arise from the negligence or breach of contract by the Owner except:

- .1 those made in writing in compliance with the Contract Documents prior to the Contractor's application for final payment and still unsettled; and
- .2 those arising from the provisions of GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES or GC 10.3 PATENT FEES.

GC 12.3 WARRANTY

Paragraph 12.3.1

Delete paragraph 12.3.1 and replace it with the following:

12.3.1 The Contractor agrees to remedy, at its costs, any defects in materials and workmanship which are identified by the Owner within the warranty period(s) specified in Article A-15 of the Agreement – WARRANTY PERIOD, or such longer periods as may be specified for certain Products or Work.” (the “Warranty Period”). This warranty shall cover labour and material, including, without limitation, the costs of removal and replacement of covering materials. This warranty shall not limit extended warranties on any items of equipment or material called for elsewhere in the specifications or otherwise provided by any manufacturer of such equipment or material.

Paragraph 12.3.2

Delete the word “The” from the beginning of the first sentence and replace it with the words "Subject to GC 3.4 – DOCUMENT REVIEW, paragraph 3.4.1, the".

Paragraph 12.3.3

Delete the words “one year”.

Paragraph 12.3.4

Delete the words “one year”.

Paragraph 12.3.6

Delete the words “one year”.

New Paragraphs 12.3.7 to 12.3.11

Add the following new paragraphs to GC 12.3:

- 12.3.7 The Contractor shall commence to correct any deficiency within five (5) Working Days after receiving a notice in writing from the Owner or the Consultant, and shall complete the correction as expeditiously as possible, except that in case the deficiency would prevent maintaining security or keeping basic systems essential to the ongoing business of the Owner and/or the Owner’s tenants, operational as designed, all necessary corrections and/or installation of temporary replacements shall be carried out immediately as an emergency service. Should the Contractor fail to attend to the service request on site within four (4) hours and provide this emergency service within 24 hours of a request made in writing during the normal business hours of the Contractor, the Owner is authorized to carry out all necessary repairs or replacements at the Contractor’s expense.
- 12.3.8 The carrying out of replacement work and making good of defects shall be executed at times convenient to the Owner and this may require work outside of normal working hours at the Contractor’s expense.”
- 12.3.9 Any material or equipment requiring excessive servicing during the Warranty Period (or free maintenance period, if applicable) shall be considered defective and the warranty (or

free maintenance period) shall be deemed to take effect from the time that the defect has been corrected so as to cause excessive servicing to terminate.

- 12.3.10 The Contractor shall assign to the Owner all warranties, guarantees or other obligations for work, services or materials performed or supplied by any Subcontractor, Supplier or other person in or about the Work, with the consent of the other party thereto where required by law or by the terms of the Contract or engagement. Such assignment shall be an addition to, and without detracting from, the warranty rights of the Owner under the provisions of the Contract Documents for the duration of the warranty period, with the exception of any extended warranties beyond the periods specified in Article A-15 of the Agreement – WARRANTY PERIOD which are subject to GC 12.3.6.
- 12.3.11 Specified warranty periods shall not be construed as limiting the provisions of CG 12.1 INDEMNIFICATION AND CLAIMS HANDLING.
- 12.3.12 The remedies of the Owner set forth above shall not deprive the Owner of any action, right or remedy otherwise available to it for breach of any provisions of the Contract Documents and the periods referred to above, or such longer time as may be specified elsewhere, shall not be construed as a limitation on the time in which the Owner may pursue such other action or remedy.

NEW GENERAL CONDITIONS GC 12.4

Add new GC 12.4 as follows:

GC 12.4 DAMAGES AND MUTUAL RESPONSIBILITY

- 12.4.1 If either party to the Contract should suffer damage in any manner because of any wrongful act or neglect of the other party or of anyone for whom the other party is responsible in law, then that party shall be reimbursed by the other party for such damage. The reimbursing party shall be subrogated to the rights of the other party in respect of such wrongful act or neglect if it be that of a third party.
- 12.4.2 Claims for damage under paragraph 12.4.1 shall be made in writing to the party liable within reasonable time after the first observance of such damage and if undisputed shall be confirmed by Change Order. Disputed claims shall be resolved as set out in PART 8 – DISPUTE RESOLUTION.
- 12.4.3 If the Contractor has caused damage to the work of an Other Contractor on the Project, the Contractor agrees upon due notice to settle with the Other Contractor by negotiation or arbitration. If the Other Contractor makes a claim against the Owner on account of damage alleged to have been so sustained, the Owner shall notify the Contractor and may require the Contractor to defend the action at the Contractor's expense. The Contractor shall satisfy a final order or judgement against the Owner and pay the costs incurred by the Owner arising from such action.
- 12.4.4 If the Contractor becomes liable to pay or satisfy a final order, judgment, or award against the Owner, then the Contractor, upon undertaking to indemnify the Owner against any and all liability for costs, shall have the right to appeal in the name of the Owner such final order or judgment to any and all courts of competent jurisdiction.

NEW PARTS

Add the following new Parts to the General Conditions of the Stipulated Price Contract:

PART 13 AUDIT

GC 13.1 AUDIT

- 13.1.1 The Owner and/or the Ministry of Labour shall have the right to audit all books and records (in whatever form they may be kept, whether written, electronic or other) relating or

pertaining to any work performed under the Contract (including any and all documents and other materials, in whatever form they may be kept, which support or underlie those books and records), kept by or under the control of the Contractor, including, but not limited to those kept by the Contractor, its employees, agents, assigns, successors and Subcontractors. The Contractor shall maintain and preserve all original books and records, together with such supporting or underlying documents and materials, for the duration of this Contract and for at least two years following the completion of this Contract, including any and all renewals thereof. The books and records, together with the supporting or underlying documents and materials shall be made available, upon request, to the Owner, through its employees, agents, representatives, contractors or other designees, during normal business hours at the Contractor's office or place of business, and the Contractor shall supply certified copies of payrolls and any other records required by the Owner as and when called for. In the event that no such location is available, then the books and records, together with the supporting or underlying documents and records, shall be made available for audit at a time and location in The Regional Municipality of York, Ontario, which is convenient for the Owner.

- 13.1.2 GC 13.1.1 shall not be construed to limit, revoke, or abridge any other rights, powers, or obligations relating to audit which the Owner may have by Federal, Provincial, or Municipal statute, ordinance, regulation, or agreement, whether those rights, powers, or obligations are express or implied.

PART 14 SOFTWARE

GC 14.1 SOFTWARE

- 14.1.1 Without limiting the generality of any other provision in the Contract, the Contractor, as a part of the Work, shall supply and install all software required by the Contract Documents or included with any systems required by the Contract Documents ("Software"). The Contractor shall grant or obtain a perpetual, irrevocable non-exclusive royalty-free license to use the Software sufficient for the Owner's purposes.

SCHEDULE

The Standard Construction Document for Stipulated Price Contract (CCDC 2 - 2008), English version, is further amended by the addition of the following Schedule:

SCHEDULE A.1 – INSURANCE

Contractor's Insurance

The Contractor shall obtain, maintain, pay the premium(s) and any deductibles for, and provide evidence of the following insurance coverage, taken out with insurance companies licensed to transact business in the Province of Ontario and who are not otherwise excluded by the Owner's Insurance and Risk Manager.

Commercial General Liability Insurance

Commercial General Liability ("CGL") insurance with limits of not less than \$5,000,000.00 inclusive per occurrence for bodily and personal injury, death, and damage to property including loss of use thereof. Should this policy contain a General Aggregate, the minimum acceptable General Aggregate shall be \$10,000,000.00. The CGL insurance shall include Cross Liability and Severability of Interest clauses, Products and Completed Operations coverage (minimum 24 months), Owner's & Contractor's Protective and a Standard Non-Owned Automobile endorsement including standard contractual liability coverage.

The following parties shall be included as Additional Insured parties on the CGL policy:

- The Regional Municipality of York
- the Consultant
- the Local Municipality

Automobile Liability Insurance

Automobile liability insurance in respect of licensed vehicles shall have limits of not less than \$5,000,000.00 inclusive per occurrence for bodily injury, death, and damage to property. Coverage shall be in the form of a standard owner's form automobile policy providing third party liability and accident benefits insurance and covering licensed vehicles owned and/or leased or operated by or on behalf of the Contractor.

Contractors' Equipment Insurance

All Risks Contractors' Equipment coverage, insuring the full amount of the Contractor's equipment, including all owned, non-owned and mobile equipment.

Property and Boiler & Machinery Insurance

- (i) All Risks Builder's Risk insurance insuring not less than the sum of the amount of the Contract Price and the full value of Products that are specified to be provided by the Region for incorporation into the Work. The Contractor and the Region shall be Named Insured's on the policy. This policy shall be maintained from the commencement of the Work until Substantial Performance of the Work has been attained, as set out in the Certificate of Substantial Performance.
- (ii) Standard Comprehensive Boiler & Machinery insurance insuring the interests of the Contractor and the Region for not less than the replacement value of boiler and pressure vessels forming part of the Work. Should testing be required as part of the Contract, the policy shall be extended to cover such testing. If production machinery is involved in the performance of the Work, the policy shall be

extended to cover such machinery. The policy shall contain a Joint Loss Agreement clause and shall be maintained from the commencement of the Work until Substantial Performance of the Work has been attained, as set out in the Certificate of Substantial Performance.

The policies shall provide that, in the event of a loss or damage, payment shall be made to the Region and the Contractor as their respective interests may appear. The Contractor shall act on behalf of the Region and itself for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined the Contractor shall proceed to restore the Work. Loss or damage shall not affect the rights and obligations of either party under the Contract except that the Contractor shall be entitled to such reasonable extension of Contract Time relative to the extent of the loss or damage as the Region may decide in accordance with PART 6 – CHANGES IN THE WORK.

The Contractor shall be entitled to receive from the Region, in addition to the amount due under the Contract in respect of Work performed prior to the date of the occurrence of the loss or damage, the amount at which the Region's interest in restoration of the Work has been appraised to the extent paid by the insurer, such amount to be paid as the restoration of the Work proceeds and in accordance with the requirements of PART 5 - PAYMENT.

Contractor's Pollution Liability Insurance

Contractor's Pollution Liability insurance is required with limits of not less than \$10,000,000.00 with the Region added as an Additional Insured. This policy shall be maintained from the commencement of the Work until Substantial Performance of the Work has been attained, as set out in the Certificate of Substantial Performance.

The form of Contractor's Pollution Liability may be an occurrence or claims-made form. Should the policy be on a claims-made form, the Contractor must provide a two year extended reporting period. Should the policy be on an occurrence form, the Contractor must provide a two year completed operations period

The Region will accept in place of the above mentioned insurance coverage, a combination of primary liability limits and umbrella insurance or excess liability limits which meet the CGL, General Aggregate and Automobile Liability limits noted above.

SUPPLEMENTARY CONDITIONS

The Standard Construction Document for Stipulated Price Contract (CCDC 2 - 2008), English version, is further amended by the addition of the following Supplementary Conditions.

SC 1. PROVISION FOR TRAFFIC

Glen Cameron Road shall be kept open to through traffic at all times.

The Contractor shall not reduce the number of through lanes or otherwise restrict traffic on Glen Cameron Road without the prior written approval of the Owner and without first obtaining a road occupancy permit from the Region.

Access shall be maintained at all times to all businesses and residences presently having access to the road.

SC 2. ROAD OCCUPANCY PERMIT

Prior to commencing any work on a Regional right-of-way the Contractor must obtain, at its own cost, a Road Occupancy Permit (“ROP”) from the Region’s Transportation Services Department.

In order to obtain a ROP the Contractor shall submit the following documentation, at a minimum, to the Roads Operations Permits Group of the Region’s Transportation Services Department for review and/or approval:

- A completed ROP Application
- Proof of the insurance required under the Contract
- A detailed written traffic control plan for the control of through traffic and, where applicable, details for the safe passage of pedestrians through the construction area
- A traffic protection plan for worker safety in accordance with the requirements of the *Occupational Health and Safety Act*, RSO 1990, c O.1

The Contractor shall abide by all of the conditions of the ROP for the duration of the Contract.

The Region shall not be responsible for any delays or additional costs incurred by the Contractor in obtaining the ROP.

Any questions regarding the ROP or the application process should be directed to the Region’s Roads Occupancy Permits Group at 1-877-464-9675 extension 75207 or 75242.

SC 3. PERMITS AND APPROVALS

The Contractor shall adhere to all requirements, conditions and restrictions as specified in the permits and approvals required for the completion of the Work.

Pending Permits and Approvals

The Region is in the process of obtaining the following permits and approvals for the work described below:

- Building Permit
- Site Plan Agreement

Copies of the permits and approvals will be provided to the Contractor once they have been obtained. The permits and approvals will form part of the Contract Documents and the Contractor shall comply with the requirements of all permits and approvals at no additional cost to the Region.

The Contractor shall not commence any work for which a permit or approval is required until such time as the permit or approval has been obtained by the Region and provided to the Contractor.

In the event that the Region encounters delays in obtaining the permits and approvals, any work for which a permit or approval is required may be deleted from the scope of Work under the Contract, or the Contract may be terminated in its entirety. The Contractor shall not have any claims for delays, on the part of the Region, in obtaining the permits and approvals, or any claims in the event that any work is deleted from the Contract or the Contract is terminated because a required permit or approval has not been obtained by the Region.

SC 4. SUBSTANTIAL PERFORMANCE OF THE WORK

The Work will not be deemed to be ready for use or being used for the purposes intended pursuant to section 2 of the Construction Act until the following conditions have been met at a minimum:

- each item of mechanical, electrical, instrumentation, piping and HVAC equipment installed under this Contract has been tested to demonstrate compliance with the performance requirements of this Contract;
- each mechanical, electrical, instrumentation, piping and HVAC system installed or modified under this Contract has been tested in accordance with the specified requirements;
- the Work has satisfactorily passed all required inspection and performance testing;
- all test results have been submitted to the Region;
- all operating manuals, maintenance manuals, and "As-Built" drawings have been completed and submitted to the satisfaction of the Region;
- all training required under the Contract has been completed and instructions have been provided to the Region's staff to enable the Region to operate the facility;
- all spare parts and materials have been supplied; and
- all warranty certificates have been submitted.

No deviations from these requirements will be permitted.

END OF DOCUMENT

THE REGIONAL MUNICIPALITY OF YORK
CORPORATE SERVICES DEPARTMENT
PROPERTY SERVICES BRANCH
CONTRACT NO. T-19-16

ABBREVIATIONS

THE REGIONAL MUNICIPALITY OF YORK

CORPORATE SERVICES DEPARTMENT

PROPERTY SERVICES BRANCH

CONTRACT NO. T-19-16

ABBREVIATIONS

When the following abbreviations are used in the Contract Documents, they have the meaning listed:

A	Ampere
AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AABC	Associated Air Balance Council
AASHO	American Association of State Highway Officials
AAADM	American Association of Automatic Door Manufacturers
AC	Alternating Current
ACG	AABC Commissioning Group
ACME	Association of Consulting Management Engineers
ACT	Acoustic Ceiling Tile
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADC	Air Distribution and Control
AODA	Accessibility for Ontarians with Disabilities Act
AFUE	Annual Fuel Utilization Efficiency
AG	Above Grade
AGA	American Gas Association
AFF	Above Finished Floor
AHRI	Air Conditioning, Heating & Refrigeration Institute
AHU	Air Handling Unit
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AIMA	Acoustical & Insulating Material Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AJT	UL Class J Time Delay Fuse
ALUM	Aluminum
AMACF	Advanced Main Air Circulating Fan
AMCA	Air Moving and Conditioning Association Inc.
ANSI	American National Standards Institute
AP	Armour Plate
API	Atmospheric Pressure Ionization
ARCH	Architectural

ARI	Air-Conditioning, Heating, and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Conditioning Engineers
ASL	Above Sea Level
ASME	American Society of Mechanical Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
AWWA	American Water Works Association
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute (USA)
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWS	American Welding Society
BAS	Building Automation System
BCup	Copper-Phosphorous Brazing Alloy
BF	Barrier Free
BHMA	Builders Hardware Manufacturers Association
BL or BLK	Block
BLKG	Blocking
BMS	Building Management System
BN	Bullnose
BFPB	Barrier-Free Push Button
BTU	British thermal unit
CATV	Cable Television
CB	Cane Bolt
CBD	Cement Board
CCA	Canadian Construction Association
CCRC	Canadian Code for Residential Construction
CCTV	Closed Circuit Television
CEC	Canadian Electrical Code
CEMA	Canadian Electrical Manufacturers Association
CFC	Chlorofluorocarbon
CFM	Cubic feet per minute
CFUA	Canadian Fire Underwriters Association
CGA	Canadian Gas Association
CG	Corner Guard
CGL	Commercial General Liability
CGSB	Canadian General Standards
CH	Coat Hook
CIQS	Canadian Institute of Quantity
CISC	Canadian Institute of Steel Construction
CISPI	Cast Iron Soil Pipe Institute
CITC	Canadian Institute of Timber Construction
CK	Caulk
CLA	Canadian Lumbermen's Association
CLG	Ceiling
cm	centimeter
CMHC	Canada Mortgage and Housing Corporation
COFI	Council of Forest Industries of British Columbia

COL.	Column
CONC	Concrete
CONST	Construction
CONT.	Continuous
CPCI	Canadian Pre-stressed Concrete Institute
CPMA	Canadian Paint Manufacturers Association
CPVC	Chlorinated polyvinyl chloride
CRCA	Canadian Roofing Contractors Association
CRN	Canadian Registration Number
CRS	Course
CSA	Canadian Standards Association
CSC	Construction Specifications of Canada
CSI	Construction Specifications Institute (USA)
CSPI	Corrugated Steel Pipe Institute
CSSBI	Canadian Sheet Steel Building Institute
CT	Ceramic Tile
CUA	Canadian Underwriter's Association
CWB	Canadian Welding Bureau
CWC	Canadian Wood Council
CWP	Cold Working Pressure
CWS	Canada-wide Standard
C/W	Complete With
C.W.	Curtain Wall
Cx	Commissioning
CYL	Cylinder Lock
dB	Decibel
dba	Decibel A-weighting
DC	Direct Current
DFO	Department of Fisheries and Oceans
DFT	Dry Film Thickness
DHI	Door Hardware Institute
DIA	Diameter
DIM	Dimensions
DIN	Deutsches Institut für Normung
DIVS.	Divisions
DN	Down
DND	Department of National Defence, Canada
DR	Door
DWGS	Drawings
DWV	Drain, Waste and Vent
Dx	Direct Expansion
ECM	Electronic Control Module
ED	Exit Device
EDC	Electronic Door Contact
EDO	Electronic Door Operator
EDS	Electronic Door Strike
EEMAC	Electrical Equipment Manufacturers Association of Canada
EHO	Electronic Hold Open

EIA	Electronic Industries Alliance
E.J.	Expansion Joint
ELECT	Electrical
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMT	Electric Metallic Tube
EMS	Electric Motor Starter
EMT	Electrical metallic tubing
EP	Epoxy Paint
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer rubber
EPX	Epoxy Flooring
EQ.	Equal
ERV	Energy Recovery Ventilator
ES	Exposed structure
ESA	Electrical Safety Authority
EXP	Exposed
EXT	Exterior
EX or EXIST	Existing
FACP	Fire Alarm Control Panel
FCC	Federal Communications Commission
FD	Floor Drain
FE	Fire Extinguisher
FEC	Fire Extinguisher Cabinet
FF	Factory Finished
FIN.	Finish
FLR	Floor
FM	Factory Mutual Engineering Society
FPM	Feet per minute
FR	Fire Retardant
FRR	Fire Resistance Rating
FS	Folding Seat
FT	foot
GALV	Galvanized
GANA	Glass Association of North America
GB	Grab Bar
GFCI	Ground Fault Circuit Interrupter
GL	Glazing
g/L	grams per liter
GPM	gallons per minute
GWB	Gypsum Wall Board
GWB-AR	Gypsum Wall Board-Abuse Resistant (inherently MR as well)
GWB-MR	Gypsum Wall Board-Moisture Resistant
GWMP	Ground Water Management Plan
HCFC	Hydrochlorofluorocarbons
HD	Hand Dryer
HDF	High Density Fiberboard
HDPE	High Density Polyethylene

HDWD	Hardwood
HDWE	Hardware
HM	Hollow Metal
HMP	Hollow Metal Panel
HOA	Hand-Off-Automatic
HORIZ.	Horizontal
HOC	Hold Open Close
HOD	Hold Open Device
HP	High Point
HR	Hour
HRC	High Rupturing Capacity
HRD	Hair Dryer
HSN	Hub and Spigot No-hub (see ASTM C564)
HSS	Hollow Steel Selection
HT	Height
HR	Hour
HS	Hardware Schedule
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IAP	Insulated Aluminum Panel
IAPMO	International Association of Plumbing and Mechanical Officials
IC	Intumescent Coatings
ICD	Implantable Cardioverter-defibrillator
ID	Identification
I.D.	Inside diameter
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society of North America
IFB	Impregnated Fibre Board
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Association
IGMAC	Insulated Glass Manufacturers Association of Canada
INSUL.	Insulation
INSUL	Insulated
ISO	International Organization for Standardization
IT	Infrastructure Technology
JT	Joint
kA	kiloampere
KHz	kilohertz
KP	Kick Plate
kPa	kilopascal
KPD	Key Pad
Kph	kilometers per hour
KVA	kilovolt amps
KVAR	kilovolt-amperes reactive
kW	kilowatt
kwh	kilowatt-hour
KWS	kilowatt-second

LAN	Local Area Network	LB	Pounds
LCD	Liquid Crystal Display		
LED	Light-Emitting Diode		
LINO	Linoleum		
LP	Low Point		
LPM	liters per minute		
l/s	liters per second		
LTIC	Laminated Timber Institute of Canada		
LSRCA	Lake Simcoe and Region Conservation Authority		
mA	milli-ampere		
MI	Mirror		
MAT	Mineral Acoustic Tile		
MAT'L	Material		
MAX.	Maximum		
MCC	Motor control center		
MECH	Mechanical		
MERV	Minimum efficiency reporting value		
MIA	Marble Institute of America		
MIN.	Minimum		
MIN	Minute		
MM	Millimeters		
MNR	Ministry of Natural Resources		
MOE	Ministry of the Environment		
mPa	megapascal		
mph	miles per hour		
MPMDD	Modified Proctor Maximum Dry Density		
MS	Metal Stud		
MSS	Manufacturers Standardization Society		
m/s	meter per second		
MTL	Metal		
mV	millivolt		
NAAMM	National Association of Architectural Metal Manufacturers (USA)		
NACE	National Association of Corrosion Engineers		
NAIMA	North American Insulation Manufacturers Association		
NCM	No Centre Mullion		
NBFU	National Board of Fire Underwriters		
NBC	National Building Code of Canada		
NBS	National Bureau of Standards (USDC)		
ND	Napkin Dispenser		
NDT	Non-destructive testing		
NEBB	National Environmental Balancing Bureau		
NEC	National Electrical Code		
NEMA	National Electrical Manufacturers Association		
NFPA	National Fire Protection Association		
NG	Natural gas		
NHLA	National Hardwood Lumber Association (USA)		
N.I.C.	Not In Contract		
NLGA	National Lumber Grades Authority		

NO/NC	Normally open/normally closed
NPT	National Pipe Thread
NPSH	net positive suction head
N.T.S.	Not To Scale
NRC	National Research Council
NWWDA	National Wood Window and Door Association
O&M	Operations & Maintenance
OBC	Ontario Building Code
OD	Outside diameter
ODP	Ozone Depletion Prevention
OESC	Ontario Electrical Safety Code
OFC	Ontario Fire Code
OHSA	Occupational Health and Safety Act
OPSS	Ontario Provincial Standard Specifications
O.C.	On Centre
OCIP	Owner Controlled Insurance Program
O.H.	Overhead
OHS	Overhead Door Stop
OHC	Overhead Closer
OSA	Outside air
OWSJ	Open Web Steel Joist
Pa	Pascal
P.A.	Paging System
PANIC	Rated Panic Device
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PE	Pressure electric (switch)
PF	Picofarad
PH	Potential hydrogen (Ph unit of measure)
PIB	Polyisobutylene
PID	Proportional Integrative Derivative
PLAM or PLL	Plastic Laminate
PL or PLL	Plastic Laminate
POL	Polished
PR	Pair
PRL	Private Lock
PREFIN.	Prefinished
PREMANUF	Pre-manufactured
PROF	Profile
PRV	Pressure reducing valve
PSI	Pounds per square inch
PSID	Pounds per square inch differential
PSIG	Pounds per square inch gauge
PT	Paint
PTFE	Polytetrafluoroethylene
P/T	Pressure/Temperature
PTD/WR	Paper Towel Dispenser & Waste Receptacle

PTTW	Permit to take Water
PVC	Polyvinyl Chloride
P.WD	Plywood
R	Radius
RAT'G	Rating
R/A	Return Air
RA	Roof Anchor
RB	Resilient Base
RCM	Removable Centre Mullion
RD	Roof Drain
REQ'D	Required
RFI	Radio Frequency Interference
RH	Robe Hook
REX	Request To Exit Device
RMS	Root Mean Square
RMCAO	Ready mix Concrete Association of Ontario
RPM	Revolutions per minute
RPU	Remote page unit
RSI	R-Value (SI units)
S	Liquid Soap Dispenser
SAE	Society of Automotive Engineers
SAT	Supply Air Temperature
SBS	Styrene Butadiene Styrene
SCADA	Supervisory Control And Data Acquisition
SC	Shower Curtain and Rod
SD	Soap Dish
SDI	Steel Deck Institute
SH/C	Shower Head & Control
SEAL	Sealer
SEI CMM	American Software Engineering Institute Capability Maturity Model
SH	Shower Head
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SND	Sanitary Napkin Disposal Unit
SPDT	Single pole double throw
SPEC'D	Specified
SPMDD	Standard Proctor Maximum Dry Density
SPS	Solid Polymer Surfacing
SPST	Single Pole Single Throw
SSPC	Steel Structure Painting Council
S.S.	Stainless Steel
SR/C	Shower Rod and Curtain
ST	Stain
STL	Steel
STN	Stone
STRUCT.	Structural
SUSP.	Suspended
TAB	Testing, Adjusting, and Balancing
TB	Thermally Broken

TBB	Tile Backer Board
TG	Tempered Glass
TDD	Paper Towel Dispenser & Disposal
TELE	Telephone
THD	Total Harmonic Distortion
TIA	Telecommunications Industry Association
TIAC	Thermal Insulation Association of Canada
T.O.S.	Top of Structure
TRCA	Toronto and Region Conservation Authority
TSSA	Technical Standards & Safety Authority
T T	Thermally Broken Threshold
TTH	Toilet Tissue Holder
TTMAC	Terrazzo, Tile and Marble Association of Canada
TRANSP.	Transparent
TV	Television
TVSS	Transient Voltage Surge Suppressor
TWB	Towel Bar
TWF	Through Wall Flashing
TYP	Typical
ULC	Underwriters Laboratories Canada
UL	Underwriters Laboratories (USA)
U.N.O.	Unless Noted Otherwise
UPS	Uninterruptible Power Supply
USAS	United States of America Standards Institute
USGPM	US Gallons Per Minute
UR	Urinal
U/S	Underside
Utc	Coordinated Universal Time
UV	Ultraviolet
V	Volts
VAC	Voltage Alternating Current
VAV	Variable Air Volume
V.B.	Vapour Barrier
VCT	Vinyl Composite Tile
VDC	Voltage direct current
VERT.	Vertical
VEST	Vestibule
VFD	Variable Frequency Drive
VLAN	Virtual Local Area Network
VOC	Volatile Organic Compound
W/	With
W	Weatherstripping
WAN	Wide Area Network
WC	Water Closet
WD	Wood
WG	Wired Glass
WOG	Water Oil Gas
WR	Washroom

WD	Wood
WS	Wall Stop
WSIB	Workplace Safety and Insurance Board
XLPE	Cross-linked Polyethylene
YR	York Region

1.1 DOCUMENT RESPONSIBILITY

- .1 Refer to Project Manual, Section 00 01 10 - Table of Contents, for indication of document responsibility (DR). Abbreviations for entity responsible for document preparation are as follows:
 - .1 A - Denotes documents prepared by Architect.
 - .2 C - Denotes documents prepared by Civil Engineer (Site Servicing).
 - .3 E - Denotes documents prepared by Electrical Engineer.
 - .4 L - Denotes documents prepared by Landscape Architect.
 - .5 M - Denotes documents prepared by Mechanical Engineer.
 - .6 S - Denotes documents prepared by Structural Engineer.
- .2 Professional seals if applied next to company names in the project directory (below) govern only those specification sections and schedules identified by the corresponding document responsibility (DR) abbreviation in Section 00 01 10.
 - .1 With regard to Section 00 31 00: The architect's seal governs only Section 00 31 00 proper, and not the documents listed therein.

1.2 PROJECT DIRECTORY

- .1 Architect (the Consultant):

Thomas Brown Architects Inc.
197 Spadina Avenue, Suite 500
Toronto, Ontario M5T 2C8
Tel: 416-364-5710
- .2 Structural Engineer:

Stephenson Engineering Ltd.
2550 Victoria Park Avenue, Suite 602
Toronto, Ontario M2J 5A9
Tel: 416-635-9970
- .3 Mechanical Engineer:

Regal Engineering
2359 Royal Windsor Drive, Suite 201
Mississauga, ON L5J 4S9
Tel: 905-855-3010
- .4 Electrical Engineer:

Regal Engineering
2359 Royal Windsor Drive, Suite 201
Mississauga, ON L5J 4S9
Tel: 905-855-3010

.5 Landscape Architect:

Harrington McAvan Ltd.
6882 14th Avenue
Markham, Ontario L6B 1A8
Tel: 905-294-8282

.6 Civil Engineer (Site Servicing):

MGM Consulting Inc.
400 Bronte Street South
Milton, Ontario L9T 0H7
Tel: 905-875-1228

END OF SECTION

PROJECT MANUAL VOL. 1

Specifications Issued for Tender

Architectural, Structural, Civil, Landscape

YORK REGION PARAMEDIC RESPONSE STATION #29

T-19-16

107 Glen Cameron Road,
City of Markham

Thomas Brown **Architects Inc.**

500-197 Spadina Avenue
Toronto, Ontario
M5T 2C8 Tel: 416-364-5710

Project No. 1509

VOLUME 1

INTRODUCTORY INFORMATION

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A

DR - indicates entity responsible for preparation of listed documents (see Section 00 01 05)

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DR

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Document Identification

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Document Identification

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PROJECT MANUAL VOL. 2

Specifications Issued for Tender

Mechanical & Electrical

YORK REGION PARAMEDIC RESPONSE STATION #29

T-19-16

**107 Glen Cameron Road,
City of Markham**

Thomas Brown Architects Inc.

500-197 Spadina Avenue
Toronto, Ontario
M5T 2C8 Tel: 416-364-5710

Project No. 1509

DR - indicates entity responsible for preparation of listed documents (see Section 00 01 05)

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END OF SECTION

THE REGIONAL MUNICIPALITY OF YORK
CORPORATE SERVICES DEPARTMENT
PROPERTY SERVICES BRANCH
CONTRACT NO. T-19-16

ABBREVIATIONS

THE REGIONAL MUNICIPALITY OF YORK

CORPORATE SERVICES DEPARTMENT

PROPERTY SERVICES BRANCH

CONTRACT NO. T-19-16

ABBREVIATIONS

When the following abbreviations are used in the Contract Documents, they have the meaning listed:

A	Ampere
AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AABC	Associated Air Balance Council
AASHO	American Association of State Highway Officials
AAADM	American Association of Automatic Door Manufacturers
AC	Alternating Current
ACG	AABC Commissioning Group
ACME	Association of Consulting Management Engineers
ACT	Acoustic Ceiling Tile
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADC	Air Distribution and Control
AODA	Accessibility for Ontarians with Disabilities Act
AFUE	Annual Fuel Utilization Efficiency
AG	Above Grade
AGA	American Gas Association
AFF	Above Finished Floor
AHRI	Air Conditioning, Heating & Refrigeration Institute
AHU	Air Handling Unit
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AIMA	Acoustical & Insulating Material Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AJT	UL Class J Time Delay Fuse
ALUM	Aluminum
AMACF	Advanced Main Air Circulating Fan
AMCA	Air Moving and Conditioning Association Inc.
ANSI	American National Standards Institute
AP	Armour Plate
API	Atmospheric Pressure Ionization
ARCH	Architectural

ARI	Air-Conditioning, Heating, and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Conditioning Engineers
ASL	Above Sea Level
ASME	American Society of Mechanical Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
AWWA	American Water Works Association
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute (USA)
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWS	American Welding Society
BAS	Building Automation System
BCup	Copper-Phosphorous Brazing Alloy
BF	Barrier Free
BHMA	Builders Hardware Manufacturers Association
BL or BLK	Block
BLKG	Blocking
BMS	Building Management System
BN	Bullnose
BFPB	Barrier-Free Push Button
BTU	British thermal unit
CATV	Cable Television
CB	Cane Bolt
CBD	Cement Board
CCA	Canadian Construction Association
CCRC	Canadian Code for Residential Construction
CCTV	Closed Circuit Television
CEC	Canadian Electrical Code
CEMA	Canadian Electrical Manufacturers Association
CFC	Chlorofluorocarbon
CFM	Cubic feet per minute
CFUA	Canadian Fire Underwriters Association
CGA	Canadian Gas Association
CG	Corner Guard
CGL	Commercial General Liability
CGSB	Canadian General Standards
CH	Coat Hook
CIQS	Canadian Institute of Quantity
CISC	Canadian Institute of Steel Construction
CISPI	Cast Iron Soil Pipe Institute
CITC	Canadian Institute of Timber Construction
CK	Caulk
CLA	Canadian Lumbermen's Association
CLG	Ceiling
cm	centimeter
CMHC	Canada Mortgage and Housing Corporation
COFI	Council of Forest Industries of British Columbia

COL.	Column
CONC	Concrete
CONST	Construction
CONT.	Continuous
CPCI	Canadian Pre-stressed Concrete Institute
CPMA	Canadian Paint Manufacturers Association
CPVC	Chlorinated polyvinyl chloride
CRCA	Canadian Roofing Contractors Association
CRN	Canadian Registration Number
CRS	Course
CSA	Canadian Standards Association
CSC	Construction Specifications of Canada
CSI	Construction Specifications Institute (USA)
CSPI	Corrugated Steel Pipe Institute
CSSBI	Canadian Sheet Steel Building Institute
CT	Ceramic Tile
CUA	Canadian Underwriter's Association
CWB	Canadian Welding Bureau
CWC	Canadian Wood Council
CWP	Cold Working Pressure
CWS	Canada-wide Standard
C/W	Complete With
C.W.	Curtain Wall
Cx	Commissioning
CYL	Cylinder Lock
dB	Decibel
dba	Decibel A-weighting
DC	Direct Current
DFO	Department of Fisheries and Oceans
DFT	Dry Film Thickness
DHI	Door Hardware Institute
DIA	Diameter
DIM	Dimensions
DIN	Deutsches Institut für Normung
DIVS.	Divisions
DN	Down
DND	Department of National Defence, Canada
DR	Door
DWGS	Drawings
DWV	Drain, Waste and Vent
Dx	Direct Expansion
ECM	Electronic Control Module
ED	Exit Device
EDC	Electronic Door Contact
EDO	Electronic Door Operator
EDS	Electronic Door Strike
EEMAC	Electrical Equipment Manufacturers Association of Canada
EHO	Electronic Hold Open

EIA	Electronic Industries Alliance
E.J.	Expansion Joint
ELECT	Electrical
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMT	Electric Metallic Tube
EMS	Electric Motor Starter
EMT	Electrical metallic tubing
EP	Epoxy Paint
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer rubber
EPX	Epoxy Flooring
EQ.	Equal
ERV	Energy Recovery Ventilator
ES	Exposed structure
ESA	Electrical Safety Authority
EXP	Exposed
EXT	Exterior
EX or EXIST	Existing
FACP	Fire Alarm Control Panel
FCC	Federal Communications Commission
FD	Floor Drain
FE	Fire Extinguisher
FEC	Fire Extinguisher Cabinet
FF	Factory Finished
FIN.	Finish
FLR	Floor
FM	Factory Mutual Engineering Society
FPM	Feet per minute
FR	Fire Retardant
FRR	Fire Resistance Rating
FS	Folding Seat
FT	foot
GALV	Galvanized
GANA	Glass Association of North America
GB	Grab Bar
GFCI	Ground Fault Circuit Interrupter
GL	Glazing
g/L	grams per liter
GPM	gallons per minute
GWB	Gypsum Wall Board
GWB-AR	Gypsum Wall Board-Abuse Resistant (inherently MR as well)
GWB-MR	Gypsum Wall Board-Moisture Resistant
GWMP	Ground Water Management Plan
HCFC	Hydrochlorofluorocarbons
HD	Hand Dryer
HDF	High Density Fiberboard
HDPE	High Density Polyethylene

HDWD	Hardwood
HDWE	Hardware
HM	Hollow Metal
HMP	Hollow Metal Panel
HOA	Hand-Off-Automatic
HORIZ.	Horizontal
HOC	Hold Open Close
HOD	Hold Open Device
HP	High Point
HR	Hour
HRC	High Rupturing Capacity
HRD	Hair Dryer
HSN	Hub and Spigot No-hub (see ASTM C564)
HSS	Hollow Steel Selection
HT	Height
HR	Hour
HS	Hardware Schedule
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IAP	Insulated Aluminum Panel
IAPMO	International Association of Plumbing and Mechanical Officials
IC	Intumescent Coatings
ICD	Implantable Cardioverter-defibrillator
ID	Identification
I.D.	Inside diameter
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society of North America
IFB	Impregnated Fibre Board
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Association
IGMAC	Insulated Glass Manufacturers Association of Canada
INSUL.	Insulation
INSUL	Insulated
ISO	International Organization for Standardization
IT	Infrastructure Technology
JT	Joint
kA	kiloampere
KHz	kilohertz
KP	Kick Plate
kPa	kilopascal
KPD	Key Pad
Kph	kilometers per hour
KVA	kilovolt amps
KVAR	kilovolt-amperes reactive
kW	kilowatt
kwh	kilowatt-hour
KWS	kilowatt-second

LAN	Local Area Network	LB	Pounds
LCD	Liquid Crystal Display		
LED	Light-Emitting Diode		
LINO	Linoleum		
LP	Low Point		
LPM	liters per minute		
l/s	liters per second		
LTIC	Laminated Timber Institute of Canada		
LSRCA	Lake Simcoe and Region Conservation Authority		
mA	milli-ampere		
MI	Mirror		
MAT	Mineral Acoustic Tile		
MAT'L	Material		
MAX.	Maximum		
MCC	Motor control center		
MECH	Mechanical		
MERV	Minimum efficiency reporting value		
MIA	Marble Institute of America		
MIN.	Minimum		
MIN	Minute		
MM	Millimeters		
MNR	Ministry of Natural Resources		
MOE	Ministry of the Environment		
mPa	megapascal		
mph	miles per hour		
MPMDD	Modified Proctor Maximum Dry Density		
MS	Metal Stud		
MSS	Manufacturers Standardization Society		
m/s	meter per second		
MTL	Metal		
mV	millivolt		
NAAMM	National Association of Architectural Metal Manufacturers (USA)		
NACE	National Association of Corrosion Engineers		
NAIMA	North American Insulation Manufacturers Association		
NCM	No Centre Mullion		
NBFU	National Board of Fire Underwriters		
NBC	National Building Code of Canada		
NBS	National Bureau of Standards (USDC)		
ND	Napkin Dispenser		
NDT	Non-destructive testing		
NEBB	National Environmental Balancing Bureau		
NEC	National Electrical Code		
NEMA	National Electrical Manufacturers Association		
NFPA	National Fire Protection Association		
NG	Natural gas		
NHLA	National Hardwood Lumber Association (USA)		
N.I.C.	Not In Contract		
NLGA	National Lumber Grades Authority		

NO/NC	Normally open/normally closed
NPT	National Pipe Thread
NPSH	net positive suction head
N.T.S.	Not To Scale
NRC	National Research Council
NWWDA	National Wood Window and Door Association
O&M	Operations & Maintenance
OBC	Ontario Building Code
OD	Outside diameter
ODP	Qzone Depletion Prevention
OESC	Ontario Electrical Safety Code
OFC	Ontario Fire Code
OHSA	Occupational Health and Safety Act
OPSS	Ontario Provincial Standard Specifications
O.C.	On Centre
OCIP	Owner Controlled Insurance Program
O.H.	Overhead
OHS	Overhead Door Stop
OHC	Overhead Closer
OSA	Outside air
OWSJ	Open Web Steel Joist
Pa	Pascal
P.A.	Paging System
PANIC	Rated Panic Device
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PE	Pressure electric (switch)
PF	Picofarad
PH	Potential hydrogen (Ph unit of measure)
PIB	Polyisobutylene
PID	Proportional Integrative Derivative
PLAM or PLL	Plastic Laminate
PL or PLL	Plastic Laminate
POL	Polished
PR	Pair
PRL	Private Lock
PREFIN.	Prefinished
PREMANUF	Pre-manufactured
PROF	Profile
PRV	Pressure reducing valve
PSI	Pounds per square inch
PSID	Pounds per square inch differential
PSIG	Pounds per square inch gauge
PT	Paint
PTFE	Polytetrafluoroethylene
P/T	Pressure/Temperature
PTD/WR	Paper Towel Dispenser & Waste Receptacle

PTTW	Permit to take Water
PVC	Polyvinyl Chloride
P.WD	Plywood
R	Radius
RAT'G	Rating
R/A	Return Air
RA	Roof Anchor
RB	Resilient Base
RCM	Removable Centre Mullion
RD	Roof Drain
REQ'D	Required
RFI	Radio Frequency Interference
RH	Robe Hook
REX	Request To Exit Device
RMS	Root Mean Square
RMCAO	Ready mix Concrete Association of Ontario
RPM	Revolutions per minute
RPV	Remote page unit
RSI	R-Value (SI units)
S	Liquid Soap Dispenser
SAE	Society of Automotive Engineers
SAT	Supply Air Temperature
SBS	Styrene Butadiene Styrene
SCADA	Supervisory Control And Data Acquisition
SC	Shower Curtain and Rod
SD	Soap Dish
SDI	Steel Deck Institute
SH/C	Shower Head & Control
SEAL	Sealer
SEI CMM	American Software Engineering Institute Capability Maturity Model
SH	Shower Head
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SND	Sanitary Napkin Disposal Unit
SPDT	Single pole double throw
SPEC'D	Specified
SPMDD	Standard Proctor Maximum Dry Density
SPS	Solid Polymer Surfacing
SPST	Single Pole Single Throw
SSPC	Steel Structure Painting Council
S.S.	Stainless Steel
SR/C	Shower Rod and Curtain
ST	Stain
STL	Steel
STN	Stone
STRUCT.	Structural
SUSP.	Suspended
TAB	Testing, Adjusting, and Balancing
TB	Thermally Broken

TBB	Tile Backer Board
TG	Tempered Glass
TDD	Paper Towel Dispenser & Disposal
TELE	Telephone
THD	Total Harmonic Distortion
TIA	Telecommunications Industry Association
TIAC	Thermal Insulation Association of Canada
T.O.S.	Top of Structure
TRCA	Toronto and Region Conservation Authority
TSSA	Technical Standards & Safety Authority
T T	Thermally Broken Threshold
TTH	Toilet Tissue Holder
TTMAC	Terrazzo, Tile and Marble Association of Canada
TRANSP.	Transparent
TV	Television
TVSS	Transient Voltage Surge Suppressor
TWB	Towel Bar
TWF	Through Wall Flashing
TYP	Typical
ULC	Underwriters Laboratories Canada
UL	Underwriters Laboratories (USA)
U.N.O.	Unless Noted Otherwise
UPS	Uninterruptible Power Supply
USAS	United States of America Standards Institute
USGPM	US Gallons Per Minute
UR	Urinal
U/S	Underside
Utc	Coordinated Universal Time
UV	Ultraviolet
V	Volts
VAC	Voltage Alternating Current
VAV	Variable Air Volume
V.B.	Vapour Barrier
VCT	Vinyl Composite Tile
VDC	Voltage direct current
VERT.	Vertical
VEST	Vestibule
VFD	Variable Frequency Drive
VLAN	Virtual Local Area Network
VOC	Volatile Organic Compound
W/	With
W	Weatherstripping
WAN	Wide Area Network
WC	Water Closet
WD	Wood
WG	Wired Glass
WOG	Water Oil Gas
WR	Washroom

WD	Wood
WS	Wall Stop
WSIB	Workplace Safety and Insurance Board
XLPE	Cross-linked Polyethylene
YR	York Region

PART 1 - GENERAL

1.1 INFORMATION AVAILABLE FOR REVIEW

- .1 The following documents have been made available by the Owner for review:
 - .1 Geotechnical report:
 - .1 "Geotechnical Investigation Report, Paramedic Response Station #29, 107 Glen Cameron Road, Markham, Ontario", dated April 17, 2017, prepared by Cambium Inc.
 - .2 Environmental site assessment reports:
 - .1 "Phase One Environmental Site Assessment Proposed EMS Station 107-111 Glen Cameron Road Markham Ontario", dated February 27, 2017, prepared by Patriot Engineering LTD.
 - .2 "Phase Two Environmental Site Assessment Proposed EMS Station 107-111 Glen Cameron Road Markham Ontario", dated May 11, 2017, prepared by Patriot Engineering LTD.
- .2 The accuracy of the information contained in the above listed documents has not been independently verified by the Consultant.
- .3 The architect's seal, if applied to the Project Manual, governs only Section 00 31 00 proper, and not the documents listed herein.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract Documents, including Sections of Division 01.

1.2 SECTION INCLUDES

- .1 Cash Allowances.

1.3 CASH ALLOWANCES

- .1 The Contract Price includes the cash allowances stated below, which allowances shall be expended as the Owner directs through the Consultant.
- .2 Cash allowances cover the net cost to the Contractor of services, products, construction machinery and equipment, freight, unloading, handling, storage, installation, and other authorized expenses incurred in performing the work stipulated under the cash allowances.
- .3 Cash allowances do not include the Value Added Taxes payable by the Owner to the Contractor.
- .4 Where cash allowances are noted for purchase only, the cost for storage at the Place of the Work and installation shall be part of the responsibility of the Contractor and is not included in the cash allowance. Storage at the Place of the Work and installation shall be in accordance with the manufacturer's instructions.
- .5 The Contract Price, and not the cash allowances, includes the Contractor's overhead and profit in connection with such cash allowances.
- .6 The value of work performed under a cash allowance is eligible to be included in progress payments. Copies of invoices pertaining to expenditures against the cash allowance shall be appended to applications for progress payments.
- .7 The Contractor shall prepare a schedule for the ordering of items called for under the cash allowances to avoid delaying the progress of the Work. Schedule shall be in accordance with Section 01 33 00.
- .8 The Contractor is required to notify the Consultant in writing at such time as when 75% of the cash allowance has been expended.
- .9 The total amount of the cash allowance shall be advised and will cover the following:
 - .1 Inspection and Testing Services. The Contractor shall obtain 3 quotes and provide to the Consultant and York Region for review prior to issuance of Cash Allowance Authorization.
 - .2 Supply and Installation of Exterior Digital Sign pylon.
 - .3 Supply and Installation Interior Building Signage
 - .4 Hydro Connection
 - .5 Supply and installation of Structured Cabling (IT)

- .6 Supply and Installation of Gas Meter Assembly Connection
- .7 Soil Remediation

PART 2- PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract Documents including Sections of Division 01.

1.2 PRODUCT SUBSTITUTION PROCEDURES

- .1 Base the Work of this Contract and the Contract Price upon using the new materials and Products specified.
- .2 Where materials and Products are specified only by reference to standards, provide any material or Product that meets the standard.
- .3 Materials and Products specified by their proprietary names or catalogue number shall form the basis for the Work. No substitutes for these may be used without the Consultant's prior written authorization which may be obtained in accordance with requirements of this Section.
- .4 Where a material or Product is specified by naming two or more acceptable materials or proprietary Products, provide any one of the specified materials or Products. If compliance with a referenced standard is also specified, the material or Product selected shall meet the standard.
- .5 Substitutions will be considered only when submitted in sufficient time to permit proper investigation by the Consultant, and under the conditions specified herein.
- .6 Requests for substitution may only be considered if submitted within 30 days after Contract award. Requests for substitutions submitted after 30 days after the Contract award may not be considered.
- .7 There is no obligation on the part of the Consultant or the Owner to accept any proposed substitutions that, in the Consultant's or the Owner's opinion, acting reasonably, do not meet the requirements of the Contract Documents, including this Section. .
- .8 Substitutions proposed may be considered only under the following conditions:
 - .1 If the proposed substitute materials and Products, having been brought to the attention of, and considered by, the Consultant as equivalent to those specified, will decrease the Contract Price.
 - .2 If the proposed substitute materials and Products, having been brought to the attention of, and considered by, the Consultant as equivalent to those specified, will not increase the Contract Price but will decrease the Contract Time.
 - .3 If a material or Product is specified together with a requirement for performance and it can be shown by the Contractor that the specified material or Product will not achieve the specified performance.
 - .4 When a substitution is otherwise advantageous to the Owner or to the execution of the Work as determined by the Consultant.
- .9 When proposing substitutions, the Contractor shall submit with each application, the material and Product names and complete specifications substantiating compliance of the proposed substitution with the requirements of the Contract Documents, including:
 - .1 Product Identification.

- .2 Detailed, item by item comparison between the properties and characteristics of the specified material or Product, and the proposed substitution.
- .3 Manufacturer's name, address and telephone number.
- .4 Manufacturer's material or Product literature.
- .5 Performance, technical and test data.
- .6 Reference standards.
- .7 Product limitations.
- .8 Samples.
- .9 List of existing installations.
- .10 Changes to the Contract Time, if any.
- .11 Changes to the Contract Price if any.
- .10 In making a request for substitution, the Contractor represents that:
 - .1 The Contractor has personally investigated the proposed Product or method, and has determined that it is equal or superior in all respects to that specified;
 - .2 The Contractor will provide the same guarantee for the substituted Product or method as for the Product or method specified or indicated;

The Contractor will coordinate the installation of an accepted substitution into the Work, making such changes as may be required for the Work to be complete in all respects;
 - .3 The Contractor waives all claims for additional costs related to the substitution; and,
 - .4 The cost data provided by the Contractor as part of the Contractor's substitution proposal is complete and includes all related costs including, but not limited to;
 - .1 Coordination and supervision;
 - .2 Installation and independent inspection and testing;
 - .3 Any change in the cost of other affected areas; and,
 - .4 Costs for any detailed design or related engineering work.
- .11 Should the proposed substitution be accepted, either in part or in whole, the Contractor assumes full responsibility when the substitution affects any other part of the Work.
- .12 The Contractor shall ensure that substitutions are accommodated by space allotted for the specified materials, Products, methods or processes.
- .13 The cost of changes in the work of all Specification Sections necessitated by the use of proposed substitutions will not be considered or approved as a change in the Work and no increase in the Contract Time will be considered or approved.
- .14 Substitutions that have not been accepted through the process described in this section and are shown on shop drawings, will be rejected, whether or not the shop drawings have been reviewed.

- .15 Credits arising from accepted substitutions will be credited to the Contract Price by way of a Change Order in accordance with Section 01 26 00.
- .16 No substitutions will be permitted without prior written recommendation by the Consultant and prior written approval by the Owner, acting reasonably.

PART 2- PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract Documents including Sections of Division 01.

1.2 SECTION INCLUDES

- .1 Changes.
- .2 Change Order.
- .3 Valuation of Changes and the Contractor's Mark-Up.
- .4 Delays.
- .5 Requests for Interpretation (RFI)

1.3 RELATED SECTIONS

- .1 Section 01 21 00 Allowances
- .2 Section 01 25 00 Product Substitution Procedures

1.4 CHANGES

- .1 The Owner, through the Consultant, without invalidating the Contract, may make changes in the Work consisting of additions, deletions, or other revisions to the Work by Change Order or a Change Directive.
- .2 The Contractor shall not perform a change in the Work without a Change Order or a Change Directive.
- .3 The Consultant will prepare and issue Notices of Change, Change Orders, and Change Directives.
- .4 Communication and correspondence related to all changes shall, at all times, be through the Consultant.

1.5 CHANGE ORDER

- .1 Refer to GC 6.2 of the General Conditions of the Stipulated Price Contract (CCDC 2008).
- .2 When a change in the Work is proposed by the Owner or the Consultant or required by conditions at the Place of the Work or authorities having jurisdiction, the Consultant shall provide a notice describing the proposed change in the Work to the Contractor, to be known as a Notice of Change.

- .3 Changes in the Work proposed by the Contractor shall be in accordance with Section 01 25 00. Proposed changes not in accordance with the requirements of Section 01 25 00 shall not be considered.
- .4 Upon receipt of a Notice of Change from the Consultant, the Contractor shall present, in a form acceptable to the Consultant and within ten (10) Working Days of the date on the Notice of Change, a method of adjustment or an amount of adjustment for the Contract Price, if any, and the adjustment in the Contract Time, if any, for the proposed change in the Work.
- .5 When the Owner and the Contractor agree to the adjustments in the Contract Price and Contract Time, or to the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a Change Order, signed by the Owner and the Contractor. The value of the work performed as the result of a Change Order shall be included in applications for progress payment as expenditures. .

1.6 VALUATION OF CHANGES AND CONTRACTOR'S MARK-UP

- .1 Valuation and the Contractor's mark-up for overhead and profit for changes in the Work shall be calculated in accordance with the provisions of the General Conditions.

1.7 DELAYS

- .1 Refer to GC 6.5 of the General Conditions of the Stipulated Price Contract (CCDC 2008).

1.8 REQUEST FOR INTERPRETATION – RFI

- .1 A request for interpretation (RFI) is a formal process used during the Work to obtain an interpretation of the Contract Documents.
 - .1 An RFI shall not constitute notice of claim for a delay.
- .2 Submittal procedures:
 - .1 RFI form:
 - .1 Submit RFI on "Request for Interpretation" form as approved by the Consultant. The Consultant shall not respond to an RFI except as submitted on this form.
 - .2 Where RFI form does not provide sufficient space for complete information to be provided thereon, attach additional sheets as required.
 - .3 Submit with RFI form necessary supporting documentation.
 - .2 RFI log:
 - .1 Maintain log of RFIs sent to and responses received from the Consultant, complete with corresponding dates.
 - .2 Submit updated log of RFIs with each progress draw submittal.
 - .3 Submit RFIs sufficiently in advance of affected parts of the Work so as not to cause delay in the performance of the Work. Costs resulting from failure to do this will not be paid by the Owner.
 - .4 RFIs shall be submitted only to the Consultant.

- .5 RFIs shall be submitted only by Contractor. RFIs submitted by Subcontractors or Suppliers shall not be accepted.
- .6 Number RFIs consecutively in one sequence in order submitted.
- .7 Submit one distinct RFI per RFI form.
- .8 The Consultant shall review RFIs from the Contractor submitted in accordance with this section, with the following understandings:
 - .1 The Consultant's response shall not be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Price or Contract Time or changes in the Work.
 - .2 Only the Consultant shall respond to RFIs. Responses to RFIs received from entities other than the Consultant shall not be considered.
- .9 Allow 10 Working Days for review of each RFI by the Consultant.
 - .1 The Consultant's review of RFI commences on date of receipt by the Consultant of RFI submittal and extends to date RFI returned by the Consultant.
 - .2 When the RFI submittal is received by the Consultant before noon, review period commences that day; when RFI submittal is received by the Consultant after noon, review period begins on the next Working Day.
 - .3 If, at any time, the Contractor submits a large enough number of RFIs such that the Consultant cannot process these RFIs within 10 Working Days, the Consultant, will confer with the Contractor within 1 Working Day of receipt of such RFIs, and the Consultant and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority between the RFIs submitted. The Contractor shall accommodate such necessary time at no increase in the Contract Time and at no additional cost to the Owner.

PART 2- PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract Documents, including Sections of Division 01.

1.2 SECTION INCLUDES

- .1 Laws, Notices, References, Standards and Regulations.
- .2 Permits, Deposits and Responsibilities.
- .3 Project Coordination and Responsibility.
- .4 Setting Out the Work and Field Engineering.
- .5 Protection and Damages of Property and Work.
- .6 Fires and Smoking.
- .7 Electronic File Agreement

1.3 LAWS, NOTICES, REFERENCES, STANDARDS AND REGULATIONS

- .1 The building code: Ontario Regulation 332/12, including amendments, shall govern the Work.
- .2 Comply with codes, bylaws, and regulations of authorities having jurisdiction over the Place of the Work. Codes and regulations form an integral part of the Contract Documents.
- .3 It shall be the responsibility of the Contractor to give the required notices and comply with the laws, bylaws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction, which are or become in force during the performance of the Work, and which relate to:
 - .1 The Work;
 - .2 The preservation of the public health;
 - .3 Environmental protection; and/or,
 - .4 Construction safety.
- .4 It is the responsibility of the Contractor to schedule notifications and inspections required by authorities having jurisdiction such that notifications can be properly received and that inspections can be properly undertaken without causing a delay in the Work. The Contractor, at no additional cost to the Owner, shall be solely responsible for any delay in the Work caused by failure to properly schedule required notifications and inspections.
- .5 The Contractor shall provide to the chief building official or the registered code agency, where a registered code agency is appointed under the Ontario Building Code Act in respect of the construction to which the notice relates, the required notices set out in Division C – Part 1 Sentence 1.3.5.1(2) and Sentence 1.3.5.2 of the Ontario Building Code, O. Reg. 332/12 as

amended. The Contractor shall be present at each site inspection by an inspector or registered code agency as applicable under Division C – Part 1 Sentence 1.3.5.2 of the Building Code.

- .1 It is the responsibility of the Contractor to schedule notifications to the chief building official or the registered code agency such that the inspection pertaining to the notifications can be made within the time frame as required under Division C – Part 1 Sentence 1.3.5.3 of the Ontario Building Code, O.Reg. 332/12 as amended, without causing a delay in the Work. The Contractor, at no additional cost to the Owner, shall be solely responsible for any delay in the Work caused by failure to properly schedule required notifications and inspections.
- .6 Without limiting the foregoing, wherever bylaws, codes, or standards are quoted in the Contract Documents, they shall be taken to mean the latest edition, including all revisions, amendments, or supplements, at the time of the Contract, unless an earlier edition is specifically quoted. If more than one bylaw, code, or standard is quoted for a given Product, material or method, the latest edition of the most stringent shall govern.
- .7 Wherever reference is made to “manufacturer’s instructions” or “manufacturer’s recommendations”, it shall mean printed instructions or recommendations, received directly from the referenced manufacturer. It shall also be taken to mean the latest edition of such instructions or recommendations.
- .8 The Contractor shall be responsible for any delay in the progress of the Work due to a violation of any legislated requirements, and shall take the necessary steps to avoid delay in the final completion of the work, and such steps will not be considered or approved as changes in the Work.

1.4 PERMITS, DEPOSITS AND RESPONSIBILITIES

- .1 The Owner will apply for, pay for, and provide the building permit.
- .2 All permits, licenses, certificates, and the like, other than the Building Permit, where required for the Work, shall be applied for, paid for, and obtained by the Contractor.
- .3 The Contractor shall pay for any deposit for clean-up of mud-tracking onto roadways, and for the repair of any damage to roadways adjacent to the Place of the Work as may be required by the authorities having jurisdiction.

1.5 PROJECT COORDINATION AND RESPONSIBILITY

- .1 The Contractor shall coordinate the progress of the Work, mobilization areas of the Place of the Work, progress schedules, submittals, access to and use of the Place of the Work and facilities subject to any restrictions and conditions in accordance with the Contract Documents, reports and records, and any other processes, events, work, approvals, inspections and testing as may be required for the complete, proper and seamless execution of the Work.
- .2 The Contractor shall be solely responsible for ensuring that the complete Contract Documents are distributed to, or otherwise made available for review by, all Subcontractors and suppliers as required for the complete and proper and informed coordination and execution of the Work. Failure in this regard will be the sole responsibility of the Contractor and will not be accepted as a justification for a change in the Work and no change in the Work will be approved therefore.

- .3 The Contractor is required to employ a competent supervisor and necessary assistants who shall be in attendance at the Place of the Work at all times throughout the progress of the Work when work is being performed. The Contractor, through the supervisor, shall maintain good order and discipline among the Contractor's employees engaged on the Work, and among any Subcontractors engaged on the Work.
- .4 The responsibility as to which Subcontractor provides the required materials or articles, and/or builds-in articles, rests solely with the Contractor unless otherwise explicitly stated in the Contract Documents, or directed by the Consultant.
- .5 The Contractor shall ensure that Subcontractors shall give the Contractor, in writing, instructions and information regarding their requirements as related to other parts of the Work.
- .6 There shall be cooperation at all times between Subcontractors as required for the proper execution of the Work. The Contractor shall ensure that Subcontractors supply others with the necessary accessories for building-in where required.
- .7 There shall be cooperation at all times with any representatives of any Inspection and Testing Companies (as may be retained by the Owner) during the performance of their duties.
- .8 The Contractor shall ensure that each Subcontractor shall report to the Consultant and the Contractor, in writing, any defects of surface or work, prepared by other Subcontractors, that adversely affects the work of their trade. Commencement of work shall imply acceptance of the prepared work otherwise.
- .9 The Contractor shall ensure that each Subcontractor, upon completion of their work, removes any equipment, surplus materials, and debris resulting from their work. Each Subcontractor shall also, and at its own expense, make good any damage to the work of another Subcontractor as a result of its own work. The definition of what constitutes "damage" shall be at the sole discretion of the Consultant.

1.6 SETTING OUT THE WORK AND FIELD ENGINEERING

- .1 The setting out of the Work shall rest solely with the Contractor, who will be responsible for same.
- .2 Verify all grades, lines, levels, and dimensions as indicated or otherwise provided, and report errors or inconsistencies to the Consultant before commencing work, or as soon as discovered.
- .3 Upon completion of foundation work, provide an accurate survey showing the location of the foundations on the Site, the foundation wall dimensions, and the gross floor area of the Foundation Plan. The survey shall be prepared by a surveyor who is a Registered Ontario Land Surveyor acceptable to the Owner and the Consultant.
- .4 Surveys and Survey Requirements:
 - .1 Surveyor shall be an Ontario Land Surveyor, acceptable to the Owner and the Consultant.
 - .2 Locate, confirm, and protect control points prior to starting Work. Preserve permanent reference points throughout the Work.

- .3 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in the Project Record Documents described under Section 01 77 00 Project Closeout.
- .4 Establish lines and levels, locate and lay out by instrumentation.
- .5 The Contractor shall provide all Subcontractors with, and be responsible for, all levels and dimensions they require. The Contractor to notify all Subcontractors that such levels and dimensions must be obtained from the Contractor only.
- .6 The Contractor shall maintain a complete and accurate log of control and survey work as it progresses.
- .7 Upon completion of foundations and major site improvements, have prepared a certified survey showing dimensions, locations, angles, and elevations of the work completed.
- .8 As the work progresses, the Contractor shall be responsible for laying-out the exact locations of walls as a guide to the Subcontractors.
- .9 The Contractor to ensure that all pipes, service lines and ducts are concealed. Any exceptions to this should be noted on the drawings. Advise the Consultant in advance of the installation or fabrication of items where conditions are such that the installation or fabrication will be exposed.

1.7 PROTECTION AND DAMAGES OF PROPERTY AND WORK

- .1 The Contractor shall ensure provision of adequate protection of materials, property, and work from damage and staining and to ensure protection of adjacent materials and work of Subcontractors to prevent damage. Any party responsible for damage to the work of another, shall make good such damage to the satisfaction of the Consultant at no additional cost to the Owner. The cost for such making good will not be considered or approved as a change in the Work.
- .2 Maintain access and surrounding areas to the Place of the Work free from soiling and debris resulting from the Work. Make good any soiling and remove any and all debris caused as a result of the Work to the satisfaction of the Owner and the Consultant.
- .3 All damage to existing sidewalks, fences, structures, curbs, services, roadways, parking and asphalt areas, grounds, sodding, trees, or other items on, or adjacent to, the Place of the Work, including mud tracks, deemed by the Consultant as being damaged due to the performance of the Work, shall be made good by the Contractor to the satisfaction of the Consultant at no additional cost to the Owner. The cost for such making good will not be considered or approved as a change in the Work.
- .4 Abide by municipal requirements for maintaining sidewalks and roads in proper condition throughout the course of the Work. Provide a flag-person as required for the safe ingress and egress of vehicles to and from the Place of the Work.
- .5 Floors and roofs shall not be over-loaded by accumulated materials. Place proper supports and braces as required to safely disseminate any temporary loading.

1.8 FIRES AND SMOKING

- .1 Fires are not permitted at the Place of the Work.
- .2 Explosives shall not be used in the execution of the Work and are not permitted at the Place of the Work.
- .3 Smoking shall be prohibited at the interior of the building at all times. Smoking shall also be prohibited in areas where volatile fumes or liquids are being used. Post "No Smoking" signs accordingly.
- .4 Precautions shall be taken to avoid fire by spontaneous combustion. Remove combustible and non-combustible waste at regular intervals and/or when directed by the Consultant or the Owner.

1.9 ELECTRONIC FILE AGREEMENT

- .1 Electronic files (CAD) will not be released until Electronic Files Transfer Form, appended to this section, has been completed and returned to the Consultant. Requests for release of electronic files for Structural, Mechanical, Electrical, Civil or Landscape will require to be completed on their release forms upon request.
- .2 CAD files shall only be released once payment has been made as stipulated on Electronic Files Transfer Form.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Release of Electronic Documents

Project Name: **York Region Paramedic Response Station #27**

Project Address: **107 Glen Cameron Road, Markham**

1. There is a retrieval / preparation fee associated with the release of electronic file requests. The fee is **\$250.00 plus applicable taxes per drawing**. The release of the drawings will be provided once this signed agreement and receipt of payment by e-transfer is provided to accounts@tbrownarch.com.
2. The release of electronic files by **Thomas Brown Architects Inc.** does not imply transfer of copyright and ownership. Electronic files shall remain the property of Thomas Brown Architects Inc., and in no case shall the transfer of these electronic files be considered a sale.
3. The information on the electronic files is considered instruments of service of **Thomas Brown Architects Inc.** and shall not be used for other projects, for additions to this project, or completion of this project by others.
4. Electronic files are an inherently unstable medium and are subject to deterioration, modifications and viruses. Electronic files are subject to inadvertent changes in the process of moving from one computer to another; or by compressing and decompressing the data; or by moving from one software program to another; or any kind of manipulation of the data that will lead to defects.
5. **Thomas Brown Architects Inc.** reserves the right to remove all indications of its ownership and/or involvement from each electronic file
6. **Thomas Brown Architects Inc.** makes no representation as to the compatibility of the electronic files with any hardware or software.
7. The User agrees not to modify or alter the electronic documents in any way.
8. The User agrees not to use or reuse the electronic documents in any manner except as expressly permitted by this agreement.
9. The User agrees to review all the documents related to the User's work. If the User does not review a complete set of documents, the User agrees that the risks and consequences of any review are the sole responsibility of the User.
10. **Thomas Brown Architects Inc.** makes no representation regarding the accuracy, completeness, or permanence of electronic files, nor their merchantability or fitness for a particular purpose.
11. The users of these electronic files shall, to the fullest extent permitted by law, indemnify, defend and hold harmless **Thomas Brown Architects Inc.** from all claims, damages, losses, expenses, penalties, and liabilities of any kind, including legal, arising out of or resulting from the use of electronic files.
12. **Thomas Brown Architects Inc.** believes that no licensing or copyright fees due to others on account of the release of electronic files, but to the extent that any are, the user of the files will pay the appropriate fees and hold **Thomas Brown Architects Inc.** harmless for such claims.
13. Contractor to identify which drawings are being requested and filled out in the chart provided.

PART 1 - GENERAL

1.1 ADMINISTRATIVE

- .1 The Contractor shall schedule meetings as specified herein.
 - .1 Such scheduling shall be in consultation both with the Owner and with the Consultant.
 - .2 Written notice of each site meeting shall, in general, appear at the conclusion of the minutes of the preceding meeting or, else, shall be issued by the Consultant, via memorandum, no less than 24 hours prior to said meeting.
- .2 The Contractor shall provide the physical space for the meetings at the Place of the Work, generally to be the site office (refer to Section 01 50 00 Temporary Work for the complete requirements of the site office).
- .3 The Consultant shall prepare agendas for meetings specified herein.
 - .1 Agendas shall include, as a minimum, the agenda items specified in the Contract Documents.
- .4 The Consultant shall distribute written notice of each meeting specified herein, complete with meeting agenda, 4 Working Days in advance of meeting date to the following, each of who shall be responsible for distributing such notices to other affected parties associated with them (such as, for example, Subcontractors in the case of the Contractor):
 - .1 The Contractor.
 - .2 The Owner.
- .5 The Consultant shall chair and record the minutes of meetings specified herein.
 - .1 The Consultant shall distribute copies of minutes to the Owner, the Contractor, and all others in attendance within 3 Working Days after date of meeting.
 - .2 Any exceptions taken to, or clarification/correction required of, the various items recorded in the minutes, shall be furnished in writing and copied to all parties listed on the distribution list of the captioned minutes.
- .6 Representatives of parties attending meetings shall be authorized to act on behalf of the parties they represent.
- .7 Subcontractors and suppliers shall not attend meetings unless authorized by the Consultant and/or the Owner.
- .8 The Contractor shall prepare, and distribute to the Consultant and the Owner at each progress meeting date, the following:
 - .1 Monthly progress reports containing updated schedules, shop drawing logs, requests for interpretation logs, submittals and budget.

1.2 CONTRACT START-UP MEETING

- .1 Within 10 Days after award of the Contract, request a meeting of parties in the Contract to discuss and resolve administrative procedures and responsibilities prior to the commencement of the Work.
- .2 The Owner, the Consultant, the Contractor, site superintendent(s), and inspection and testing company will be in attendance.
- .3 Agenda to include the following:
 - .1 Appointment of official representative of participants in the project.
 - .2 Status of permits, fees and requirement of authorities having jurisdiction. Action required.
 - .3 Establishing a schedule for progress meetings.
 - .4 Requirements for the Contract modification and interpretation procedures, including, but not limited to: requests for interpretation, Notices of Change, Change Orders, Supplemental Instructions, procedures, approvals required, mark-up percentages permitted, and administrative requirements.
 - .5 Submittal procedures.
 - .6 Schedule of submission of samples, colour chips, and items for Owners and/or Consultant's consideration.
 - .7 Construction schedule and progress scheduling.
 - .8 Delivery schedule of specified equipment.
 - .9 Appointment of inspection and testing agencies or firms.
 - .10 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to the Consultant for review of the Work.
 - .11 Requirements for temporary facilities, signs, offices, storage sheds, utilities, fences.
 - .12 Security requirements at and for the Place of the Work.
 - .13 Record drawings.
 - .14 Maintenance manuals.
 - .15 Take-over procedures, acceptance, warranties.
 - .16 Progress claims, administrative procedures, holdbacks.
 - .17 Insurances, transcripts of policies.
 - .18 The Contractor's safety procedures.
 - .19 Workplace Safety and Insurance Board Certificate.

1.3 PRE-INSTALLATION MEETINGS

- .1 During the course of the Work prior to Substantial Performance of the Work, schedule pre-installation meetings as required by the Contract Documents or as directed by the Consultant.
- .2 As far as possible, pre-installation meetings shall be scheduled to take place on the same Day as regularly scheduled progress meetings.
- .3 Agenda to include the following:
 - .1 Appointment of official representatives of participants in the project.
 - .2 Review of existing conditions and affected work, and testing thereof as required.
 - .3 Review of installation procedures and requirements.
 - .4 Review of environmental and site condition requirements.
 - .5 Schedule of the applicable portions of the Work.
 - .6 Schedule of submission of samples, colour chips, and items for the Consultant's consideration.
 - .7 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
 - .8 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to the Consultant for review of the Work.
 - .9 Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests.
 - .10 Delivery schedule of specified equipment.
 - .11 Special safety requirements and procedures.
- .4 The following shall be in attendance:
 - .1 The Contractor.
 - .2 The Subcontractors affected by the work for which the pre-installation meeting is being conducted.
 - .3 The Consultant.
 - .4 Manufacturer's representatives, as applicable.
 - .5 Inspection and testing company, as applicable.

1.4 PROGRESS MEETINGS

- .1 During the course of the Work prior to Substantial Performance of the Work, schedule progress meetings as directed by the Consultant.
- .2 Attendees at progress meetings shall include the following:
 - .1 The Contractor.

- .2 The Contractor's site superintendent(s).
- .3 The Consultant.
- .4 The Owner.
- .3 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Review of items arising from proceedings.
 - .3 Review of progress of the Work since previous meeting and the Contractor's monthly progress report.
 - .4 Field observations, problems, conflicts.
 - .5 Update construction schedule.
 - .6 Problems that impede compliance with construction schedule.
 - .7 Review of off-site fabrication delivery schedules.
 - .8 Review material delivery dates/schedule.
 - .9 Corrective measures and procedures to regain construction schedule.
 - .10 Revisions to construction schedule.
 - .11 Progress, schedule, during subsequent period of the Work.
 - .12 Review submittal schedules.
 - .13 Review status of submittals.
 - .14 Maintenance of quality standards.
 - .15 Pending changes and substitutions.
 - .16 Review of the Contract modifications and interpretations, including, but not limited to: requests for interpretation and log, Notices of Change, Change Orders, Supplemental Instructions, for effect on construction schedule and on the Contract Time.
 - .17 Review of status of as-built documents.
 - .18 Other business.

1.5 PRE-TAKEOVER MEETING

- .1 Prior to application for Substantial Performance of the Work, schedule a pre-takeover meeting.
- .2 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Review of items arising from proceedings.

- .3 Review of procedures for Substantial Performance of the Work, completion of the Contract, and handover of the Work.
- .4 Field observations, problems, conflicts.
- .5 Review of outstanding Contract modifications and interpretations, including, but not limited to: requests for interpretation and log, Notices of Change, Change Orders, Supplemental Instructions, for effect on construction schedule and on the Contract Time.
- .6 Problems which impede Substantial Performance of the Work.
- .7 Review of procedures for deficiency review. Corrective measures required.
- .8 Review of arrangements for hydro, heating, and other services.
- .9 Progress, schedule, during succeeding period of the Work.
- .10 Review submittal requirements for warranties, manuals, and all demonstrations and documentation required for Substantial Performance of the Work.
- .11 Review of keying and hardware requirements.
- .12 Review of status of as-built documents and record drawings.
- .13 Status of commissioning and training.
- .14 Review the Contractor's deficiency list and status.
- .15 Cleaning for occupancy.
- .16 Other business.

1.6 POST-CONSTRUCTION MEETING

- .1 Prior to application for completion of the Contract, schedule a post-construction meeting. Four days prior to date for meeting, the Consultant shall confirm a date for meeting based on evaluation of completion requirements.
- .2 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Confirmation that no business is arising from proceedings.
 - .3 Confirmation of completion of the Contract, and handover of reviewed documentation from the Consultant to the Owner.
 - .4 Confirmation of completion of Notices of Change, Change Orders, and Supplemental Instructions.
 - .5 Problems that impede the Contract completion.
 - .6 Identify unresolved issues or potential warranty problems.
 - .7 Confirmation of completion of deficiencies.
 - .8 Corrective measures required.

- .9 Confirmation of arrangements for hydro, heating and other services.
- .10 Confirm submittal requirements for warranties, manuals, and demonstrations and documentation for Contract completion are in order.
- .11 Review of procedures for communication during post-construction period.
- .12 Handover of reviewed record documents by the Consultant to the Owner.
- .13 Handover of the Contract completion insurance policy transcripts by the Contractor.
- .14 Submission of final application for payment.
- .15 Review and finalize outstanding claims, pricing, and allowance amounts.
- .16 Status of commissioning and training.
- .17 Demobilization and the Place of the Work restoration.
- .18 Review of requests for interpretation log.
- .19 Other business.

1.7 SPECIAL MEETINGS

- .1 The Owner and/or the Consultant reserve the right to require special meetings which may be held on short notice and at which attendance by the Contractor and representatives of affected Subcontractors and suppliers is mandatory. The Consultant shall keep detailed and accurate meeting notes and distribute copies promptly to all in attendance and those affected by agreements made at such meetings.

PART 2- PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract Documents, including Sections of Division 01.

1.2 SECTION INCLUDES

- .1 Bonds, certificates and statements.
- .2 Shop drawings and product data.
- .3 Samples.
- .4 Construction progress schedule.

1.3 ADMINISTRATIVE

- .1 Submit to the Consultant all submittals listed for review. Submit with reasonable promptness and in an orderly sequence so as not to cause any delay in the Work. Failure to submit in ample time will not be considered sufficient reason for an extension of the Contract Time, and no claim for extension by reason of such default will be allowed.
- .2 Submit only those submittals specifically required by the Contract Documents, or those specifically requested by the Consultant. Any submittals submitted that are not specifically required by the Contract Documents, or requested by the Consultant, will be returned to the Contractor at the Contractor's expense without being reviewed.
- .3 Work affected by a submittal shall not proceed until the review of that submittal is complete.
- .4 Submittals that contain substitutions will be rejected. Substitutions are permitted only when approved in accordance with Section 01 25 00.
- .5 The Contractor's review of submittals:
 - .1 The Contractor is to review submittals prior to submission to the Consultant. This review represents that the necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and all of the Contract Documents.
 - .2 Submittals shall bear stamp of the Contractor and signature of a responsible official in the Contractor's organization indicating in writing that such submittals have been checked and coordinated by the Contractor. The Contractor's review shall be performed by qualified personnel who have detailed understanding of those elements being reviewed and of the conditions at the Place of the Work proposed for installation.
 - .3 Check and sign each submittal and make notations considered necessary before submitting to the Consultant for review. Where submittal is substantially and obviously in conflict with requirements of the Contract Documents, reject submittal without submitting to the Consultant and request resubmission.
 - .4 The Contractor shall assume sole responsibility for any conflicts occurring in the Work that result from lack of comparison and coordination of submittals required for the Work.

- .5 Notify the Consultant in writing of changes made on submittals from the Contract Documents. The Consultant's review of submittals shall not relieve the Contractor of responsibility for changes made from the Contract Documents not covered by written notification to the Consultant.
- .6 Submittals that clearly have not been reviewed by the Contractor, or are not stamped, signed, dated, and identified as to the specific project, will be returned without being reviewed.
- .6 The Consultant's review of submittals:
 - .1 Review of submittals by the Consultant is for the sole purpose of ascertaining conformance with the general design concepts and the general intent of the Contract Documents. This review shall not mean that the Consultant approves the detail design inherent in the submittals, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the submittals, or responsibility for meeting requirements of the Contract Documents.
 - .2 The Contractor shall be responsible for dimensions to be confirmed and correlated at the Place of the Work for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the Work.
 - .3 The Consultant's review and markings on submittals do not authorize changes in the Work or the Contract Time, and will be accommodated at no additional cost to the Owner. If, in the opinion of the Contractor, the Consultant's markings on submittals constitute a change in the Work or will effect a change in the Contract Time, then the Contractor shall so notify the Consultant in writing and request an interpretation following the procedures for requests for interpretation in accordance with Section 01 26 00. If the Consultant finds that the Consultant's markings on submittals do constitute a change in the Work or will effect a change in the Contract Time, then a Change Order will be prepared therefore. The time taken to process such a request for interpretation shall not, in and of itself, constitute a change in the Work nor increase the Contract Time.
 - .4 Submittals received but not required by the Contract Documents or requested by the Consultant will not be reviewed by the Consultant and will be marked 'NOT REVIEWED' by the Consultant and returned to the Contractor.
- .7 Prepare submittals using SI (metric) units.
- .8 Verify that field measurements and affected adjacent work are coordinated.
- .9 The Contractor's responsibility for errors and omissions in the submissions is not relieved by the Consultant's review of submittals.
- .10 The Contractor's responsibility for deviations in the submission from the requirements of the Contract Documents is not relieved by the Consultant's review of submittals.
- .11 Keep one reviewed copy of each submittal in the site office.
- .12 Engineered submittals:

- .1 Submittals for items required to be engineered shall be prepared under the direct control and supervision of a qualified professional engineer registered in the Place of the Work, and having the minimum professional liability insurance, requirements as required by the Professional Engineers of Ontario who shall also apply his/her professional seal and signature to submittals prepared under their direct control and supervision.
- .2 Include with engineered submittal, Professional Engineer's certificate of insurance.
- .3 Design includes life safety, sizing of supports, anchors, framing, connections, spans, and as additionally required to meet or exceed requirements of applicable codes, standards, regulations, and authorities having jurisdiction.
- .4 Engineered submittals shall include design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal. Prepare calculations in a clear and comprehensive manner so that they can be easily reviewed. Incomplete or haphazard calculations will be rejected.
- .5 The Professional Engineer responsible for the preparation of engineered submittals shall undertake periodic field review, including review of associated mock-ups, at locations wherever the work as described by the engineered submittal is in progress, during fabrication and installation of such work, and shall submit a field review report after each visit. Field review reports shall be submitted to the Consultant, to authorities having jurisdiction as required, and in accordance with the Ontario Building Code.
- .6 Field reviews shall be at intervals as necessary and appropriate to the progress of the work described by the submittal to allow the Professional Engineer to be familiar with the progress and quality of such work and to determine if the work is proceeding in general conformity with the Contract Documents, including reviewed shop drawings and design calculations.
- .7 Upon completion of the parts of the Work covered by the engineered submittal, the Professional Engineer responsible for the preparation of the engineered submittal and for undertaking the periodic field reviews described above, shall prepare and submit to the Consultant and authorities having jurisdiction, as required, a letter of general conformity for those parts of the Work, certifying that they have been provided in accordance with the requirements both of the Contract Documents and of the authorities having jurisdiction over the Place of the Work.
- .8 Costs for such field reviews and field review reports and letters of general conformity are included in the Contract Price.

1.4 BONDS, CERTIFICATES AND SCHEDULES

- .1 Prior to commencement of the Work, the Contractor is required to provide to the Owner a copy of the Contractor's current Certificate of Clearance from the Workplace Safety and Insurance Board.
- .2 No later than 10 Working Days prior to, and as a condition of, the first application for progress payment, the Contractor is required to submit the following to the Consultant:
 - .1 A copy of the Contractor's Certificate of Clearance from the Workplace Safety and Insurance Board provided to the Owner in accordance with paragraph 1.4.1 (above).

- .2 A schedule of values for the parts of the Work showing values for each part of the Work distributed over each section of the Technical Specifications to the satisfaction of the Consultant. Make revisions to the schedule as required until acceptance by the Consultant is achieved.
- .3 A construction progress schedule in accordance with paragraph 1.8 of this Section (below).
- .4 Bonding information shall be submitted to the Region in accordance with the requirements of the Contract Documents.

1.5 SCHEDULE OF SUBMITTALS

- .1 Before commencement of the Work, submit to the Consultant a detailed schedule of submittals required by the Contract Documents correlated to the construction progress schedule specified under paragraph 1.8 of this section (below).
 - .1 Schedule shall be accompanied by a checklist, correlated to both the schedule of submittals and the schedule of inspections and tests (specified under Section 01 45 00), listing the following:
 - .1 Shop drawings.
 - .2 Samples.
 - .3 Mock-ups.
 - .4 Reviews, tests and inspections by:
 - .1 Manufacturers.
 - .2 Authorities having jurisdiction.
 - .3 Inspection and testing companies.
 - .5 Demonstration and training.
 - .2 Indicate dates for submitting, review time, resubmission time, float time, and last date for meeting construction schedule.
 - .3 Consultant will review submittal schedule and advise the Contractor if volume and timing of submittals will permit timely review and response. The Consultant may require modifications to submittals schedule in order to allow adequate time for review of submittals. Adjust submittals schedule and construction schedule as required to comply with Consultant's needs.
 - .4 Make provisions in schedule for at least 10 Working Days for the Consultant's review of submittals. When submittals have to be reviewed by one or more of the Consultant's subconsultants, add 5 more Working Days for a total of 15 Working Day review period.
 - .5 If the Consultant requires resubmission of submittals, allow for an additional 10 Working Days review for each resubmission.
 - .6 If, at any time, the Contractor submits a large enough number of submittals such that the Consultant cannot process these submittals within 10 Working Days, the Consultant, in consultation with the Contractor within 3 Working Days of receipt of such submittal, will provide the Contractor with an estimate of the time necessary for processing same. The Contractor shall

accommodate such necessary time at no increase in the Contract Time and at no additional cost to the Owner.

- .7 The Contractor shall periodically resubmit the submittal schedule to correspond to changes in the construction schedule. Such resubmissions shall maintain the minimum 10 Working Day period for the Consultant's review.

1.6 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
- .2 The Contractor shall provide all shop drawings called for in the Contract Documents or as the Consultant may reasonably request.
- .3 The Contractor shall submit at least eight copies of each shop drawing for review by the Consultant, for final distribution as follows (the Contractor shall ensure that additional copies are submitted in sufficient quantity for distribution to the Subcontractors affected by the work indicated therein):
 - .1 One copy of each shop drawing for the Consultant's records;
 - .2 One copy of each for the records of the reviewer;
 - .3 One copy of each for the records of the Contractor (to be kept at the site office throughout the duration of the Work); and,
 - .4 Five copies of each to return to the Contractor three of which are for inclusion in the Operating and Maintenance Manuals in accordance with Section 01 77 00.
- .4 All submitted copies, other than the two for the records of the Consultant and the reviewer, shall be returned to the Contractor once the review is complete.
- .5 The Contractor shall submit copies of reviewed shop drawings to authorities having jurisdiction as required.
- .6 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and all other information necessary for completion of the work.
- .7 Where articles or equipment attach or connect to other articles or equipment, clearly indicate that such items have been coordinated, regardless of where in the Contract Documents the adjacent items are specified or indicated. Indicate cross references to the Contract Documents.
- .8 Shop drawings shall clearly define the division of responsibility. No Products, items or equipment, or description of work, shall be indicated to be supplied, or work to be done, "By Others" or "By Purchaser." It shall also be understood that any items, equipment, or description of the work shown on the shop drawings shall form a part of the Contract Documents unless specifically noted to the contrary. Shop drawings that do not clearly define the division of responsibility will be returned to the Contractor for same before being accepted for review by the Consultant.
- .9 Shop drawings shall include:
 - .1 Fabrication and erection dimensions.

- .2 Plans, sections, elevations, arrangements and sufficient full size details which indicate complete construction, components, methods of assembly as well as interconnections with other parts of the Work.
- .3 Design calculations prepared by professional engineer, as required, substantiating sizes for members and connections based on design loads.
- .4 Clear definition of the division of responsibility for the work described thereon. No Products, items or equipment, or description of work, shall be indicated to be supplied, or work to be done, "By Others" or "By Purchaser". Shop drawings marked with either of these phrases will be rejected without having been reviewed by the Consultant.
- .5 Location and type of exposed anchors, attachments and locations and types of fasteners, including concealed reinforcements to accept mounted fasteners.
- .6 Adhesives, joinery methods and bonding agents.
- .7 Kinds and grades of materials, their characteristics relative to their purpose, detailed description of finishes and other fabrication information.
- .8 Configurations, types and sizes required; identify each unit type on drawing and on Product.
- .9 Descriptive names of equipment and mechanical and electrical characteristics when applicable.
- .10 Data verifying that superimposed loads will not affect function, appearance and safety or work shown on shop drawings, as well as other interconnected work.
- .11 Assumed design loadings, dimensions of elements and material specifications for load-bearing members.
- .12 Proposed chases, sleeves, cuts and holes in structural members.
- .13 Wall thicknesses of metals.
- .14 Location and types of welds. For structural welds use AWS symbols and clearly show net weld lengths and sizes.
- .15 Materials, gauges, and sizes being supplied including connections, attachments, reinforcement, anchorage and locations of exposed fastenings.
- .16 Installation instructions and details for products to be installed by separate Subcontractors, including function of each part.
- .17 A list of Products covered by, or included on, the shop drawing. List of Products shall be complete and show manufacturer's name, Product name, generic description, standard certification where specified, manufacturer's complete installation data and precautions against wrong installation, operation and maintenance.
- .18 Refer to individual sections of the specifications for more particular requirements for shop drawings.
- .10 Compatibility statement: Include with each shop drawing a statement that each Product and material indicated on the shop drawing is compatible with each other Product and material with which it comes into contact.
- .11 The Consultant will require a maximum of 10 Working Days from receipt of shop drawings for processing of same. The Contractor shall make allowances in the scheduling of the Work for this

period of time for each submission and shall, also, make allowances in the schedule for the following potentialities:

- .1 If, upon review, adjustments are made on the shop drawings by the Consultant and they are returned to the Contractor marked "Revise and Resubmit," the shop drawing shall be revised as required and clean copies resubmitted to the Consultant for an additional review. The Consultant shall, for each resubmission, require a maximum of 10 Working Days from receipt for processing of shop drawings.
- .2 No claim for an increase in the Contract Time or claim for a change in the Work shall be considered or approved as a result of any of the following:
 - .1 The time taken for processing of shop drawings by the Consultant unless longer than 10 Working Days after receipt of same.
 - .2 The time taken by the Contractor for revision and resubmission of shop drawings.
 - .3 Any adjustments made on the shop drawings by the Consultant that are consistent with the intent of the Contract Documents.
- .12 Make the changes in the shop drawings as the Consultant may require, consistent with the Contract Documents. When resubmitting, notify the Consultant in writing of any revisions made other than those requested.
- .13 If, upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, all submitted copies of the shop drawing (except the two retained by the Consultant) will be returned to the Contractor marked as "Reviewed" or "Reviewed as Noted", and fabrication or installation of the work may proceed.
- .14 Submit at least 8 copies of product data sheets or brochures for requirements requested in the Contract Documents and as the Consultant may reasonably request where shop drawings will not be prepared due to a standardized manufacture of a Product.

1.7 SAMPLES

- .1 Submit for review samples as requested in the Contract Documents. Label samples as to origin and intended use in the Work.
- .2 Unless otherwise directed by the Consultant, deliver samples prepaid to the site office and notify the Consultant in writing of the availability of sample for review.
- .3 Notify the Consultant in writing at the time of submission of any deviations in the samples from the requirements of the Contract Documents.

1.8 CONSTRUCTION PROGRESS SCHEDULE

- .1 Submit a construction progress schedule on which the following shall be indicated in addition to the schedule for the various items of work:
 - .1 Dates for the submittal of each shop drawing and product data sheet required by the Contract Documents;
 - .2 Dates for the submittal of samples required by the Contract Documents;

- .3 Dates for the performance of inspections and tests required by the Contract Documents;
- .4 Dates for the construction and review of mock-ups required by the Contract Documents; and,
- .5 Dates for expenditures against the cash allowances identified in Section 01 21 00.
- .2 Prepare schedule in the form of a horizontal bar chart.
- .3 Provide a separate bar for each trade or operation.
- .4 Provide a horizontal time scale identifying the first work day of each week.
- .5 The format for the listings shall be the chronological order of the start of each item of work.
- .6 The identification of the listings shall be by a brief systems description.
- .7 Submission:
 - .1 Submit initial schedules within 10 Working Days after award of the Contract, but before commencing the Work.
 - .2 Submit two copies to the Consultant, who shall retain one copy.
 - .3 The Consultant will review the submitted schedules and return a reviewed copy to the Contractor within 10 Working Days after receipt.
 - .4 The Contractor shall resubmit a finalized copy of the required schedules within five Working Days after return of reviewed copy.
 - .5 The Contractor shall submit a revised construction progress schedule with each application for progress payment.
- .8 Distribute copies of the revised schedule to:
 - .1 The site office.
 - .2 Subcontractors.
 - .3 All concerned parties.
- .9 Instruct Subcontractors, suppliers, and manufacturers, to report to the Contractor in writing within 10 Working Days, any problems anticipated by the timetable shown in the schedule. The Contractor shall convey this information to the Consultant if necessary.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Inspection and testing: administrative requirements.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Equipment and system adjustments and balance.
- .5 Manufacturer's field review.

1.2 INSPECTION

- .1 The Owner and the Consultant shall have access to the Work at all times. If part of the Work is in preparation at locations other than the Place of the Work, access shall be given to such work whenever it is in progress.
- .1 Inspection and testing services shall be required for, but not limited to, the following:
 - .1 Excavation, backfill and compaction; inspection and testing.
 - .2 Founding soils; inspection.
 - .3 Paving systems; inspection and testing.
 - .4 Concrete reinforcement.
 - .5 Concrete.
 - .6 Mortar.
 - .7 Structural steel.
 - .8 Steel deck.
 - .9 Roofing (except metal roofing).
 - .10 Building envelope.
- .2 Give timely notice requesting inspection if the Work is designated for special tests, inspections or approvals by the Contract Documents or by the Consultant's instructions, or authorities having jurisdiction.
- .3 If the Contractor covers, or permits to be covered, work that has been designated for special tests, inspections or approvals before such tests, inspections or approvals have been made, the Contractor shall, if so directed by the Consultant uncover the work, have the inspections or tests satisfactorily completed, and make good the work. Such uncovering and making good will not be considered or approved as a change in the Work.
- .4 The Consultant may order any part of the Work to be examined if the Work is suspected not to be in accordance with the Contract Documents. If, upon examination, such work is found not to be in accordance with the Contract Documents, the Contractor shall correct such work and pay the cost of the examination and correction neither of which will be considered or approved as a change in the Work. If such work is found to be in accordance with the Contract Documents, the

Owner shall pay for the cost of examination and replacement as a change in the Work in accordance with Section 01 26 00.

- .5 Additional testing required because of changes in materials, proportions of mixes requested by the Contractor or Subcontractors as well as any extra testing of materials occasioned by lack of identification or by failure of such materials being replaced to meet requirements of the Contract Documents or testing of structure or elements including load testing, shall be carried out at no additional cost to the Owner.
- .6 Inspection and tests required by codes or ordinances, or by an Authority Having Jurisdiction, and made by a legally constituted authority, shall be the responsibility of the Contractor and not requested or directed by the Consultant. Required inspection and testing shall be paid for by the Contractor and not be paid by the Owner, unless otherwise specified in the Contract Documents.
- .7 Inspection or testing performed exclusively for Contractor's convenience shall be the sole responsibility of the Contractor, and will not be paid for by the Owner.
- .8 Inspection and testing schedule:
 - .1 Prepare schedule for inspection and testing by advance discussion with the selected inspection and testing company to determine the time required for the inspection and testing company to perform its tests and to issue each of its findings, and allow for required time in the construction schedule.
 - .2 Correlate the inspection and testing schedule with the construction progress schedule specified under Section 01 33 00 and accommodate and allow for time required for inspection and testing, including laboratory testing, in the construction progress schedule.
- .9 The inspection and testing service does not relieve the Contractor of its responsibility to perform regular shop and site inspection, and quality control of production.

1.3 INDEPENDENT INSPECTION AND TESTING AGENCIES

- .1 Independent Inspection and Testing Agencies may be engaged by the Owner for the purpose of inspecting and/or testing portions of the Work. Costs shall be covered by the cash allowance set out for this purpose in accordance with Section 01 21 00 Allowances.
- .2 The Contractor shall provide equipment as required for executing inspection and testing by the appointed agencies.
- .3 The employment of Independent Inspection and Testing Agencies does not relieve the Contractor of its responsibility to perform the Work in accordance with the Contract Documents.
- .4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain the full degree of the defect. The Contractor will correct the defect or irregularity with no increase in the Contract Time and such correction will not be considered or approved as a change in the Work.
- .5 The Contractor will be responsible for paying the costs for re-testing and re-inspection of work corrected in accordance with paragraph 1.4. (below) which costs will not be considered or approved as a change in the Work and will not be charged against the cash allowance for independent inspection and testing.

1.4 ACCESS TO THE WORK AND COOPERATION

- .1 The Contractor shall allow the Independent Inspection and Testing Agencies access to the Work, wherever the Work is in progress, or wherever Products, materials, or equipment are stored prior to shipping, including to off-site manufacturing and fabrication plants.
- .2 Cooperate to provide reasonable facilities for such access.
- .3 Provide inspection company with materials and installation information as required and/or requested.
- .4 Cooperate with inspection and testing companies and give adequate notification of any changes in source of supply, additional work shifts and any other proposed changes.
- .5 No Product nor part of the Work shall be installed before it is tested when a test is specified or required, nor shall work be executed where a test or inspection is required and the inspector cannot attend.
- .6 Supply labour required to assist inspection and testing company in sampling and making tests.
- .7 Repair work damaged as a result of inspection and testing work.
- .8 Cost of above labour and material shall be borne by the Contractor.

1.5 PROCEDURES

- .1 The Contractor shall notify the appropriate agency and the Consultant sufficiently in advance of the requirement for tests in order that attendance arrangements can be made reasonably.
- .2 Submit samples and/or materials required for testing, as specifically requested in the Contract Documents. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the progress of the Work.
- .3 The Contractor shall provide labour and facilities to obtain and handle samples and materials at the Place of the Work. Provide sufficient space to store and cure test samples.

1.6 DEFECTIVE WORK

- .1 The Contractor shall remove defective work, whether the result of poor workmanship, use of defective Products, or damage, and whether the defective work has been incorporated into the Work or not, which has been rejected by the Consultant as failing to conform to the Contract Documents and replace or re-execute in accordance with the Contract Documents.
- .2 The Contractor shall make good any Subcontractor's work damaged by such removals or re-executions at the Contractor's expense and promptly.
- .3 Removal, replacement or re-execution, and making good of defective work in accordance with paragraphs 1.7.1 and 1.7.2 (below) will not be considered or approved as a change in the Work.
- .4 If, in the opinion of the Consultant, it is not expedient to correct the defective work or the work not performed in accordance with the Contract Documents, the Owner may deduct from the monies otherwise due to the Contractor, the difference in value between the work performed and that required in the Contract Documents, the amount of which shall be determined by the Consultant.

1.7 REPORTS

- .1 Submit four copies of inspection and test reports promptly to the Consultant.
- .2 Provide copies to the Subcontractor whose work is being inspected and/or tested, or to the manufacturer/fabricator of the material being inspected and/or tested.
- .3 Copies of all inspection and test reports shall be submitted as part of the Project Records Documents in accordance with Section 01 77 00.

1.8 TEST AND MIX DESIGNS

- .1 Furnish test results and mix designs as required by the Contract Documents or as may reasonably be requested by the Consultant.
- .2 The procedures for submittal of test results and mix designs shall be the same as those required for shop drawings in accordance with Section 01 33 00 Submittals.
- .3 Test results and mix designs are to be considered as forming part of the Project Record Documents in the same manner as shop drawings in accordance with Section 01 77 00 Project Closeout.
- .4 The costs of tests and mix designs beyond those called for in the Contract Documents, or beyond those required by the authorities having jurisdiction, shall be appraised by the Consultant and may be authorized as a change in the Work.

1.9 MILL TESTS

- .1 Submit mill test certificates required by the Contract Documents.
- .2 The procedures for submittal of mill test certificates shall be the same as those required for shop drawings in accordance with Section 01 33 00 Submittals.
- .3 Mill test certificates are to be considered as forming part of the Project Record Documents in the same manner as shop drawings in accordance with Section 01 77 00.

1.10 MOCKUPS

- .1 The Contractor shall ensure that all Subcontractors and suppliers prepare mockups for work specifically requested in the Contract Documents. Any costs associated with the preparation of mockups shall be included in the Contract Price.
- .2 Construct in locations acceptable to the Consultant unless otherwise indicated in the Contract Documents.
- .3 Prepare the mockups for review by the Consultant with reasonable promptness and in an orderly sequence, so as not to delay the progress of the Work.
- .4 Failure to prepare mockups in ample time will not be considered sufficient reason for an extension of the Contract Time, and no claim for extension by reason of such default will be allowed.
- .5 Refer to the respective Specification Sections to determine whether the mockup may remain as part of the Work, or must be removed.

- .6 Work for which a mockup is required in accordance with the Contract Documents shall not proceed until the required mockup has been reviewed by the Consultant.

1.11 EQUIPMENT AND SYSTEMS

- .1 Submit testing, adjustment and balancing reports for mechanical and electrical systems as required by the Contract Documents, and in accordance with Divisions 21, 22, and 23 and Divisions 26, 27, and 28, as applicable.
- .2 The procedures for submittal of adjustment and balancing reports for mechanical and electrical systems shall be the same as those required for shop drawings in accordance with Section 01 33 00 Submittals.
- .3 Adjustment and balancing reports for mechanical and electrical systems are to be considered as forming part of the Project Record Documents in the same manner as shop drawings in accordance with Section 01 77 00 Project Closeout.

1.12 MANUFACTURER'S FIELD REVIEW

- .1 Where manufacturer's field review is specified, manufacturer's representative shall review the relevant parts of the work at the Place of the Work, or wherever such affected work is in progress, to ensure that work is being executed in accordance with manufacturer's written recommendations.
- .2 Manufacturer's field review is to ensure that the Products specified are being used in the Work and are being applied on surfaces prepared in accordance with their recommendations and the requirements of the Contract Documents.
- .3 Unless otherwise indicated in the Contract Documents, manufacturer's representative shall undertake a minimum of 1 field review, with additional reviews as deemed necessary by the manufacturer, to determine that the work of such sections is in accordance with the manufacturer's written recommendations.
- .4 The Contractor shall ensure that the manufacturer's representative submits a type-written report on manufacturer's letterhead within 2 Working Days after each field review. Report shall document manufacturer's representative's field observations and recommendations.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract and sections of Division 1.

1.2 SECTION INCLUDES

- .1 Temporary utilities.
- .2 Temporary facilities.
- .3 Temporary controls.

1.3 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities, facilities and controls in order to execute the Work expeditiously.
- .2 Arrange, obtain and pay cost for permits required for temporary facilities and controls.
- .3 Remove from the Place of the Work all such work after use.

1.4 TEMPORARY DRAINAGE AND DEWATERING

- .1 The Work includes the removal of collected groundwater and surface water accumulating from precipitation and groundwater infiltration throughout the course of the Work until date of Substantial Performance of the Work.
- .2 Provide temporary drainage and pumping facilities to keep excavations and the Place of the Work free from standing water.
- .3 Do not discharge onto adjacent properties. Do not discharge onto adjacent roadways where such discharge may interfere with the safe and normal use thereof or where catchbasins do not exist.
- .4 Keep drainage lines and gutters open. No flow of water shall be directed across or over pavements except through pipes or properly constructed troughs. Keep portions of the Work properly and efficiently drained during construction and until completion. Be responsible for disturbances, dirt and damage which may be caused by or result from water backing up or flowing over, through, from or along any part of the Work, or due to operations which may cause water to flow elsewhere.
- .5 Keep trenches and other excavations free of water. Remove water in a manner that will prevent loss of soil, and maintain the stability of existing soils.
- .6 Dispose of such water in a manner that will not be hazardous to public health and safety, private property, or to the Work.
- .7 Drainage of trenches or other excavation through storm drainage pipe will be allowed only with the express permission of the authority having jurisdiction.

- .8 When drainage is permitted in writing to be directed to existing catch basins, regularly and at Substantial Performance of the Work inspect such catch basins and remove accumulated debris and sediment.

1.5 SANITARY FACILITIES

- .1 Provide sufficient sanitary facilities for workers in accordance with local health authorities.
- .2 Maintain in clean condition and properly screened from public view.

1.6 WATER SUPPLY

- .1 Provide a continuous supply of potable water for use in the Work.
- .2 Arrange for connection with the appropriate utility company and pay costs for installation, maintenance, and removal.
- .3 Pay for utility charge at prevailing rates.

1.7 TEMPORARY HEATING AND VENTILATION

- .1 Provide and pay for temporary heating, cooling and ventilating required for the Work during the construction period, including attendance, maintenance and fuel.
- .2 Provide temporary heat and ventilation as required to:
 - .1 Facilitate continuous uninterrupted progress of the Work.
 - .2 Protect the Work and Products against damage and defacement caused by weather, harmful levels of temperature, humidity, and moisture.
 - .3 Provide ambient temperatures and humidity levels for proper storage, installation and curing of materials, in accordance with specified standards and manufacturer's requirements.
 - .4 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Construction heaters used inside buildings must be vented to the outside or be flameless type. Solid fuel salamanders are not permitted.
- .4 Maintain temperatures of minimum 10°C in areas where the Work is in progress, unless indicated otherwise in the specification sections.
- .5 Ventilate heated areas and keep building free of exhaust or combustion gases.
- .6 Heat shall be uniformly distributed to avoid hot or cold areas or excessive drying.
- .7 Make good any damage caused by inadequate or excessive heat. Such making good will not be considered or approved as a change in the Work.

1.8 TEMPORARY POWER AND LIGHT

- .1 Arrange for temporary power required during construction for the proper execution of the Work and the safe and proper operating of power tools. Temporary power to be in accordance with Divisions 26, 27, and 28.
- .2 Arrange for connection with the appropriate utility company. Pay costs for any required permits, for installation, maintenance, and removal.
- .3 Pay for utility charge at prevailing rates.
- .4 Abide by the rules of the Canadian Electrical Code.
- .5 Maintain in good working order throughout the course of the Work.

1.9 TEMPORARY TELEPHONE

- .1 Provide and pay for a temporary telephone, to be located in the site office, and available for use by the Owner, Consultant, and Subcontractors.
- .2 The Contractor shall pay all service and local use charges for the telephone, including installation and removal on completion of the Work. Long distance charges shall be paid to the Contractor by the person or company making the call.

1.10 HOISTING

- .1 Provide, operate and maintain any hoists/cranes required for moving of workers, materials and equipment.
- .2 Hoists/cranes are to be operated by a qualified operator only. Proof of operator's qualification shall be provided upon request.

1.11 SITE STORAGE AND OVER LOADING

- .1 Confine the Work and the operations of workers to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with Products or construction machinery and equipment.
- .2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.

1.12 SITE OFFICE

- .1 Provide a weathertight, lockable office for the use of the Contractor, Subcontractors, the Consultant, engineers, and the Owner when at the Place of the Work, and for the purposes of site meetings.
- .2 The site office shall have heat, light, and ventilation from sources as outlined above.

- .3 Provide a meeting table, shelving, file cabinets, and the like, suitable for the storage and review of the Contract Documents, shop drawings, Change Orders, Supplemental Instructions, and all other record documents as required by the Contract Documents and by the authorities having jurisdiction.
- .4 The site office shall not be used for the storage of Products, or construction machinery or equipment.

1.13 EQUIPMENT, TOOL, AND MATERIAL STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds at the Place of the Work in a manner to cause the least interference with the Work.

1.14 CONSTRUCTION SIGN

- .1 If a painted plywood sign is supplied to the Contractor by the Owner for installation at the Place of the Work during the course of the Work, then Contractor is to supply and install nominal 100 mm x 100 mm wood posts and framing, and is to fix the sign to the framing.
- .2 The maximum size of the sign shall be 1200 mm x 2400 mm.
- .3 No other signs, other than for safety, caution, or instruction, will be permitted.

1.15 HOARDING

- .1 Provide hoarding and barricades as and where required by authorities having jurisdiction or required to protect the public, workers, and public and private property from injury or damage.
- .2 Include for the provision of overhead protection and temporary exits and exit signs as may be required during the course of the Work.
- .3 Include for the provision of temporary gates and/or doors to provide restricted access to the Place of the Work as required.

1.16 WEATHER ENCLOSURES

- .1 Provide weathertight closures to unfinished door and window openings, tops of shafts, and other openings in floors and roofs.
- .2 Close-off floor areas where walls are not finished, seal-off other openings, and enclose building interior work area for temporary heat.

1.17 DUST TIGHT SCREENS

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work, and the public.
- .2 Maintain and relocate protection until such work is complete.

1.18 PROTECTION OF BUILDING FINISHES AND EQUIPMENT

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of the Work.
- .2 Contractor will be held responsible for damage due to lack of, or improper, protection, and will be required to make good any such damage. Such making good will not be considered or approved as a change in the Work.

1.19 SNOW REMOVAL

- .1 Allow no accumulation of ice and snow within the Place of the Work. There shall be no use of salt for de-icing in areas of building work.
- .2 Remove snow from access routes to the Work to maintain uninterrupted progress of the Work.

1.20 TRAFFIC CONTROL AND ROAD MAINTENANCE

- .1 Do not block roads or impede traffic. Keep construction traffic to designated roads only.
- .2 Provide flagperson to direct traffic as required.
- .3 Provide a hard surface area at the Place of the Work for cleaning down trucks prior to entry onto municipal roads or private roads outside of the Place of the Work.
- .4 Keep public and private roads free of dust, mud and debris resulting from truck, machinery and vehicular traffic related specifically to this Project, for the duration of Work.
- .5 Clean roads regularly, public or private. Wash down and scrape flush roads at least daily when earth moving operations take place. Maintain public property in accordance with requirements of Authorities Having Jurisdiction.

1.21 SECURITY

- .1 The Contractor shall be solely responsible for securing the Place of the Work and the Work, and for securing areas used for the storage of Products or construction machinery and equipment. The Owner shall have no responsibility in this regard.
- .2 Provide and maintain security lighting.
- .3 Provide and maintain temporary locks. Premises to be locked after working hours.

1.22 DESIGN AND SAFETY REQUIREMENTS FOR TEMPORARY FACILITIES

- .1 Be responsible for design, erection, operation, maintenance and removal of temporary structural and other temporary facilities. Engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform these functions where required by law or by the Contract Documents; and in cases where such temporary facilities and their method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.
- .2 Engage and pay for a Professional Engineer to design and supervise construction and maintenance of hoardings, covered ways, protective canopies and project sign(s). Designs provided by Consultant or Owner for such work cover general appearance only.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract and sections of Division 1.

1.2 SECTION INCLUDES

- .1 Product quality, availability, and delivery, storage, and handling.
- .2 Existing facilities.
- .3 Workmanship, coordination, and fastenings.
- .4 Manufacturer's instructions.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 The Contractor is to be responsible for the costs of transportation of the Products required in the performance of the Work.
- .2 Transportation costs of Products supplied by the Owner will be paid for by the Owner.
- .3 The Contractor shall be responsible for unloading, handling, and storing all Products in accordance with the manufacturers' requirements and recommendations, and in a manner to prevent damage, adulteration, deterioration and soiling.
- .4 Store packaged or bundled Products in original and undamaged condition, with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.
- .5 Store Products subject to damage from weather in weathertight enclosures.
- .6 Store any cementitious products clear of earth or concrete floors, and away from walls.
- .7 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .8 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .9 Removal and replacement of Products damaged due to improper delivery, storage, or handling will not be considered or approved as a change in the Work.

1.4 CONCEALMENT

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls, and ceilings, except where indicated otherwise.
- .2 Before installation, inform the Consultant if there is a contradictory situation where concealment is not possible. Install as required by the Consultant.

1.5 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace the parts or portions of the Work identified as defective or unacceptable. Coordinate adjacent affected work as required.
- .2 Perform remedial work using specialists familiar with the materials affected. Perform the work in such a manner as to neither damage nor endanger any other portion of the Work.
- .3 Any remedial work required will not be considered or approved as a change in the Work.

1.6 LOCATION OF FIXTURES

- .1 Consider the location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform the Consultant of a conflicting installation and proceed as directed.

1.7 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour, and finish as adjacent materials, unless specifically indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the Contract Documents.
- .4 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.8 PROTECTION OF WORK IN PROGRESS

- .1 Adequately protect items of Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant. Such removal and replacement, or repair, will not be considered or approved as a change in the Work.
- .2 Prevent overloading of any part of the Work. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without the written approval of the Consultant.

PART 2 - PRODUCTS

2.1 QUALITY

- .1 Products, construction materials and equipment, and articles (any of which may be referred to as "Products" throughout the Contract Documents) incorporated in the Work shall be new, not damaged or defective, and of the best quality (compatible with the Contract Documents) for the purpose intended. If requested, the Contractor shall furnish evidence as to the type, source, and quality of the Products provided.
- .2 Defective Products, whenever identified prior to the completion of the Work, will be rejected, regardless of previous inspections or reviews. Inspection or review of the Work in progress by the Consultant, the Owner, or Independent Inspection and Testing Agencies does not relieve the Contractor of responsibility for the quality of the Products or Work, but, rather, is a precaution against oversight or error. The Contractor shall remove and replace defective Products at the Contractor's own expense and be responsible for any delays and expenses caused by rejection, which delays and expenses will not be considered or approved as changes in the Work.
- .3 Should any dispute arise as to the quality or fitness of the Products, the decision rests solely with the Consultant and shall be based upon the requirements and intent of the Contract Documents.
- .4 Unless otherwise indicated in the Contract Documents, maintain uniformity of manufacture and manufacturer for any particular or similar item or items throughout the Work.
- .5 Permanent labels, trademarks, and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in the mechanical/electrical room, or as may be provided otherwise in the Contract Documents.

2.2 AVAILABILITY

- .1 While it was the intent of the Bid Documents and procedures, and the goal of the competitive Bid process that led to the formation of this Contract, to provide unlimited competition to Provide Products, certain Products specified or indicated are accompanied by reference to brand names, proprietary names, trade marks, catalogue numbers, or catalogue designations or symbols, indicated as "acceptable products," "acceptable materials," or "acceptable manufacturers". In such cases, the name of a distributor, supplier, or a dealer is sometimes given to assist the Contractor in finding a source of supply.
- .2 The naming of a source of supply does not relieve the Contractor of the responsibility of finding his or her own source of supply. If unable to obtain the specified Product, the Contractor shall supply a substitute Product equal to, or superior to, the Product specified and in accordance with the procedures and requirements of Section 01 25 00, which substitution will not be considered or approved as a change in the Work. Should the Contractor be unable to obtain a substitute Product equal to, or superior to, the specified Product, and the Owner accepts an inferior Product, the Contract Price shall be adjusted accordingly in an amount determined by the Consultant, in consultation with the Contractor, and in accordance with Section 01 25 00 Contract Modification Procedures.
- .3 The use of Product brand names, proprietary names, trade marks, catalogue numbers, or catalogue designations or symbols does not preclude the Contractor from proposing substitutions for the named Products, provided such proposals are in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in the Contract Documents, install Products in accordance with manufacturer's printed installation or application instructions. Do not rely on labels or enclosures supplied with Products. Obtain printed instructions directly from manufacturers.
- .2 Notify the Consultant in writing, of conflicts between the Contract Documents and manufacturer's instructions.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes the Consultant to require removal and re-installation at no additional cost to the Owner.
- .4 Manufacturers' representatives shall have access to the Work at all times. Contractor shall render assistance and facilities for such access in order that the manufacturers' representatives may properly perform their function.

3.2 GALVANIC/DISSIMILAR METAL CORROSION

- .1 Insulate dissimilar metals from each other by suitable plastic strips, washers or sleeves to prevent galvanic corrosion where conductive liquid or electrolyte (rainwater or condensation) exists.

3.3 WORKMANSHIP

- .1 General:
 - .1 Execute the Work using workers experienced and skilled in the respective duties for which they are employed.
 - .2 Do not employ an unfit person or anyone unskilled in their required duties.
 - .3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with Consultant, whose decision is final.
 - .4 Upon request by the Consultant, submit proof, in the form of CCDC 11 - Contractor's Qualification Statement, of qualifications of Subcontractors to verify Subcontractor's qualifications and experience meet or exceed the requirements of the Contract Documents.
 - .1 If, upon review of the Contractor's Qualification Statement, it is found that the Subcontractor does not meet the qualification requirements specified in the Contract Documents pertaining to the parts of the Work for which the Subcontractor has been retained, the Contractor shall replace the unqualified Subcontractor with a qualified Subcontractor, satisfactory to the Contractor and the Owner, at no additional cost to the Owner and at no increase in the Contract Time.
- .2 Coordination:
 - .1 Ensure cooperation of workers in layout of the Work. Maintain efficient and continuous supervision.
 - .2 Be responsible for coordination and placement of openings, sleeves and accessories.

.3 Concealment:

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Consultant of any contradictory situation. Install as directed by Consultant.

.4 Cutting and remedial work:

- .1 Perform cutting and remedial work required to make parts of the Work come together. Coordinate the Work to ensure this requirement is maintained. Obtain permission from Consultant before commencing any cutting. Refer also to requirements of Section 01 73 29.

.5 Location of fixtures:

- .1 Consider location of fixtures, access panels, outlets and mechanical and electrical items indicated as approximate only. Locate fixtures, and the like approximately; Architectural drawings will relate these items to known dimensions, such as ceiling tile grid or wall locations and the like.
- .2 Obtain Consultant's acceptance for precise locations of fixtures, access panels, outlets, mechanical, and electrical items.
- .3 Consultant reserves the right to relocate electrical outlets and mechanical fixtures at a later date, but prior to installation, without cost, provided that the relocation per outlet does not exceed 3050 mm (10') from the original location.
- .4 Inform Consultant of conflicting installations. Install only as directed by Consultant.

.6 Fastenings:

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action and corrosion between dissimilar metals and materials.

.7 Protection of work in progress:

- .1 Take reasonable and necessary measures, including those required by authorities having jurisdiction, to Provide protection.
- .2 Adequately protect parts of the Work completed or in progress. Parts of the Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no additional cost to the Owner.
- .3 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member without written permission of Consultant, unless specifically indicated. Refer also to Section 01 73 29.
- .4 Adequately protect finished flooring from damage. Take special measures when moving heavy loads or equipment on them.
- .5 Keep floors free of oils, grease or other materials likely to discolour them or affect bond of applied surfaces.
- .6 Protect work of other Subcontractors from damage while doing subsequent work. Damaged work shall be made good by appropriate Subcontractors but at expense of those causing damage.

- .7 Protect existing buildings, curbs, roads and lanes. If, during the Work, any buildings, curbs, roads or lanes are damaged, bear costs for repairs.
- .8 Existing utilities:
 - .1 When breaking into or connecting to existing services or utilities, execute the Work at times approved by Owner, with a minimum of disturbance to Owner's ongoing operations, the Work, and traffic.
 - .2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction and stake or otherwise record location of capped service.
- .9 Protection of mechanical and electrical Products or materials:
 - .1 Wrap in protective plastic and seal mechanical and electrical items of mechanical and electrical equipment prior to and during for shipment, storage at the Place of the Work and after installation.
 - .2 Remove protective coverings only to the extent required for installation of the items. Re-install protection immediately following installation.
 - .3 Remove protective coverings in stages, as work areas are completed, or when directed by Consultant.
- .10 Operational requirements: Operable Products shall be Provided fully operational and ready for intended use.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract and sections of Division 1.

1.2 SECTION INCLUDES

- .1 Requirements and limitations for cutting and patching the Work.

1.3 SUBMITTALS

- .1 Submit a written request in advance of cutting or alteration which affects:
 - .1 The structural integrity of any element of the Work;
 - .2 The integrity of weather-exposed or moisture-resistant elements;
 - .3 The efficiency, maintenance, or safety of any operational element; and,
 - .4 The visual qualities of sight-exposed elements.
- .2 Include in the request:
 - .1 Identification of the Work;
 - .2 The location and description of the affected work;
 - .3 A statement on the necessity for cutting or alteration;
 - .4 A description of the proposed work and products to be used;
 - .5 Any alternatives to cutting and patching; and,
 - .6 The date and time the work will be executed.

1.4 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting the performance of the Work.
- .3 Beginning of cutting and patching shall be taken to mean acceptance of the existing conditions.
- .4 Provide supports to assure the structural integrity of the surrounding elements as well as devices and methods to protect other portions of the Work from damage.
- .5 Provide protection from weather for areas that may be exposed by uncovering work.

1.5 PERFORMANCE REQUIREMENTS

- .1 Perform cutting, fitting, and patching to complete the Work.

- .2 Fit the several parts together to integrate with other work.
- .3 Remove and replace defective and non-conforming work.
- .4 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical work.
- .5 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
- .6 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements and sight-exposed surfaces.
- .7 Cut rigid materials using power saw or core drill. Pneumatic or impact tools shall not be allowed.
- .8 Restore work with new Products in accordance with the requirements of the Contract Documents.
- .9 Fit work airtight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- .10 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material, full thickness of construction element.
- .11 Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection. For an assembly, refinish entire unit.
- .12 If any field cutting is performed not in accordance with the above, the Contractor shall be held responsible for any failure or distress from such cutting.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Work of this section consists of the following:
 - .1 Requirements for Construction IAQ Management: During Construction Operations.
 - .2 Requirements for Construction IAQ Management: Before Occupancy.

1.2 PRE-CONSTRUCTION MEETING

- .1 After award of Contract and prior to the commencement of the Work, schedule and conduct a meeting with Owner and Consultant to discuss the proposed IAQ Management Plan and to develop mutual understanding relative to intent and details of the plan.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 and Section 01 81 13.
- .2 Indoor Air Quality (IAQ) Management Plan:
 - .1 Not less than 10 days before Pre-construction meeting, prepare and submit an IAQ Management Plan. Revise and resubmit Plan as required by Owner. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental. The Plan shall include, but not be limited to, the following:
 - .1 Describe any strategies for:
 - .1 Containing the Work area.
 - .2 Modifying HVAC operation
 - .3 Reducing emissions
 - .4 Intensifying Housekeeping
 - .2 Identify sources of indoor pollutants and describe how their impact will be minimized.
 - .3 Confirm which Pre-Occupancy compliance method will be employed (Baseline Testing or Building Flush-put or Building Flush-out Overlapping with Occupancy.)
- .3 Product data:
 - .1 Submit Product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).
- .4 Material Safety Data Sheets: Submit MSDS for inclusion in Operation and Maintenance Manual in accordance with Section 01 77 00 for the following products:
 - .1 Adhesives.
 - .2 Floor and wall patching/leveling materials.
 - .3 Caulking and sealants.
 - .4 Insulating materials.
 - .5 Fireproofing and firestopping.

- .6 Carpet.
- .7 Paint.
- .8 Clear finish for wood surfaces.
- .9 Lubricants.
- .10 Cleaning products.

PART 2 - PRODUCTS

[Not Used.]

PART 3 - EXECUTION

3.1 EXECUTION

- .1 During construction, comply with SMACNA IAQ Guidelines for Occupied Buildings under Construction (available from www.smacna.org/bookstore). This includes:
 - .1 HVAC Protection: to the greatest extent possible, isolate and/or shut down the return side of the HVAC system during construction. When ventilation system must be operational during construction activities, provide temporary filters.
 - .2 Source Control: Provide low and zero VOC materials as specified.
 - .3 Pathway Interruption: Isolate areas of work as necessary to prevent contamination of clean occupied spaces. Provide pressure differentials and/or physical barriers to protect clean or occupied spaces.
 - .4 Housekeeping: During construction, maintain project and building products and systems to prevent contamination of building spaces.
 - .5 Protect stored on-site and installed absorptive materials from moisture damage.
 - .6 Provide adequate ventilation during and after installation of interior wet Products and interior final finishes.
 - .7 Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction. Coordinate with work of Divisions 21, 22, and 23.
 - .8 Scheduling: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.
- .2 Construction IAQ Management Before Occupancy: Indoor Air Quality (IAQ) Baseline Testing:
 - .1 Upon completion of the commissioning and verification of the HVAC operation, and prior to Substantial Performance of the Work coordinate the commissioning activities as provided by commissioning consultant retained by the Region. Testing shall include:
 - .1 Perform testing for minimum 20 locations. Perform in the breathing zone, between 1.2m and 2.1m from the finished floor.
 - .2 Collect air samples on three consecutive days during normal occupied hours, with building operating at normal HVAC rates. Average the results of each three-day test

cycle to determine compliance or non-compliance of indoor air quality for each zone tested.

- .3 Sample and record outside air levels of formaldehyde and Total Viable Aerobic Count (TVAC) contaminants at outside air intake of each respective air handling unit simultaneously with indoor tests to establish basis of comparison for these contaminant levels.

- .3 Baseline IAQ shall conform to the following standards and limits:

- .1 Carbon Monoxide: not to exceed 9 ppm.
- .2 Carbon Dioxide: set points not to exceed 800 ppm. Assess indoor Carbon Dioxide concentrations in accordance with ASTM D6245.
- .3 VOCs and particulates: monitor VOCs (volatile organic compounds) in indoor air in accordance with ASTM D6345. Indoor room air concentration levels, emission rates, and qualities of the listed contaminants shall not exceed the following limits:

MAXIMUM INDOOR AIR CONCENTRATION STANDARDS

INDOOR CONTAMINANTS	ALLOWABLE AIR CONCENTRATION LEVELS
FORMALDEHYDE	<20 MICROGRAMS PER CUBIC METRE ABOVE OUTSIDE AIR CONCENTRATIONS
TOTAL VOLATILE ORGANIC COMPOUNDS	<200 MICROGRAMS PER CUBIC METRE ABOVE OUTSIDE AIR CONCENTRATIONS
4-PHENYLCYCLOHEXENE (4-PC)	<3 MICROGRAMS PER CUBIC METRE
TOTAL PARTICULATES (PM)	<20 MICROGRAMS PER CUBIC METRE
REGULATED POLLUTANTS	<NAAQS

- .4 If any test fails the standard, the Contractor is responsible to ventilate the building with 100 percent outside air until the building passes both air quality tests and duct inspections. Retesting shall be performed at no additional expense to the Owner.
- .5 Replace all filtration media immediately prior to Occupancy. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999 for media installed at the end of construction.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 All materials generated from the Work are to be managed in accordance with Ontario Regulation 347 "General – Waste Management Regulation R.R.O. 1990 (as amended) and Ontario Regulation 102/94 "Waste Audits and Waste Reduction Work Plans" and Ontario Regulation 103/94 "Industrial, Commercial and Institutional source Separation Programs" of the Ontario Environmental Protection Act (EPA).

1.2 DEFINITIONS

- .1 Waste Reduction Plan (WRP): Relates to the tracking and auditing of actual waste generated from the Work. The Plan consists of identified and unidentified construction waste materials that are to be salvaged, recycled and diverted from landfill and involves a series of ongoing activities to separate reusable and recyclable waste materials into material categories from other types of waste at point of generation. See sample appended to this section.
- .2 Record of Disposal and Recycled Materials (RDRM): Identifies and tracks, on a monthly basis, all waste materials and verifies quantities of all recycled materials and final disposal locations.
- .3 Waste Management Coordinator (WMC): Designated individual who is in attendance on- site full or part-time. Contractor is to designate, or have designated, individuals from each Subcontractor to be responsible for waste management related to their Trade and for coordinating activities with the WMC.

1.3 DESCRIPTION OF WORK

- .1 Salvage, recycle and divert from landfill a minimum of 95% of all construction waste generated from the Work. Identify significant generic types of products, work, or requirements that will achieve this goal. Develop a Waste Reduction Plan and participate in Materials Source Separation Program. Provide the documentation specified in this Section.
- .2 Comply with the requirements of the latest edition of the Ontario Environmental Protection Act and 3-R's Regulations related to source separation (recycling) programs and waste audits and waste reduction work plans on construction sites.
- .3 Take an active role in implementing environmentally sound business practices and producing goods and services that lessen burden on environment in production, use and final disposition. Support implementation of reduction, re-use and recycling strategies and use of environmentally sound products. Reduce or eliminate excessive packaging and promote use of environmental responsible packaging practices.
- .4 Enter into agreements with local recycling companies and haulers for all anticipated recycled materials.

1.4 WASTE REDUCTION PLAN

- .1 Within fourteen (14) days after receipt of Notice to Proceed and prior to any waste removal from the Project, develop and submit to the Owner for review a Waste Reduction Plan on sample appended to this section.

.2 Waste Reduction Plan to Include:

- .1 Types and estimated quantities of salvageable materials that are expected to be generated during demolition.
 - .2 Types and estimated quantities of recyclable materials expected to be generated during construction including but not limited to those listed below.
 - .3 Contracting with a deconstruction specialist to salvage all or most materials generated.
 - .4 Selective salvage as part of demolition contractor's work.
- .3 The methods to be used to recycle these materials. Methods shall include one or more of the following options:
- .1 Requiring Subcontractors to take materials back for recycling at a permitted facility.
 - .2 Contracting with a full service recycling service.
 - .3 Processing and reusing materials on-site.

1.5 DOCUMENTATION

- .1 Final Waste Reduction Plan: Once the Owner has accepted the Waste Reduction Plan, submit, within 14 working days, a Final Waste Reduction Plan.
- .2 To each application for Progress Payment attach a record of the amount of material disposed (in tons) and the amount of each material recycled (in tons) using form appended to this section as Sample Record of disposal and Recycled Materials. For co- mingled materials, include weight tickets from the recycling facility and verification of the recycling rate for mixed loads at the facility.
- .3 Be responsible for providing such information whether directly involved in recycling the materials or not.

1.6 SUBMITTALS

- .1 Submit spreadsheet of Record of Disposal and Recycled Materials following sample form appended to this section as Sample Record of Disposal and Recycled Materials.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Supply all equipment as necessary to complete work.

PART 3 - EXECUTION

3.1 DEMOLITION AND NEW CONSTRUCTION

- .1 Recycle the items listed in Sample Record of Disposal and Recycled Materials appended to this Section (on or off-site).

- .2 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials.
- .3 Provide containers to deposit reusable and/or recyclable materials.
- .4 Locate containers in locations to facilitate deposit of materials without hindering daily operations.
- .5 Collect, handle, store on-site and transport off-site, salvaged materials in separate condition. Transport to approved and authorized recycling facility.
- .6 Use safety meetings, signage, and subcontractor agreements to communicate the goals of the Waste Reduction Plan.
- .7 Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- .8 Comply with Division 1 requirements for controlling dust and dirt, environmental protection, and noise control.

3.2 DIVERSION OF MATERIALS

- .9 Maximize the amount of materials that can be recycled, salvaged or reused. An emphasis shall be placed on, but shall not be limited to, wood, steel and metal, concrete, brick, gypsum board, etc. in accordance with Ontario Regulations 102/94 and 103/94 and as described herein.
- .10 Following the list on Sample Record of Disposal and Recycled Materials appended to this section, separate materials from general waste stream and stockpile in separate piles or containers to approval of Consultant and consistent with applicable fire regulation. Mark containers or stockpile areas. Provide instruction on disposal practices.

3.3 SUPPLEMENTS

- .1 The documents listed below, attached following END OF SECTION, form part of this Section:
 - a. Sample Construction Waste Reduction Plan.
 - b. Sample Record of Disposal and Recycled Materials.

END OF SECTION

SAMPLE CONSTRUCTION WASTE REDUCTION PLAN

Company	
Project Name	Project Size (m2)
Goals:	

1. Analysis of Expected Job-Site Waste:

Drywall – Wood – Paper - Concrete Debris – Cardboard - Asphalt Debris - Foam board – Plastic – Plywood – Gravel – Dirt - Trees, branches, and other organic products mixed with dirt - Metals, including rebar, brass, chrome, aluminum, copper, metal stud scrap, screws, nails.

2. Measurement

Rough quantities will be measured in tonnes where possible, and in cubic yards and pounds where necessary and converted to tonnes afterward. The recycling coordinator estimates a total of _____ tonnes of material will be produced through our activities on this job site, and the _____ % of these materials will be recycled, reused, or salvaged.

3. Removal Methods

We have entered into an agreement with _____, a wasteless disposal service, to provide recycling services for the duration of the project. The disposal bin is set up as the main recycling station. Drop boxes will be used for individual materials as space quantities allow. Projected savings for all debris will be approximately \$ _____. All materials will be taken to _____ recycling depot located at _____. Mixed waste drop boxes will be separate by the disposal company off-site and recycled to the greatest extent possible. At their location, the disposal company _____ is currently recycling 90% - 100% of their intake.

4. Removal Costs and Revenues

The current costs and revenues in Halton Region for recycling construction waste materials are as follows:

Material	Cost or Revenue / 40 cubic yard bin
Asphalt and Concrete	_____ <\$75> _____ cost
Commingled Recyclables	_____ <\$100> _____ cost
Wood	_____ <\$100> _____ cost
Light scrap metal	_____ <\$100-120> _____ revenue
Cardboard	_____ <\$90-105> _____ revenue

5. Options for Disposal

To the greatest extent practicable, all reusable items will be salvaged. The demolition and deconstruction plans will address in detail the measures to be taken. Items to be reused include (but are not limited to):

Siding – Roof decking – Timber and beams – Windows – Doors and Hardware – Mechanical and Electrical equipment – Concrete (pulverize and use as base rock) – Landscaping and organic materials (such as mulch and compost). All salvageable materials will be donated to a local <charity> <organization>, or sold to a <used building supplier>. Any materials that cannot be retained or salvaged will be recycled.

Furnishings, equipment, doors and hardware, electrical, mechanical will be salvaged to the greatest extent possible. Asphalt and concrete will be ground as appropriate for reuse. Dirt and gravel will be trucked to reclamation or reuse sites as appropriate for the material. Any wood landscape waste to be chipped and mulched for reuse on site. All non-woody organic materials to be composted for reuse on site. Mixed dry-waste, including wood, drywall, metal, cardboard, plastic and Styrofoam will be recycled.

6. Materials Handling Procedures

An area will be designated for recycling and separation activities. The interior of the construction site office will have recycling containers for paper, glass, cardboard and aluminum. Drop boxes will be used adjacent to the new building as appropriate. Labels directing the separation of materials will be posted at the construction trailer and on each of the drop boxes. Construction debris will be continually picked up during the day and placed into the proper recycling or disposal bins.

The Project Manager will instruct each Trade's Supervisor and all workers as to proper waste management and recycling practice. This instruction will include hazardous wastes generated through chemical use and through demolition. We will incorporate waste reduction and recycling instructions into each Trade's Contract requiring all Trades to cooperate fully.

7. Personnel

The Project Manager will supervise the implementation of this plan in the field by the following individuals who will:

Assist with oversight and monitoring of the plan in the field. Organize and keep recycling area tidy.
Coordinate recycling bin pick-up and removal.
Receive waste production and recycling information from each Trade and vendor. Compile and report of all waste material information sheets.
Review waste management plan results.

The Construction Waste Management Reporting Sheet will be submitted to _____ at the Trade meeting and on a biweekly basis, no later than 15 days after month end. Each trade will be responsible for ensuring the accuracy of this information.

8. Hazardous Wastes

Hazardous wastes will be separated, labeled, stored and recycled or disposed of according to local regulations, worker safety regulations, and provincial and federal regulations under the direction of our safety Officer. Where practical, efforts will be made to reuse hazardous materials like paints, adhesives and other products.

SAMPLE RECORD OF DISPOSAL AND RECYCLED MATERIALS

Company	Contact Person	Phone: email:
Project Location	Waste Contractor	Report Start Date: Report End Date:

Material Type	Minimum Diversion %	Actual Diversion %	Material Destination	Weight
Acoustic Ceiling Tile	95			
Aluminum	95			
Asphalt	95			
Cardboard	95			
Concrete	100			
Copper	95			
Drywall	95			
Ductwork	100			
Fill-clean	100			
Fill – other	100			
Fluorescent lamps and ballasts	N/a			
General waste – office paper, pop cans, bottles	75			
Glass	95			
Land-clearing debris	100			
Plastic - general	75			
Plastic -packaging	95			
Steel	95			
Topsoil	100			
Trees	95			
Wood	95			

I, _____ declare this report is accurate to the best of my knowledge.
Submitted on this _____ day of _____, 20_____.
Signed: _____

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the Contract and sections of Division 1.
- .2 No less than three percent (3%) of the Contract Price is to be assigned as the cost for the preparation and delivery to the Consultant of the Project Record Documents. This value is to be indicated on the schedule of values in accordance with Section 01 33 00.
- .3 The review to determine Substantial Performance of the Work will not take place until the documents and products described in this section have been received by the Consultant.

1.2 SECTION INCLUDES

- .1 Cleaning.
- .2 Project record documents.
- .3 Spare parts and maintenance materials.
- .4 Systems demonstration.
- .5 Substantial Performance of the Work and takeover procedures.

1.3 PROGRESSIVE CLEANING

- .1 Maintain the Work in a tidy condition, free from the accumulation of waste products and debris.
- .2 Remove waste materials and debris from the Place of the Work at the end of each Day.
- .3 Clean interior areas prior to start of finish work and maintain these areas free of dust and other contaminants during finishing operations.

1.4 FINAL CLEANING

- .1 Remove waste products and debris and leave the Work clean and suitable for occupancy by the Owner.
- .2 Remove surplus Products, tools, construction machinery, and equipment.
- .3 Leave work broom clean before review to determine Substantial Performance of the Work begins.
- .4 Clean and polish all interior and exterior glass, mirrors, hardware, tile, stainless steel, aluminum, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures.
- .5 Replace broken, scratched, or disfigured glass and/or mirrors in accordance with the Contract Documents. Such replacement will not be considered or approved as a change in the Work.
- .6 Remove stains, spots, marks, and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, and walls.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres, and screens.

- .8 Wax, seal, shampoo, or prepare floor finishes as recommended by the relevant flooring manufacturer.
- .9 Broom clean and wash exterior walks, steps, and surfaces.
- .10 Remove dirt and other disfigurations from exterior surfaces.
- .11 Remove surplus mortar, caulking compound, and the like, from all interior and exterior surfaces of the building.

1.5 PROJECT RECORD DOCUMENTS

- .1 Operation and Maintenance Manuals:
 - .1 Fifteen (15) days prior to applying for the review to determine Substantial Performance of the Work, the Contractor shall submit to the Consultant three (3) copies of the Operation and Maintenance Manuals.
 - .2 If revisions to the Operation and Maintenance Manuals are required, two (2) copies will be returned to the Contractor by the Consultant, with comments attached, for re-submission prior to undertaking the review to determine Substantial Performance of the Work.
 - .3 Manuals are to be re-submitted to the Consultant for review once any required revisions have been made.
 - .4 Manuals shall contain operational information on equipment, cleaning and lubrication schedules, filters, overhaul and adjustment schedules, and all other operation and maintenance information as required by the Contract Documents, including all warranties.
 - .5 Organize the data in the form of an instructional manual in binders of commercial quality, with hard covers, 8-1/2" x 11" in size, with a maximum ring size of 2".
 - .6 On the cover, identify each binder with the typed or printed title "Operation and Maintenance Manuals," listing also the title of the project, and identifying the subject matter of the contents.
 - .7 Arrange the contents into applicable categories of work, parallel to the sections of the specifications.
 - .8 When multiple binders are used, correlate data into consistent related groupings.
 - .9 Provide tabbed fly-leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .10 If drawings are included, provide with reinforced punched binder tab, bind in with text, folding drawings of a larger size to size of text pages.
 - .11 For each Product or system, list names, addresses, and telephone numbers of Subcontractors and Suppliers, including a local source of supplies and replacement parts.
 - .12 Product Data: mark each sheet to clearly identify specific products and component parts, as well as data applicable to the installation, and delete inapplicable information.
- .2 As-Built Documents:
 - .1 Prior to the commencement of the Work, the Consultant will provide the Contractor with a set of Contract Documents for the purpose of recording changes in the Work, as well as the actual locations of concealed services.

- .2 Accurately and neatly record deviations from the Contract Documents caused by conditions at the Place of the Work and changes in the Work as the Work progresses.
 - .3 Record information by means of red felt-tip marker.
 - .4 Identify each document as "As-Built Copy." Maintain in good condition in the site office and make available for review by the Consultant and the Owner upon request.
 - .5 In the specifications, legibly mark each item to record actual construction, including manufacturers, trade names, and catalogue number for each product actually installed, particularly optional items and substitute items.
 - .6 Mechanical and electrical records shall be kept by the respective Subcontractors (who shall receive an extra copy each of the mechanical and electrical drawings and specifications for this purpose from the Contractor), and shall be delivered to the Contractor who shall transfer the information to the As-Built Drawings.
 - .7 Contractor shall provide As-Built Survey once foundations are completed to ensure building is situated as required. Drawing shall be submitted in PDF and CAD Format. Contractor shall provide AS-Built site survey upon the completion of the project in PDF and CAD format.
 - .8 On completion of the construction work, and fifteen (15) days prior to applying for the review to determine Substantial Performance of the Work, the Contractor shall submit to the Consultant the complete As-Built Documents.
- .3 Shop Drawings and Inspection Reports:
- .1 Fifteen (15) days prior to applying for the review to determine Substantial Performance of the Work, the Contractor shall submit to the Consultant copies of all reviewed shop drawings including an inventory of the shop drawings submitted.
 - .2 Fifteen (15) days prior to applying for review to determine Substantial Performance of the Work, the Contractor shall submit to the Consultant copies of all inspection and testing reports bound together in one (1) volume and arranged in chronological sequence.

1.6 SPARE PARTS AND MAINTENANCE MATERIALS

- .1 At the time of submission of the Project Record Documents, or earlier if acceptable to the Consultant and the Owner, the Contractor shall submit to the Owner maintenance equipment for the various items, pieces of equipment, systems, or accessories required by the Contract Documents.
- .2 At the time of submission of the Project Record Documents, or earlier if acceptable to the Consultant and the Owner, the Contractor shall submit to the Owner extra materials for the various items, pieces of equipment, systems, or accessories required by the Contract Documents.
- .3 Spare parts, maintenance materials, and extra materials provided shall be new, not damaged or defective, and of same quality, manufacture, and manufacturer as of the Products provided in the Work. If requested, the Contractor is to furnish evidence as to the type, source, and quality of the Products provided.

- .4 Defective Products will be rejected, regardless of previous inspections. The Contractor is to replace such Products and such replacement will not be considered or approved as a change in the Work.
- .5 Store spare parts and maintenance materials in a manner to prevent damage or deterioration.

1.7 SYSTEMS DEMONSTRATION

- .1 Systems demonstrations to occur prior to the application for the review to determine Substantial Performance of the Work.
- .2 Preparation:
 - .1 Submit to both the Owner and the Consultant, a schedule of time and date for demonstration of each item of equipment and each system at least fifteen (15) Days prior to designated dates.
 - .2 Ensure that the services, apparatuses, and equipment are installed and complete, have been inspected, tested and adjusted, and are all in perfect operating condition.
 - .3 Verify the conditions for demonstration and instructions comply with requirements and that designated personnel are present.
- .3 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
 - .2 Instruct personnel in all phases of operation and maintenance using the Operation and Maintenance Manuals as the basis of instruction.
 - .3 Review the contents of the Operation and Maintenance Manuals in detail to explain all aspects of operation and maintenance.
 - .4 Prepare and insert additional data in Operation and Maintenance Manuals when the need for additional data becomes apparent during instructions.
- .4 Instruction Reports:
 - .1 Submit reports within five (5) Working Days after completion of demonstration, recording that demonstration and instructions have been satisfactorily completed. Give time and date of each demonstration, with a list of persons present.

1.8 SUBSTANTIAL PERFORMANCE AND TAKEOVER PROCEDURES

- .1 The Contractor shall conduct an inspection of the Work to identify deficiencies and defects, which shall be repaired as required. When the Contractor considers that the Work is substantially performed, the Contractor shall prepare and submit to the Consultant a comprehensive list of items to be completed or corrected and apply for a review by the Consultant to establish Substantial Performance of the Work. Failure to include an item on the list does not alter the responsibility of the Contractor to complete the Contract.
- .2 No later than ten (10) Working Days after the receipt of the Contractor's application, the Consultant and the Contractor will review the Work to identify any defect or deficiencies. If

necessary, the Consultant will tabulate a list of deficiencies to be issued to the Contractor for correction of same.

- .3 When the Consultant considers that the deficiencies and defects have been completed and that it appears that the requirements of the Contract Documents (as may have been amended during the Work) have been substantially performed, the Consultant will issue a certificate of Substantial Performance of the Work to the Contractor, stating the date of Substantial Performance of the Work. The Contractor must obtain the Region's approval of the Certificate of Substantial Performance prior to publication.
- .4 The Warranty Period shall commence in accordance with Article A-15 of the Agreement between Owner and Contractor.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by conditions of the Contract Documents and sections of Division 1.

1.2 GENERAL

- .1 Refer to Article A-15 of the Agreement between Owner and Contractor for the Warranty Periods provisions.
- .2 The Owner will give prompt notice in writing to the Consultant of any defects noted during the warranty periods(s) and the Consultant shall notify the Contractor promptly requesting him to remedy such defects.
- .3 A minimum of 30 Working Days prior to the expiration of the Warranty Period stipulated in Article A-15 of the Agreement between Owner and Contractor, the Owner, the Consultant and the Contractor, shall conduct an inspection of the Work. The Contractor shall promptly remedy any defects due to faulty materials or workmanship.
- .4 Use of permanent heating system for temporary heat shall not affect requirement that all warranties start on the date specified in Article A-15 of the Agreement between Owner and Contractor.
- .5 Prior to application for Substantial Performance of the Work, the Contractor shall formally assign to the Owner all extended warranties given by Subcontractors for their work on the project and such Subcontractors shall be formally advised of the assignment.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Conform to the requirements stated in the General Conditions, Supplementary Conditions and all addenda.

1.2 RELATED WORK

- | | | |
|----|--------------|------------------|
| .1 | Aggregates | Section 31 05 17 |
| .2 | Site Grading | Section 31 23 13 |

1.3 REFERENCES

- .1 ASTM D4791-89, Test Method for Flat or Elongated Particles in Coarse Aggregate.
- .2 OPSS 1001.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Allow continual sampling by Consultant during production.
- .3 Provide Consultant with access to source and processed material for sampling.
- .4 Install sampling facilities at discharge end of production conveyor to allow Consultant to obtain representative samples of items being produced. Stop conveyor belt when requested by the Consultant to permit full cross section sampling.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Clear stone for mud mat and along bottom of silt control fencing: 50 mm clear stone in accordance with OPSS 1001.
- .3 Geotextile for siltation control fence shall be Class I non-woven geotextile fabric in accordance with OPSS 1860.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Consultant of proposed source of aggregates and provide access for sampling at least four weeks prior to commencing production.

- .2 If, in opinion of Consultant, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .3 Advise Consultant four weeks in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Mud Mat Installation
 - .1 Place clear stone to the dimensions indicated on the Contract Drawings to a depth of 300 mm.
 - .2 Remove and replace top layers of clear stone when they become laden with mud and the mud mat becomes ineffective in removing mud from equipment exiting the site.
 - .3 The mud mat installation does not alleviate the Contractor's responsibility to clean mud from adjacent roadways as a result of the construction.
- .2 Silt Control Fence
 - .1 Install silt control fence along construction Site perimeter including tee bars, geotextile filter fabric, clear stone along the upstream side of the fence in the instance the ground is frozen.

3.2 MAINTENANCE

- .1 Maintain the mud mat and replace clear stone during the construction period as required to maintain the function of the mud mat.
- .2 Maintain silt control fencing for the duration of the construction and replace as required until the Site is stabilized as determined by the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Conform to the requirements stated in the General Conditions, Supplementary Conditions, and all addenda.

1.2 RELATED WORK

- .1 Excavating, Trenching and Backfilling Section 31 23 10
- .2 Granular Base Section 32 11 23
- .3 Granular Sub-Base Section 32 11 19
- .4 Asphalt Paving Section 32 12 16

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.2-M89, Boiled Linseed Oil
 - .2 CAN/CGSB-3.3-M89, Kerosene
- .3 American Society for Testing and Materials (ASTM).
 - .1 ASTM D698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³)
- .4 OPSS 353.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Concrete mixes and material shall conform to OPSS 1301, 1302, 1303, 1305, 1306, 1308, 1315, and 1350. Concrete for curb and toe wall construction shall have a minimum compressive strength of 30 MPa after 28 days.
- .2 Granular Base and Sub-Base: to Section 32 11 23 and 32 11 19 respectively.
- .3 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.
- .4 Fill material: to Section 31 23 10.
- .5 Boiled linseed oil: to CAN/CGSB-1.2.
- .6 Kerosene: to CAN/CGSB-3.3.

PART 3 - EXECUTION

3.1 GRADE PREPARATION & SUB-BASE COURSE

- .1 Grading: to Section 32 23 13.
- .2 Place sub-base course of OPSS Granular 'B', Type I in maximum 150 mm loose lifts and compact to a minimum of 100% of SPMDD.

3.2 GRANULAR BASE

- .1 Obtain Consultant's approval of subbase before placing granular base.
- .2 Place compacted OPSS Granular 'A' to depth, lines and widths as indicated.
- .3 Compact granular base to a minimum of 100% of SPMDD.

3.3 CONCRETE

- .1 Obtain Consultant's approval of granular base.
- .2 Do concrete curb construction in accordance with OPSS 353.
- .3 Provide 1.0m. wide depressions in curb where specified on the drawings as required to allow surface drainage to be conveyed to adjacent bio-swale areas.

3.4 TOLERANCES

- .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

- .1 Joints are to be constructed in accordance with OPSS 353.07.06

3.6 CURING

- .1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by Consultant.
- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.
- .4 Concrete curing is to be in accordance with OPSS 904.

3.7 LINSEED OIL TREATMENT

- .1 After concrete has cured for specified curing time and when surface of concrete is dry, apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters.

3.8 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material approved by Consultant. Compact and shape to required contours as indicated or as directed by Consultant.

3.9 DEFECTIVE CONCRETE

- .1 Concrete is defective when:
 - .1 Containing excessive honeycombing or embedded debris.
 - .2 Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
 - .3 Average 28-day strength of any three consecutive strength tests is less than specified minimum 28-day strength.
 - .4 Any 28-day strength test result is more than 3.5 MPa below the specified minimum 28-day strength.
- .2 Repair of defective concrete work:
 - .1 Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
 - .2 Grind off high surface variations where directed by Consultant.
- .3 Remove and replace defective concrete where directed by Consultant:
 - .1 Remove between joints by sawing through concrete across full width.
 - .2 Replace with new concrete to this Section as directed by Consultant.
 - .3 Construct contraction joint between sawn face of existing concrete and face of new concrete.
 - .4 Install tie bars between old and new concrete as directed by Consultant.

3.10 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Consultant in accordance with CAN/CSA-A23.1.
- .2 Consultant may take additional test cylinders during cold weather concreting. Cure cylinders on Site under same conditions as concrete which they represent.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 This section specifies the supply and installation of concrete pavement, seat walls, furniture bases and footings.

1.2 QUALITY ASSURANCE

- .1 All materials must conform to C.S.A. Standard A23.1, latest edition (metric), and ASTM C979, latest edition, if applicable.
- .2 Furnish the Consultant with a certificate prepared by the Ready-Mix concrete suppliers stating that all requirements regarding strength, slump, air entrainment, mix, materials and ratio have been maintained.
- .3 When required by the Consultant, have core tests taken at not less than 30 metre intervals, to determine the actual thickness of the slab. Cost of testing shall be paid for out of the Inspection and Testing Cash Allowance included as Item No. CA1 in the Bid Form. Patch slab to the satisfaction of the Consultant at no extra cost.
- .4 When required by the Consultant, have all concrete tested for compressive strength, slump and air content, in accordance with C.S.A. Standard A23.2, latest edition (metric). Submit test reports in duplicate. Cost of testing shall be paid for out of the Inspection and Testing Cash Allowance included as Item No. CA1 in the Bid Form.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Store all materials in accordance with C.S.A. Standard A23.1, latest edition (metric).
- .2 If applicable, store colour additives in dry conditions in accordance with manufacturer's instructions. Deliver colour additives to job site or batch plant in original, unopened packaging.
- .3 Store forms off the ground and sufficiently supported to prevent warping or distortion. Protect from contamination by oil, grease, water, earth, etc.
- .4 All concrete shall be ready-mixed at plant and transported to the site by truck in accordance with C.S.A. Standard A23.1, latest edition (metric). Hand mixed concrete is not allowed unless approved in writing by the Consultant prior to starting any work.
- .5 Place concrete in final position at such a rate that it remains plastic at all times and flows readily into all corners and crevices and around all embedded fixtures. Pour in a continuous operation between expansion joints.
- .6 Do not allow concrete to be contaminated by foreign materials or hardened concrete. Do not use re-tempered concrete unless approved in writing, by the Consultant.
- .7 Obtain the approval of the Consultant of the type, number and method of use of mechanical vibrators.

1.4 JOB CONDITIONS

- .1 Protect all concrete surfaces from damage or harmful effects of weather, water, mechanical shock or trespassers until concrete is properly cured.
- .2 If temperature is expected to drop below 5°C, place and protect concrete in accordance with C.S.A. Standard A23.1, latest edition (metric).

1.5 SUBMISSIONS

- .1 The Contractor is to produce a representative sample (minimum 1.0m x 2.0m) of each type of concrete specified for approval prior to full installation. Samples shall be produced by the same workers who will install the work using the contemplated materials, tools and techniques. Samples shall be finished, cured and sealed as specified.

1.6 INSPECTION

- .1 Obtain the approval of the Consultant of the layout, compacted sub-grade, compacted granular base, formwork and reinforcing before proceeding with subsequent work.

PART 2 - PRODUCTS

2.1 FORMS

- .1 Forms shall be designed to support the construction loads coming on or against them without excessive deflection. Joints in formwork shall be made sufficiently tight to prevent leakage or mortar. Forms shall be made accurately so that the finished concrete shall conform to the lines, levels and dimensions shown on the drawings.
- .2 Lumber used in forms shall be free from warp and defects which would impair its strength. Forms shall be made of matched pine or spruce boards dressed on three (3) sides and of uniform width. In locations where plywood forms are specified or in other locations where this contractor wishes to use plywood forms, such formwork shall be of a minimum thickness of 19mm (3/4").
- .3 The inside of all forms shall be carefully and thoroughly wetted before concrete is placed. In freezing weather, forms shall be coated with non-staining mineral oil or other approved liquid. Where oil is to be used, it shall be applied before the reinforcing is set.
- .4 Use new solid face sanded plywood forms for all concrete which will remain exposed. Take special care with joints and bracing and leave a smooth, even surface, requiring a minimum of finishing, all to the Consultant's approval.
- .5 The Contractor shall be solely responsible for the safety of the structure before and after forms are removed. The Consultant shall be given ample notice in advance of the time proposed for removal of the forms and their approval obtained. Care shall be taken in removing the forms that the concrete is not chipped or cracked and that the hardening is not due to freezing.

2.2 DESIGN OF CONCRETE MIXES

- .1 Concrete strength shall be based on the minimum compressive strengths at 28 days. The concrete shall be designed in accordance with the C.S.A. Standard A23.3, latest edition (metric), to produce the strengths specified.

- .2 The concrete mix shall consist of water, cement, coarse and fine aggregates. When an admixture is specified, it shall be considered an integral part of the mix design in attaining specific strengths and slump. The minimum water/cement ratio shall be 0.55. The minimum cement content shall be 320 kg/cu.m of concrete.
- .3 If applicable, integral coloured concrete shall be mixed in strict adherence with the Colour Admixture manufacturer's specifications and instructions.
- .4 The maximum slump for concrete on this work shall be 100mm (4") but whenever possible, slump shall be maintained to 75mm (3").
- .5 Vibrators shall be used throughout concrete placing to ensure no air pockets or voids. The concrete must be adequately vibrated to eliminate honey combing.
- .6 The concrete mixture shall not be changed without prior written approval of the Consultant. Should a change in material source(s) be proposed, the new mix design shall be approved by the Consultant.

2.3 CONCRETE

- .1 Concrete shall be cast on top of compacted, excavated sub-grade. Lay and compacted granular base and sub-base as shown on Drawings. Concrete depth shall be to thickness shown, 30 MPa with 5-7% Air Entraining, or as otherwise shown.
- .2 Exposed concrete must be of good quality, free of pitting or honeycombing. It must be well rubbed to present smooth, architectural finish, uniform in texture and colour.
- .3 No traffic will be allowed over concrete during curing period unless plank runways are used.
- .4 The Contractor shall be responsible for the removal and replacement, or for remedial measures necessitated by faulty workmanship or materials which fail to meet the requirements specified.

2.4 MATERIALS

- .1 Granular Base: Compacted Granular 'A', as defined by OPSS 1010
- .2 Concrete: Only mixed-in-transit concrete shall be used on this work. The Company producing the concrete shall be approved by the Consultant and shall carry out the work in accordance with C.S.A. Standard A23.1, latest edition (metric).
- .3 Cement: All cement shall be Portland Cement of Canadian manufacture, from a source approved by the Consultant and at the time of incorporation in the mix shall comply with the requirements of CSA Standard Specification A5, Type 10.
- .4 Air Entraining Agent: Shall be "Pozzolith" plus M.B.V.R., as manufactured by Master Buildings Co. Ltd. or W.R.D.A. plus Darex A.E.A. as manufactured by Construction Chemicals Ltd. or equivalent. It shall be added to all exterior exposed concrete slabs, walks and curbs and shall be used in strict accordance with the manufacturer's instructions. Entrained air content shall not be

- less than 5% nor more than 7%. Agent and mix shall conform to ASTM C200, latest edition.
- .5 Concrete Additives: Add "Pozzolith" as manufactured by Master Buildings Co. Ltd., or W.R.D.A., as distributed by Construction Chemicals Ltd. or equivalent. Use in all concrete, except for concrete with "Air Entrainment". Use in strict accordance with manufacturer's instruction. "Pozzolith" content in the concrete mix shall not exceed 2%. Do not use any admixture or additive containing calcium chloride. During cold weather concrete installation, a non-chloride accelerator may be used. Do not use waterproofing admixtures or superplasticizers in the coloured concrete mix. The addition of slag and/or fly ash shall not be permitted in coloured concrete.
- .6 Concrete Sealant: Clear, water resistant, exterior grade sealant.
- .7 Aggregates: All aggregates must conform to CSA Standard A23.1, latest edition (metric) and have a nominal size of 20mm. No pit-run gravel will be permitted. Aggregates used in colour concrete mix shall be non- reactive.
- .8 Water: The water for concrete shall be potable, clean and free from injurious amounts of oil, acids, alkali, organic matter or other deleterious substances.
- .9 Reinforcing: 152x152 MW18.2xMW18.2 welded wire mesh reinforcement
Conforming to the current CSA Standard G30.5.
- .10 Tie Wires: #16 U.S.S.G. annealed wire or heavier conforming with CSA Standard G30.3, latest addition.
- .11 Chairs, Spacers, Bolsters & Bar Supports: Shall provide quality for strength and support of the construction conditions, so that there is no possibility of displacement or deformation of the reinforcement during construction. All chairs and spacers shall be plastic.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Fine grade sub-grade eliminating uneven areas and filling low spots. Remove all debris.
- .2 Compact finished sub-grade to 100% Standard Proctor Maximum Dry Density (SPMDD).
- .3 The Contractor shall adhere to the geotechnical engineering notes listed on the Drawings.

3.2 GRANULAR BASE/ SUB-BASE

- .1 Spread the specified granular materials in horizontal layers not exceeding 150mm loose depth and compact to 100% Standard Proctor Maximum Dry Density (SPMDD).
- .2 In areas where compaction by roller is not possible, compact with approved mechanical or hand tamping devices to the specified density.
- .3 Correct all irregularities or depressions resulting from rolling and compact until the granular surface is smooth, uniform and true to line and grade.

3.3 FORM WORK

- .1 Erect forms true to line and level in accordance with the drawings, and sufficiently braced to maintain their shape and alignment when pouring concrete.
- .2 Prior to each pouring operation, coat affected form surfaces with an approved form separating material.
- .3 Provide for all openings, sleeves, hangers, anchors and ties to be cast into the concrete.
- .4 Do not use treated plywood for exposed surfaces more than 5 times. Do not use plywood if surface is damaged.

3.4 REINFORCEMENT

- .1 Place reinforcement in accordance with CSA Standard A23.1, latest edition (metric).

3.5 JOINTS

- .1 Expansion Joints
 - .1 Locate expansion joints between new concrete and all new or existing structures (buildings, walks, hydrants, as shown on drawings, etc.) or as directed in the field by the Consultant.
 - .2 Expansion joints shall be of 10mm non-extruding and resilient bituminous or non-bituminous types conforming with M.T.C. form 1308 and as approved by the M.T.C.
 - .3 Expansion joints shall be located where the placing of concrete must be stopped for a period in excess of one hour.
 - .4 No offsets will be allowed between adjacent sections of joint fillers and no plugs of concrete will be permitted anywhere within an expansion joint.
 - .5 Joints must be cast in place.
 - .6 Saw-cut expansion joints will not be allowed.
- .2 Control Joints
 - .1 Execute control joints in accordance with AC1-301 and as detailed on the Drawings.
 - .2 Locate control joints as indicated on the drawings and details, or as directed in the field by the Consultant.
 - .3 Ensure control joints are to a minimum depth of 1/4 the thickness of the concrete.

3.6 PLACING OF CONCRETE

- .1 Do not place concrete until formwork and grades have been inspected and approved by the Consultant.
- .2 Convey concrete from the mixer to the place of final deposit as rapidly as possible, with as little re-handling as is practical. Avoid separation and/or loss of material.
- .3 While placing concrete, compact thoroughly and uniformly by approved means to ensure a dense homogeneous structure free of air pockets or honeycombs and closely bonded with reinforcement.
- .4 Vibrate concrete to provide a surface suitable for finishing. Do not over vibrate to a point where segregation of the mix occurs.

3.7 FINISHING

- .1 All pavement surfaces shall be finished in accordance with CSA Standard A23.1, latest addition (metric). Concrete surface shall be uniformly finished with a light broom finish to the approval of the Consultant, with standard tooled edge.
- .2 Strike off and float all exposed paving surfaces as soon as possible after consolidation and in accordance with recommendations of the Portland Cement Association.
- .3 Concrete bases for site furnishings shall have a broom finish and a standard tooled edge, evenly swept perpendicular to length of walkway. Other concrete surfaces shall be finished as shown on Drawings and details.
- .4 Ensure finished surface is true to line and level as shown on the Drawings.
- .5 All irregularities greater than 3mm under a 3m straight edge, operated parallel to the centre line, must be repaired.
- .6 Immediately after stripping form work, obtain the approval of the Consultant before commencing patching, finishing or curing operations.
- .7 The intent, method and type of mix for patching shall have the approval of the Consultant before commencing work. Ensure patching mix contains an approved bonding and waterproofing agent and that it is installed in accordance with the manufacturer's specifications.
- .8 Apply one coat of clear sealant by airless sprayer.

3.8 CURING

- .1 Keep concrete moist for at least 3 days after placement, in accordance with CSA Standard A23.1, latest addition, (metric).
- .2 Moist curing: use burlap or equivalent. Ensure it is thoroughly wet when applied and kept continuously wet and in full contact with the surface during the curing period.
- .3 Waterproof paper or white polyethylene sheeting: ensure sheet is large enough to cover entire concrete surface. Secure to prevent displacement during curing period. Immediately repair any tears or holes.

3.9 CLEAN-UP

- .1 Clean and remove all concrete spills from the Site.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

- .1 Also included in this section are clauses for the following items:
 - Architectural Quality Concrete
 - Concrete Forming and Accessories
 - Concrete Reinforcing
 - Concrete Toppings
 - Defective Concrete
 - Finishing of Formed Surfaces
 - Finishing Treatment of Slab Surfaces (Screeding and Trowelling)
 - Sealing and Curing
 - Slabs-on-Grade
 - Vapour Retarder Membrane for Slabs-on-Grade
- .2 Make a thorough examination of the Drawings, Site, Specifications and geotechnical report, to determine the intent, extent, materials and conditions of interfacing with other work and to be fully cognizant of the requirements.
- .3 Assume full responsibility for the design, for the adequacy and for the safety of all formwork and falsework.
- .4 The Contractor shall ensure that no asbestos containing materials are used in connection with the work of this Section.

1.2 Reference Standards

- .1 Comply with The Building Code Act, as amended, the 2012 Ontario Building Code (OBC) as amended and Regulations and by-laws of other authorities having jurisdiction, including latest amendments thereto; all hereafter referred to as the "Building Code".
- .2 All codes, standard specifications and by-laws referred to in this Specification shall be current editions including all latest revisions, addenda and supplements, unless otherwise noted in the Building Code.
- .3 Conform to the following CSA Standards:
 - .1 A23.1 Concrete Materials and Methods of Concrete Construction.
 - .2 A23.2 Test Methods and Standard Practices for Concrete.
 - .3 A23.3 Design of Concrete Structures.

- .4 A3000 Cementitious Materials Compendium.
- .5 G30.18 Carbon Steel Bars for Concrete Reinforcement.
- .6 S269.1 Falsework and Formwork.
- .7 W186 Welding of Reinforcing Bars in Concrete Construction.
- .4 Conform to the following ASTM Standards:
 - .1 C94/C94M Standard Specification for Ready-Mixed Concrete.
 - .2 C309 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.
 - .3 C661 Standard Test Method for Indention Hardness of Elastomeric-Type Sealants by Means of a Durometer.
 - .4 C1116/C1116M Standard Specification for Fiber Reinforced Concrete.
 - .5 D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .6 E1643 Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - .7 E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

- .5 Conform to:
 - .1 ACI 214R Guide to Evaluation of Strength Test Results of Concrete.
 - .2 ACI 303R Guide to Cast-in-Place Architectural Concrete Practice.
- .6 Conform to SP-66, ACI Detailing Manual - 2004 and the RSIC Reinforcing Steel Manual of Standard Practice.
- .7 In the event of conflict between reference standards, codes, drawings and specifications, the Contractor shall request clarification by the Consultant. The Consultant's decision as to which requirements govern shall be final and binding. Generally the more stringent provision shall govern. No extras to the Contract will be approved due to such clarification.
- .8 Conform to the Occupational Health and Safety Act, R.S.O. 1990, c. O.1, last amendment.

1.3 Shop Drawings

- .1 Provide shop drawings (placing drawings and bar lists) showing dimensions and complete information necessary for fabrication and placing reinforcing steel and accessories.
- .2 Submit shop drawings in accordance with directions.
- .3 Allow ten (10) Working Days for the review of shop drawings and supply as many copies for review and distribution as directed. Shop drawings shall be checked in detail by the General Contractor before submission. Drawings which fail to meet this requirement shall be returned marked NOT REVIEWED.
- .4 Review of the Shop Drawings is for general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming, correlating all quantities and dimensions, and is not relieved of the responsibility for compliance with the intent of the drawings and specifications.
- .5 Only shop drawings bearing the review stamps, signed and dated shall be kept at Site.

1.4 Source Quality Assurance

- .1 Concrete supplied to this project shall meet the "Performance Based Specification" for concrete supply as adopted by the Ready Mix Concrete Association of Ontario.

.2 SUBMITTALS

Brand names, and when requested, manufacturer's data sheets, detail drawings or diagrams of all items which are proposed for use in the concrete mix, or which are to be cast in or attached to the concrete structure or will affect the concrete structure in any way, are to be submitted for review.

These shall include but not be limited to:

- .1 A schedule of "Standardized mix designs" which indicates compliance with the Construction Documents. Schedule to include but not be limited to:
 - .1 Concrete mix for each exposure class and strength to be utilized in the project.
 - .2 Water/cementitious materials ratio (w/cm).
 - .3 Air entrainment %, if applicable.
 - .4 Include "Pump Mixes" if proposed for use.
 - .5 Brand name and dosage of synthetic fibres.
 - .6 Brand names of all admixtures to be incorporated into the mixes.
- .2 Brand names and, if requested, manufacturers' data sheet of proposed curing compound.
- .3 If requested, provide a certified copy of a mill test report of the reinforcing supplied, and samples of reinforcing bars to be used on this project for testing by the appointed Inspection and Testing Company before delivery to the Site.
- .4 If requested, for unidentified reinforcing steel or reinforcing steel from non- Canadian mills, submit test data from an approved testing company verifying that each size and grade of reinforcing steel meets the Specification requirements. Pay for cost of such testing.
- .5 Shop drawings of elevators, showing complete details of proposed connections to the structure, including pockets, inserts and loadings.
- .6 Shop drawings of exterior walls panels showing complete details of proposed connections to the structure, including pockets, inserts and loadings.
- .7 Shop drawings of steel and precast concrete stairs showing complete details of connections to the structure including pockets, inserts and loadings. Shop drawings to be stamped by a Professional Engineer.

- .8 Cement finishing of floors shall be by a specialist Subcontractor thoroughly experienced in this type of work and a member in good standing with the Concrete Floor Contractors Association of Ontario (CFCAO). Submit references when requested.
- .3 Refer to **Coloured Surfaced Hardened Finishes** later in this Section.
- .4 MATCH SAMPLE OF ARCHITECTURAL QUALITY CONCRETE.
 - .1 Provide a sample of "Architectural Concrete" including reveals for the Architect's approval. Repeat at no cost to the Owner until approval has been given.
 - .2 All "Architectural Quality" concrete throughout the project shall match or exceed the quality level of the approved "Match" sample as to surface, cone tie pattern and other features as directed.
 - .3 Refer also to **Architectural Quality Concrete** later in this Section.
- .5 Pre-Construction meetings as specified in this section.

PART 2 - PRODUCTS

2.1 Materials

- .1 FORMWORK
 - .1 Formwork lumber: Plywood and wood formwork materials are to conform to CSA A23.1.
 - .2 Plywood: Form plywood shall be exterior grade. Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make-up or patching strips between panels shall be kept to a minimum.
 - .3 Falsework Materials: To conform to CSA S269.1. Materials shall bear grade marks or be accompanied with certificates, test reports or other proof of conformity.
 - .4 Formwork Release Agent: Shall be a proprietary material which will not stain the concrete or impair the natural bonding or color characteristics of coating intended for use on the concrete.
 - .5 Form Ties: Removable or "snap off" metal ties, fixed or adjustable lengths, free of devices leaving holes larger than 25 mm [1"] diameter in the concrete surface.
 - .6 Exposed Surfaces

- .1 Form materials for concrete surfaces which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edged smooth panels of plywood, metal or plastic. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.
- .2 Refer also to **Architectural Quality Concrete** later in this Section.

.7 Circular (Tubular) Column Forms

- .1 Internally treated with release material.

Acceptable Types:

SONOTUBE by Sonoco or equivalent
POLI-PERMAFORM by Atlas Construction Specialties
Other types subject to submission and acceptance.

- .2 Where required by the Architectural drawings and finish schedules provide lined forms so that no spiral line is visible in the finished concrete surface.

.2 REINFORCING AND ACCESSORIES

.1 Reinforcing Bars:

- .1 Shall be new deformed "Hi-Bond" bars conforming with CSA G30.18M with a minimum yield stress of 400 MPa [58 ksi]. All bars to have Typical Identification Patterns and standard identification requirements.
- .2 Epoxy coating is to conform to the specified standard, applicator is to be certified by RSIC.

.2 Welded Wire Mesh: Unless otherwise approved shall be supplied in flat sheets only.

.3 Chairs, bolsters, bar supports, side wall spacers and bar spacers:

- .1 Provide quantity for strength and support of the construction conditions, so that there is no possibility of displacement or deformation of the reinforcement during construction.
- .2 Use plastic chairs and/or sidewall spacers for all concrete.

Acceptable Types as supplied by:

Drummond & Reeves
Acrow Richmond
Superior Concrete
Or equivalent

- .4 Tie Wires: Annealed wire 1.29 mm [0.05"] diameter (No.16 U.S. Standard Gauge), or heavier or an approved proprietary system.
- .5 Provide all necessary support bars and spacers in accordance with recommendations of the RSIC Manual.
- .3 READY MIX CONCRETE:
 - .1 Unless otherwise specified, concrete shall be premixed, quality controlled conforming to CSA A23.1 with minimum 28 day compressive strengths as noted on the Drawings.
 - .2 Cement shall be Portland Cement of Canadian manufacture conforming to CSA A3000, Type GU (10).
 - .3 Supplementary cementing materials shall conform to the requirements of CSA A3000.
 - .4 Aggregates shall be clean, uncoated sand and coarse aggregates from approved sources conforming to CSA A23.1. Nominal size of coarse aggregate shall not exceed 20 mm [3/4"] unless otherwise stated on the structural drawings or specifications.
 - .5 Water shall be potable from a municipal supply.
 - .6 Chemical Admixtures, where permitted shall conform to the requirements of CSA A23.1.
 - .1 Provide an approved water-reducing agent in all concrete.
Acceptable Types:

EUCON WR by Euclid
WRDA 82 by Grace
PLASTOCRETE 161..... by Sika
MASTERSET R 100 by BASF
MASTERPOZZOLITH 210..... by BASF
Or equivalent
 - .2 High Range Water Reducing Admixture (Super P)
Acceptable Types:

EUCON 37 by Euclid
WRDA 20 by Grace
SIKAMENT 686..... by Sika
MASTERRHEOBUILD 1000 by BASF
MASTERGLENium 51..... by BASF
 - .3 Mid-Range Water Reducing Additive where approved for use:
Acceptable Types:

MASTERPOLYHEED 1020 by BASF
EUCON MR by Euclid
DARACEM 55 by Grace
SIKAMENT 500..... by Sika

.4 Air-Entraining Agent:
Acceptable Types:

AIREXTRA by Euclid
DARAX AEA ED by Grace
SIKA AIR by Sika
MASTERAIR by BASF

.7 Calcium chloride or chloride based admixtures **shall not** be used.

.8 Salt or other chemicals shall not be added to reduce the freezing point of concrete.

.9 All admixtures shall be used in strict accordance with the manufacturers' instructions.

.10 SYNTHETIC FIBRE REINFORCING

.1 Synthetic Fibre Reinforcing to control plastic shrinkage cracking:
100% virgin polypropylene fibres specifically manufactured for concrete reinforcement and containing no reprocessed materials. Fibres to be added at the concrete batching plant at the rate of 0.9 kg/m³ [1.52 lb/yd³] of concrete for defibrillated fibres and 0.6 kg/m³ [1.01 lb/yd³] for monofilament fibres, unless otherwise noted, in strict accordance with manufacturer's instructions.

Acceptable Types:

PSI FIBRESTRAND 150..... by Euclid
SIKAFIBER PPF-50 mm by Sika Canada Inc.
MICROFIBRE by Grace
MASTERFIBER by BASF
Or equivalent

.2 Macro Synthetic Fibre Reinforcing where approved for use as a replacement for Welded Wire Mesh or as specified on the Drawings. Add at the batching plant at the rate as specified (min 1.8 kg/m³ [3.03 lb/yd³] of concrete) in strict accordance with the manufacturer's instructions.

Acceptable Products:

TUF-STRAND SF by Euclid
Or equivalent

.11 Typical Concrete Mixes: See schedule on Drawings.

- .4 CONSTRUCTION GROUTS: Non-shrink grout unless otherwise noted shall be a premixed non-metallic, non-shrink grout.

Acceptable Types:

EUCO NS OR DRY PACK GROUT by Euclid
M-BED STANDARD by Sika
MASTERFLOW 555 by BASF
CG-86 by W.R. Meadows
CPD NON-SHRINK GROUT by CPD
Or equivalent

- .5 CURING, SEALING AND/OR CURING/SEALING COMPOUND where approved for use shall conform to ASTM C309.

.1 Acceptable Types:

MASTERKURE CC 300 XS by BASF
FLORSEAL WB 25 by Sika
SUPER DIAMOND CLEAR TB by Euclid
CS-309-30 by W.R. Meadows
ACRYLIC CURE & SEAL 30% by CPD
Compounds must be compatible with applied finishes.
Or equivalent

.2 Compound used for Coloured Surface Hardened Finishes shall be:

.1 SUPERDIAMOND (CLEAR) FOR SURFLEX...by Euclid
.2 FLORSEAL WB25 (CLEAR) FOR COLORPLETE...by Sika
.3 MASTERKURE CC 300 XS..... by BASF
.4 or equivalent

.3 For LEED Projects, use:

EVERCLEAR VOX by Euclid
VOCOMP 25..... by W.R. Meadows
Or equivalent

.4 Compounds applied at the rates as recommended by the manufacturers.

- .6 POST INSTALLED WEDGE (MECHANICAL) AND ADHESIVE ANCHORS FOR CONCRETE

.1 Refer to Section 05 05 19 Post Installed Anchors.

- .7 ADJUSTABLE INSERT

Malleable Wedge Inserts with high tensile steel askew head bolts and lock washers.

Acceptable types as manufactured by:

Peerless Hardware
Blok-Lok
Or equivalent

- .8 SURFACE HARDENER: Unless otherwise noted shall be a non-metallic dry shake hardener.

Acceptable types:

MASTERTOP 110ABR..... by BASF
SURFLEX TR by Euclid
DIAMAG 7 by Sika
CPD FLOOR HARDENER PRE-MIX by CPD
Or equivalent

- .1 Colour to be plain or natural.

- .2 Coloured Surface Hardener acceptable types:

SURFLEX FRENCH GREY by Euclid
COLORPLETE FRENCH GREY by Sika
Or equivalent

- .9 BONDING AGENT:

ALBITOL CONCENTRATE by Sika
INTRALOK by W.R. Meadows
SBR LATEX by Euclid
CPD CONCENTRATED LATEX ADHESIVE by CPD
MASTEREMACO A 660 by BASF
Or equivalent

- .10 PRE-MOULDED JOINT FILLERS: Provide bituminous impregnated fibreboard conforming to ASTM D1751.

Acceptable types:

FIBRE EXPANSION JOINT FILLER by W.R. Meadows
CPD ASPHALT FIBRE EXPANSION JOINT FILLER by CPD
Or equivalent

- .11 JOINT FILLER FOR "SAW-CUT" CONTROL JOINTS: Two component self-leveling sealant, minimum Shore A Durometer hardness of 80 at 20°C [68°F] as conforming to ASTM C661.

Acceptable types:

MASTERSEAL CR 190 by BASF
EUCO QWIKJOINT 200 by Euclid

LOAD FLEX POLYUREA by Sika
REZI-WELD FLEX..... by W.R.Meadows
CIPADAM E-13 by CPD
Or equivalent

.12 VAPOUR RETARDER MEMBRANE FOR SLAB-ON-GRADE

.1 Provide a vapour retarder membrane cover over the prepared base material below slabs-on-grade where noted on the drawings.

.2 Membrane shall have the following properties:

.1 Performance as tested after conditioning (ASTM E1745)

.2 Strength minimum CLASS B (ASTM E1745)

.3 Minimum thickness 0.25 mm [0.01"]

.3 Lap joints minimum 150 mm [6"] and tape with material as recommended by membrane manufacturer.

.4 Acceptable membrane types as manufactured by:

FLORPRUFE 120 by Grace
STEGO WRAP by Stego Industries
PERMINATOR..... by W.R.Meadows
MOISTOP ULTRA by Fortifiber Building
Systems
Or equivalent

.13 Other materials or products which are not listed herein shall comply with the latest CSA, ASTM, CGSB, or ACI Standards appropriate to those materials. Refer to **Source Quality Assurance** in **PART 1** of this section.

PART 3 – EXECUTION

3.1 Work by this Section as Supplied by Others

.1 Install anchors and other items to be cast into the concrete as supplied by others.

3.2 Formwork

.1 Formwork design, materials, and erection shall conform with CSA A23.1 including all falsework and ties.

.2 Column and wall footings and caps shall have plywood side forms. The placement of footings directly against neat cut excavations may be approved subject to review and acceptance by the Structural Consultant. Approval to proceed must be given in writing by the Structural Consultant before any concrete is placed.

3.3 Reinforcing Fabrication and Placement

- .1 Conform to CSA A23.1.

3.4 Concrete

- .1 Mixing, Transportation and placement to conform to CSA A23.1.
- .2 Maximum time between adding mix water and complete discharge of concrete into forms shall be 120 minutes. Exemptions to this time frame shall only be permitted with approval by the Structural Consultant when previously approved chemical additives are used.
- .3 Approved synthetic fibres to be added to the concrete for slabs where noted on drawings. Refer elsewhere in this Section for dosage rates and superplasticizers.

3.5 Cold Weather Conditions

- .1 When the air temperature is at or below 5°C [41°F] or when there is a probability of its falling to that limit within 24 hours of placing (as forecast by the nearest weather office).

Conform to the requirements of CSA A23.1 including, but not limited to the following:

- .1 Job Preparation.
- .2 Concrete Temperature.
- .3 Concrete Placing.
- .4 Protection Requirements and Methods:
 - .1 Heated Enclosures.
 - .2 Protective Covers and Insulation.
- .5 Cooling after protection.
- .6 Cold-Weather Curing.
- .2 All materials and equipment needed for adequate protection and curing shall be on hand and ready for use before concrete placement has started.

3.6 Hot Weather Protection Requirements

- .1 Conform to the requirements of CSA A23.1.

3.7 Finishing Treatment of Slab Surfaces (Screeding and Trowelling)

- .1 Screeding, Bull Floating, Darbying, Trowelling.
 - .1 Conform with the requirements of Clause 7.5 of CSA A23.1 and as modified hereinafter.
 - .2 Bring tops of floors to even level or sloping surfaces as shown on the drawings.
 - .3 Slabs shall be finished only when bleed water on the slab surface has evaporated.
 - .4 Machine trowel all floor slabs, except as required by the drawings and/or specifications to Class A Conventional (Smooth) classification.
 - .5 Surfaces of exterior exposed steps and platforms shall be finished with a wood float and given a "fine broom" finish to the Consultant's satisfaction. (Class A Conventional (Smooth) classification). Refer also to Architect's "Finish Schedule".
 - .6 Unless otherwise shown or specified, roof slabs shall be finished for waterproofing with a Steel Trowel Finish. (Class A Conventional (Smooth) Classification).
 - .7 Floors to receive separate finishes shall be screeded to proper elevation, and wood float finished. (Class A Conventional (Smooth) Classification).
 - .8 Class A Conventional (Smooth) Classification shall be as defined in CSA A23.1 Table 22 and shall be determined by the Straight Edge Method as defined in Clause 7.5.1.2 or by F-number method as defined in Clause 7.5.1.3 unless otherwise directed.
 - .9 Finished surfaces not conforming to the specified tolerances shall be deemed as **Defective Concrete**. See later in this section.

.2 Slab-On-Grade

- .1 VAPOUR RETARDER MEMBRANE FOR SLABS-ON-GRADE
 - .1 For areas specified to receive on under slab membrane:
 - .1 Ensure that the prepared subgrade is approved by the Geotechnical Consultant.
 - .2 Level, tamp and/or roll the subgrade as required.
 - .3 Install the membrane in accordance with manufacturer's instructions and to ASTM E1643.

- .4 Unroll membrane with the longest dimension parallel to the direction of the concrete pour.
- .5 Lap membrane over footings and seal to foundation walls, columns and column caps etc., and overlap joints 150 mm [6"].
- .6 Seal all penetrations (including pipes) and seal as per manufacturer's directions.
- .7 Repair damaged areas with membrane patches overlapping damaged areas by 150 mm [6"] and taping all four sides.

.2 READY MIX CONCRETE

- .1 Refer to Drawings and also to **Materials** in this Section.
- .2 Synthetic Fibres: Refer to READY MIX CONCRETE earlier in this Section.
- .3 Superplasticizer
 - .1 Where shown on the Drawings and specifications as slabs to have superplasticizer added to the mix, the approved superplasticizing agent can be added at the site or at the plant subject to the appropriate mix design being submitted for review and approval issued by the Consultant. NO WATER IS TO BE ADDED AT SITE.
 - .2 As an alternative, the specified Mid-Range Water Reducing additive, added at the batching plant, may be approved for use. Subject to the appropriate mix design being submitted for review and approval issued by the Consultant.
- .4 Quantities and procedure for admixtures shall be determined and supervised with the assistance of the manufacturer's technical staff.

.3 EXECUTION

- .1 Refer to **Field Quality Control** later in this section.
- .2 Obtain geotechnical consultant's approval of the granular fill before placing the concrete slabs-on-grade.
- .4 Provide screeds set to an engineer's level for leveling the surface of floor slabs-on-grade.
- .5 Provide keys or dowels at construction joints as detailed on the Drawings.

.6 CONTROL JOINTS

- .1 Where shown on plans or on Typical Details, provide saw-cut control joints as indicated.
- .2 Control joints in slabs-on-grade shall be cut using power driven abrasive or diamond tipped blades.
- .3 Cutting shall begin as soon as the concrete surface has hardened sufficiently to resist raveling as the cut is made and before shrinkage cracks form in concrete. Generally, saw-cutting of slabs-on-grade shall be done within the first 24 hours after the slabs are placed. Alternatively, use the Soff-Cut method immediately after finishing the slab.
- .4 The depth of control joints shall be one-third (1/3) of the thickness of the slab, with a minimum of 40 mm [1.5"] unless otherwise noted.
- .5 Clear saw-cuts of all debris and ensure sides are clean and dry before proceeding.
- .6 Mix saw-cut joint filler according to manufacturer's instructions.
- .7 Pour filler into joints, flush with adjacent surfaces.

.3 Surface Hardened Finishes

- .1 For slabs designated to be surface hardened, apply the specified surface hardener in strict accordance with the manufacturer's instructions at a rate of 5.0 kg/m² [1.00 lb/ft²].

.4 Coloured Surface Hardened Finishes

- .1 Pre-Construction Meeting:
 - .1 Prior to start of work arrange for a project meeting of all parties associated with the placement of Coloured Surface Hardened Concrete. Presided by the Architect, the meeting shall include Floor Finishing Subcontractor, General Contractor's Representative, Owner's Representative, a Representative of the Backfilling and Compaction Subcontractor, Testing Company's Representative, Concrete Supplier's Representative, Surface Hardener Supplier's Representative, the Geotechnical Consultant's Representative and a Representative of the Structural Consultant.
 - .2 The meeting shall review Specifications for Work included under this section and determine a complete understanding of requirements and responsibilities relative to Work included,

storage and handling of materials, materials to be used, installation of materials, sequence and quality control, project staffing, restrictions on areas of pours, and other matters affecting the construction so as to permit compliance with the intent of this section.

- .2 For slabs shown on the drawings and/or specification to be “Colour Surface Hardened.”
 - .1 Note: No water is to be added to the concrete on Site. Superplasticizer additive is approved for use.
 - .2 Apply specified surface hardener at the rate of 6 kg/m² [1.25 lb/ft²].
 - .3 Apply specified curing sealing compound at the rate recommended by the manufacturer.
 - .4 Hardener and sealing compounds to be installed in strict accordance with manufacturer’s directions.
 - .5 The manufacturer of the hardener and sealing compound shall be notified prior to the application in order that they can supervise the use on this project. The manufacturer shall submit a concrete slab-on-grade field service report to the Architect and Structural Consultant for each application of these products, verifying that the products have been applied in accordance with the manufacturer’s recommendations. A sample report form shall be provided by the Structural Consultant at the Pre-Construction Meeting.
 - .6 See Architectural Drawings and Finish Schedules for required locations.
 - .7 Refer to **Quality Control** in this section.

3.8 Finishing of Formed Surfaces

- .1 Conform to the requirements of CSA A23.1 Clause 7.7.3.
- .2 Refer to Architectural Finish Schedules and Drawings.
- .3 Refer to **Architectural Quality Concrete** later in this Section.

3.9 Sealing and Curing

- .1 Apply specified compounds in strict accordance with manufacturer’s directions.
- .2 All floor slabs and all EXPOSED concrete surfaces, such as walls, beams, columns, etc., are to receive a minimum of one coat of curing and sealing compound unless not compatible with architectural finishes.

.3 CURING

.1 Conform to the requirements of CSA A23.1 including but not limited to the following:

- .1 Basic curing period.
- .2 Additional curing for durability.
- .3 Additional curing for structural safety.
- .4 Methods for curing.
- .5 Cold weather curing.
- .6 Hot weather curing.
- .7 Curing for Accelerated Strength Development.

.4 Refer also to **Cold Weather Conditions** and **Hot Weather Protection Requirements**, elsewhere in this Section.

3.10 Protection of Slab Surfaces

- .1 Fully protect exposed concrete finishes from damage and staining.
- .2 Protect all exposed surfaces from dropping plaster, welding debris, paint, dirt or other marring agents, by heavy building paper, tarpaulins or other appropriate means. The surface must be perfectly dirt-free before this protection is placed.
- .3 Do not allow any pipe threading or similar machines using oil or other permanently staining liquid on any concrete floor unless set up on large oil-tight and properly constructed metal pans. Plywood sheets or other absorbent materials will not be permitted as a substitute for pans.

3.11 Miscellaneous Items

- .1 This Section to provide and place concrete, formwork and reinforcing and/or grout fill for all concrete work shown on or implied by the Drawings and Specifications.
- .2 DRY-PACK GROUT: Provide and install specified non-shrink grout as required, in accordance with manufacturer's directions.
- .3 REINFORCED MASONRY LINTELS: Where required, provide reinforcing and place concrete in accordance with the Typical Notes and Details on the drawings.
- .4 VERTICAL MASONRY WALL REINFORCING BARS: Provide, for installation by the Mason, bars as required by the drawings and typical details.

- .5 MASONRY GROUT: Co-ordinate with the Mason for supply and installation of grout. Grout as specified on the drawings.
- .6 BONDING AGENT: Provide and install specified agent as required in accordance with manufacturer's directions.
- .7 DRILLED AND SET ANCHORS AND DOWELS:

Provide and install the specified products and materials as required in accordance with manufacturer's directions. Refer also to Section 05 05 19 Post Installed Anchors.

3.12 Architectural Quality Concrete

Where concrete surfaces are denoted as Architectural Quality or Architectural Finished Concrete, comply with the following:

- .1 Refer to MATCH SAMPLE FOR ARCHITECTURAL QUALITY CONCRETE earlier in this section.
- .2 Use same formwork and joint sealing on final work as was used on "Match" sample.
- .3 Conform with the requirements of CSA A23.1 Clause 8.3 and ACI 303.
- .4 DESIGN
 - .1 The mix shall be designed by the Contractor so that it will achieve all the properties specified and in addition will achieve a high workability.
 - .2 Regardless of specified strength, architectural concrete exposed to weather shall have a maximum water cement ratio of 0.48 by mass.
 - .3 The maximum slump permitted is 90 mm [3.5"].
 - .4 Take care to reduce variation in mix proportions and particularly the quality of water used in various batches, in order to ensure reasonable colour uniformity of concrete.
- .5 Architectural quality concrete shall meet the standards set out below when the forms are stripped, without further finishing work other than treatment of tie holes and clean-up:
 - .1 Dense, even concrete, uniform in colour and free of defects such as colour change, honeycombing, voids, loss of fines, flow lines, cold joint lines or other similar imperfections. Patching, unless it is required to only an insignificant extent, will not be permitted to repair these defects. Where patching is permitted, it must accurately match the colour and texture of the surrounding concrete to be acceptable. The judgement as to what constitutes insignificant defects which may be patched and the acceptance of the patch shall be made solely by the Architect.

- .2 Concrete members of generally uniform colour.
 - .3 Concrete members with true, accurate definition at corner, arises, reglets and the like, generally free of chipped or spalled areas and within dimensional tolerances set out in ACI 303.
 - .4 Weathertight construction joints in members exposed to weather.
 - .5 Under no circumstances shall patches or repair to any architectural concrete be undertaken without the Architect's written consent. Concrete members which are patched without the Architect's consent will be classified as defective work and the Architect may require their removal and replacement.
 - .6 Colour and texture matching the sample panel designated by the Architect.
- .6 FORMS
- .1 Use approved cone type form ties, spaced as required by the Architect. Align vertical and horizontal form panel joints.
 - .2 Seal joints on exterior side between form panels with an approved joint seal and securely fasten 25 x 50 mm [1" x 2"] wood battens over each joint seal.
 - .3 Provide formwork for reveals as detailed on the architectural drawings to the Architect's satisfaction.
- .7 SANDBLAST FINISH: Where denoted.
- .1 Sandblast the exposed surface of concrete members as required to a depth sufficient to at least remove the surface skin and expose the coarse aggregate and match the approved sample designated by the Architect.
 - .2 Sandblast individual concrete members at the same age to ensure reasonable colour uniformity. Protect adjacent surfaces not noted to be sandblasted.
 - .3 Do not proceed with sandblasting operations until the Architect has inspected and approved the surfaces to be sandblasted.
- .8 When specified or shown on the drawings fill form tie holes with Mills gray concrete plugs in strict accordance with the manufacturer's recommendations.

3.13 Defective Concrete

- .1 Concrete not meeting the requirements of the specifications and drawings shall be considered defective concrete.

- .2 Defective concrete and concrete not conforming to lines, details, quality and grade specified or as shown on the Drawings shall be modified or replaced at no extra cost to the Owner, and to the satisfaction of the Architect.
- .3 Finished lines, dimensions and surfaces shall be correct and true within tolerances specified.
- .4 Non-exposed Surfaces: Honeycombing shall be cut out and filled and any fins which interfere with strapping, etc., shall be cut back. Holes left by form separators shall be filled.
- .5 Crack Repair: After concrete has cured, examine concrete floor surfaces and repair all cracks. Route out cracks with mechanical router to a minimum depth of 13 mm [1/2"]. Then clean and fill cracks in same manner as control joints.
- .6 Use approved curing/sealing compound in strict accordance with manufacturer's recommendations.

3.14 Quality Control

- .1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- .2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and give recommendations in writing.
- .3 The Consultant 's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Consultant are both undertaken to inform the Consultants of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility. The Contractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.
- .4 Refer to **Source Quality Assurance** included in this section.
- .5 If requested, provide a copy of the Concrete Supplier's Certificate confirming that the specified fibre reinforcement at the specified dosage was added to all required concrete delivered to the Site.

3.15 Notification

- 1. Prior to commencing significant segments of the work, give the Consultant and Independent Inspection and Testing Companies appropriate notification so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective. . A minimum notification of 24 hours in advance of placing concrete is required.

3.16 Inspection and Testing

1. The Owner will appoint an Independent Inspection and Testing Companies to make inspections or perform tests as the Consultant directs. The Independent Inspection and Testing Companies shall be responsible only to the Consultant, and shall make only such inspections or tests as the Consultant may direct. The representative of the Inspection and Testing Company shall NOT be required to supervise or instruct the Contractor.
2. The following are responsibilities of the Contractor regarding the Inspection and Testing Company:
 - .1 Co-operate with the representatives of the Inspection and Testing Company.
 - .2 Provide the Inspection and Testing Company with a set of construction documents to enable them to understand the scope of their services.
 - .3 Provide an insulated storage box according to the specification and drawing supplied by the Inspection and Testing Company.
 - .4 Protect test cylinders.
 - .5 Keep a record set of drawings upon which shall be marked by the contractor's superintendent, the time and date of pouring of each section of concrete, the date of removal of forms and a daily record of the temperature.

3.17 Defective Materials and Work

- .1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength, made and the like, in order to help determine whether the work must be corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the work may be acceptable.
- .2 All testing shall be conducted in accordance with the requirements of The Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- .3 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Masonry procedures for masonry work.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in masonry assemblies.
- .3 Shop drawings:
 - .1 Submit shop drawings for masonry unit wall assemblies indicating:
 - .1 Proposed locations of control joints.
 - .2 Types of masonry units, grade, texture, typical dimensions, colours, special shapes and shape dimensions.
 - .3 Layout/coursing for each type of masonry unit. Units are not to be cut without approval of Consultant: Layout using full brick masonry units.
- .4 Samples:
 - .1 2 of each type of brick masonry unit specified.
 - .2 2 of each type of concrete masonry unit specified.
 - .3 2 of each type of architectural concrete masonry unit specified including corner units and in varying degrees of "roughness" or texture.
 - .4 1 of each type of masonry accessory specified
 - .5 1 of each type of masonry reinforcement and tie proposed for use.
- .5 Masonry reinforcing and connector certification: Submit manufacturer's written certification that masonry reinforcing and connector Products supplied for the masonry parts of the Work, comply with CAN/CSA A370-15. Certification shall be typewritten and signed on manufacturer's letterhead and shall include lists and quantities of reinforcing and connector Products Provided in the Work.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors: Provide work of this section, executed by competent installers with a minimum 5 years' experience in application of Products, systems and assemblies specified and with approval of Product manufacturers.
- .2 Mock-ups:

- .1 Provide mock-ups in accordance with Section 01 33 00.
- .2 Quality control mock-ups for masonry veneer walls:
 - .1 Construct mock-up panel of each type of masonry veneered wall construction 2000 mm x 2000 mm (78" x 78") at locations designated by Consultant showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar colours and workmanship.
 - .2 Select masonry units for use in mock-ups that represent the maximum variation in texture and colour.
 - .3 Mock-up shall remain in place until acceptance of masonry and as directed by the Consultant.
- .3 Accepted mock-ups may not remain as part of the completed Work.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to the Place of the Work in dry condition.
- .2 Keep materials dry until use.
- .3 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.5 FIELD CONDITIONS

- .1 Cold weather construction requirements:

- .1 Comply with requirements of CAN/CSA A371-04, and as follows:

Air Temperature, °C	General requirements during construction
0 to 4.....	Sand or mixing water shall be heated to a minimum of 20°C and a maximum of 70°C.
-4 to 0.....	Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C.
-7 to -4.....	(1) Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C. (2) Source heat shall be provided on both sides of the walls under construction. (3) Windbreaks shall be employed when the wind speed exceeds 25 km/h.
-7 and below.....	(1) Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C. (2) Enclosures and supplementary heat shall be provided to maintain an air temperature above 0°C. (3) The temperature of the unit when laid shall be not less than 7°C.

- .2 Grout shall be placed in masonry at a minimum temperature of 20°C and a maximum temperature of 50°C.
 - .3 Mortar temperature shall not exceed 50°C to avoid flash set.

- .4 Maintain dry beds for masonry and use dry masonry units only. Do not wet masonry units in winter.
- .2 Cold weather protection requirements:
 - .1 Comply with requirements of CAN/CSA A371-04, and provide protection requirements for completed masonry or sections not in progress shall be as follows:

MEAN DAILY AIR TEMPERATURE, °C	PROTECTION
0 to 4	Masonry shall be protected from rain or snow for 48 h
-4 to 0	Masonry shall be completely covered for 48 h
-7 to -4	Masonry shall be completely covered with insulating blankets for 48 h
-7 and below	The masonry temperature shall be maintained above 0 °C for 48 h by enclosure and supplementary heat

- .3 Hot weather construction requirements:
 - .1 Comply with requirements of CAN/CSA A371-04, and as follows:
 - .1 The spreading of mortar beds shall be limited to 1.2 m, and the masonry units shall be set within 1 minute of spreading the mortar, when the air temperature is above:
 - .1 38°C; or
 - .2 32°C, with a wind velocity greater than 13 km/h.
 - .2 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
- .4 Masonry units, cementitious materials, and sand stored on site shall be protected from contaminants and shall not be wetted by rain, snow, or groundwater. Other materials and components to be installed by the mason shall be handled and stored in accordance with the manufacturer's instructions.
- .5 When work is not in progress, the exposed top surfaces of masonry shall be covered to prevent intrusion of precipitation with non-staining coverings. The cover shall extend a minimum of 600 mm (24") down both sides and shall be held securely in place until masonry work is protected by flashings or other permanent construction. Ensure that coverings are secured to resist wind loads.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Mortar and grout for masonry: in accordance with Section 04 05 13.
- .2 Masonry reinforcement and connectors: in accordance with Section 04 05 19.
- .3 Masonry accessories: in accordance with Section 04 05 23.
- .4 Brick masonry units: in accordance with Section 04 21 00.
- .5 Concrete masonry units: in accordance with Section 04 22 00.
- .6 Architectural concrete masonry units: in accordance with Section 04 22 00.

PART 3- EXECUTION

3.1 WORKMANSHIP

- .1 Build masonry plumb, level, and true to line, with vertical joints in proper alignment. Lay masonry to tolerances specified in CAN/CSA A371-04.
- .2 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .3 Masonry mortar and grout work: CAN/CSA A179-04 except where specified otherwise.
- .4 Masonry work: CSA S304.1-04, CAN/CSA A370-15 and CAN/CSA A371-04 except where specified otherwise.

3.2 GENERAL ERECTION TOLERANCES

- .1 Lay masonry units with required mortar joint thickness specified below, not to exceed 12.7 mm (1/2").
- .2 Construction tolerances:
 - .1 Maximum variation from plumb in vertical lines and surfaces of columns, walls and arrises:
 - .1 6.4 mm (1/4") in 3 m (10').
 - .2 9.6 mm (3/8") in a storey height not to exceed 6 m (20').
 - .3 12.7 mm (1/2") in 12 m (40') or more.
 - .2 Maximum variation from plumb for external corners, expansion joints and other conspicuous lines:
 - .1 6.4 mm (1/4") in any story or 6 m (20') maximum.
 - .2 12.7 mm (1/2") in 12 m (40') or more.
 - .3 Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:
 - .1 6.4 mm (1/4") in any bay or 6 m (20').
 - .2 12.7 mm (1/2") in 12 m (40') or more.

- .4 Maximum variation from plan location of related portions of columns, walls and partitions:
 - .1 12.7 mm (1/2") in any bay or 6 m (20').
 - .2 19 mm (3/4") in 12 m (40') or more.
- .5 Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on drawings:
 - .1 Minus 6.4 mm (1/4").
 - .2 Plus 12.7 mm (1/2").
- .6 Where masonry surfaces serve as substrate for thin-set tile and direct applied and insulated finish coatings, build to tolerance of 3.2 mm in 2440 mm (1/8" in any 8') under a straight edge.

3.3 LAYING MASONRY UNITS

- .1 Coursing design:
 - .1 Brick masonry units: Fifty percent running bond.
 - .2 Concrete masonry units: 1/3 running bond.
 - .3 Architectural concrete masonry units: Fifty percent running bond.
- .2 Installation and materials shall meet or exceed that of accepted samples and mock-up.
- .3 Units shall be cut only upon acceptance of Consultant. Walls are to be laid-up with full size masonry units.
- .4 Keep cavity space at cavity and/or veneer walls clear of mortar droppings and debris.
- .5 Remove loose and foreign materials from supporting bed surfaces to ensure bonding.
- .6 Do not tooth at wall terminations. Rake back 1/2 unit length where stop-off occurs in horizontal run of masonry.
- .7 Do not install masonry units with face or faces exhibiting chips, cracks, blemishes, texture variation, and other imperfections detracting from appearance when viewed from distance of 4600 mm (15').
- .8 Do not install defective, cracked, and broken masonry units.
- .9 Mixing and blending: Mix units from a minimum of 3 pallets to ensure uniform blend of colour and texture and comply with manufacturer's recommended installation instructions. Distribute masonry units of varying textures to avoid spotty appearance over wall surfaces exposed to view. Do not use units which contrast too greatly with overall range.
- .10 Maintain bracing of walls and piers continuously during construction until structure provides support.
- .11 Locate bearings and piers as indicated. Provide solid masonry units at bearings. Grout under bearing plates installed on masonry with non-shrink grout.
- .12 Extend masonry and partitions to deck, slab or structural members, as applicable, except where otherwise noted in the Contract Documents. Incorporate both lateral support and deflection space at termination of walls as required by this Section.

- .13 Grouted reinforced masonry: incorporate reinforcing steel and construct masonry to indicated requirements.
- .14 Lay masonry level, true to line, square, plumb, and as indicated. Lay masonry courses in vertical alignment to ensure vertical joints align for full height of masonry and full height of building face.
- .15 Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, and deep or excessive furrowing of mortar joints are not permitted.
- .16 Fully bond intersections, and external corners.
- .17 Do not adjust masonry units after placement. Where resetting of masonry is required, remove units, clean and reset in new mortar.
- .18 Cut masonry around obstructions, leaving maximum joint size as specified in this section (below).
- .19 Build chases, do not cut them.
- .20 Lay hollow concrete masonry units so that shells rest and align.
- .21 Exposed cuts shall be made clean and true with a suitable masonry saw.

3.4 EXPOSED MASONRY

- .1 Do not lay chipped, cracked, blemished, and otherwise damaged units in exposed masonry.
- .2 Do not lay chipped, cracked, and otherwise damaged units in concealed masonry.
- .3 Do not lay concrete masonry units that will appear smooth or slick where exposed to view, whether painted or not finished.
- .4 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.
- .5 Maintain and control water-to-cement ratio, rate of hydration, environmental conditions, tooling of the mortar joints, and cleaning procedures, to produce masonry of uniform appearance matching accepted mock-up.

3.5 JOINTING

- .1 Form tooled mortar joints whenever exposed to view, and behind cabinets, fittings, and wall accessories. Tool when mortar is thumb-print hard by tools having long bearing surface to avoid uneven depressions. Close cracks and crevices.
- .2 Tool with non-staining pointing tool to provide smooth, compressed, uniformly formed joints as follows:
 - .1 For exposed brick masonry: Concave.
 - .2 For exposed concrete unit masonry: Concave.
 - .3 For exposed architectural concrete unit masonry: Concave.
 - .4 For concealed masonry: strike flush joints concealed in walls and joints in walls to receive plaster, stucco, tile, insulation, resilient bases, or other applied material except paint or similar thin finish coating. Ensure that no mortar protrudes from joints on wall surfaces to receive materials and coatings.

- .5 Joint thickness:
 - .1 Maintain mortar joint thickness of 10 mm (3/8"), unless otherwise specified or indicated.
 - .2 At masonry cut around obstructions: maximum joint size of 13 mm (1/2").
- .3 Make joints of uniform thickness with vertical joints in alignment.
- .4 Trowel point joints in unparged masonry at below grade locations in contact with earth.
- .5 Form reglets where indicated for metal flashing in masonry.
- .6 Remove loose or defective mortar when masonry is removed and replace.
- .7 Rake out joints at junctions of masonry with concrete walls and columns, and at intersection of masonry walls and partitions where joint reinforcement is installed. These joints shall be sealed in accordance with Section 07 92 00.

3.6 BUILT-IN WORK

- .1 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .2 Coordinate and cooperate in the provisions for setting, anchorage and alignment of built-in work.
- .3 Metal door frames:
 - .1 Build masonry around metal door frames.
 - .2 Ensure that anchors are secured solidly, and that frames are true and plumb.
 - .3 Fill back void of frames with Type N or S mortar unless otherwise indicated.
 - .4 Protect frame with protective covering and leave no mortar on exposed frame faces.

3.7 REINFORCED MASONRY

- .1 Conform to requirements of CAN/CSA A371-04.
- .2 Grout beneath bearing plates: Fill voids beneath steel bases bearing on masonry with approved non-shrink grout having minimum compressive strength at 28 days cure time of 35 MPa. In addition, use non-ferrous grout where grout is exposed to view, in-service moisture conditions, and weather.
- .3 Reinforced block lintels:
 - .1 Install reinforced block lintels over doorways, other openings and recesses as indicated.
 - .2 Support masonry units of reinforced block lintels built in place. Provide a level platform, true to the proper elevation and of sufficient strength to support the load without visible deflection. Maintain supports in place for a minimum of 7 days and for a period sufficient to permit the concrete to cure and gain sufficient strength to safely support all loads.
 - .3 Lay masonry units with full mortar coverage on abutting edges with joints shoved tight. Where masonry construction is continued above the lintel, place the first course of masonry units on the lintel in full mortar bed.

- .4 Fill voids of masonry units that form the fill depth of lintel beams at one time per beam, with grout having minimum compressive strength at 28 days curing time of 35 MPa.

3.8 PROVISION FOR MOVEMENT

- .1 Deflection space:
 - .1 Incorporate deflection space between tops of non-load-bearing walls/partitions and structure to prevent transference of structural loads to masonry.
 - .1 Exterior masonry wall deflection space: 12.7 mm (1/2").
 - .2 Interior masonry partition deflection space: 25 mm (1").
 - .2 Coordinate work of this section with installation of lateral supports.

3.9 LOOSE LINTELS

- .1 Loose lintels: Install loose lintels as required to suit required openings. Set and level lintels, centred over opening width, on a 20 mil PVC slip-sheet membrane, placed over bed or mortar. Allow suitable movement joint at ends of lintels for expansion and contraction movement at exterior lintels.

3.10 LATERAL SUPPORTS

- .1 In addition to requirements of Contract Documents, Provide horizontal and vertical wall and partition lateral support anchors in accordance with CAN/CSA A370-15.

3.11 MOVEMENT (CONTROL) JOINTS

- .1 For masonry without openings, space vertical movement joints at no more than 7620 mm (25') on centre.
- .2 For masonry with multiple openings, provide symmetrical placement of movement joints and reduced spacing of no more than 6096 mm (20 ft) on center.
- .3 Place movement joints at changes in wall direction, changes in building heights, at door and window locations where necessary and directed, at major changes in thickness of wall.
- .4 Extend control (movement) joints to top of masonry, including parapets.
- .5 Review and coordinate control joint locations with the Consultant prior to installation of masonry.

3.12 TEMPORARY BRACING

- .1 Provide adequate temporary bracing to masonry walls until floor and roof decks are installed and can develop adequate diaphragm action to brace walls.

3.13 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00 and perform field control tests in accordance with CSA S304.1-04.

3.14 ADJUSTING AND CLEANING

- .1 Protect masonry and adjacent work from damage from cleaning work.
- .2 Clean masonry in accordance with masonry manufacturer's printed instructions. Remove masonry and install new masonry, if masonry is damaged by cleaning work.
- .3 Test cleaning agent and procedures by cleaning small, inconspicuous sample location prior to commencement of overall cleaning work. Review cleaning test area with Consultant and obtain acceptance in writing prior to cleaning remainder of areas requiring cleaning.
- .4 Soak wall with clean water and flush off loose dirt and mortar.
- .5 Apply specified cleaning agent in accordance with the manufacturer's direction, working from top to bottom.
- .6 Rinse areas thoroughly with clean water to remove cleaning solutions, dirt, and mortar residue.
- .7 Remove mortar from exposed masonry face immediately after pointing and prior to full set to avoid mortar staining of masonry units. Remove efflorescence and mortar deposits from surfaces to receive coatings and surfaces which are exposed to view. Remove masonry and install new masonry, if mortar staining cannot be removed without damaging masonry work.
- .8 Remove mortar droppings from flashings and other materials immediately to prevent damage and discolouration.
- .9 Remove efflorescence and mortar deposits from surfaces to receive coatings or surfaces which are exposed to view, occurring within a time period of 1 year after date of Substantial Performance of the Work as required by the Consultant or the Owner.

3.15 PROTECTION

- .1 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- .2 Protect other materials and finishes from contamination by mortar droppings.
- .3 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Mortar and grout for masonry work.
 - .2 Pigmented mortar at following masonry assemblies; locations as indicated:
 - .1 Brick masonry units.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 and Section 04 05 00.
- .2 Test and evaluation reports: Submit test results confirming compliance of aggregates with CAN/CSA A179-04.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Protect cementitious materials against moisture.
- .2 Prevent contamination by foreign materials, and freezing.

1.4 FIELD CONDITIONS

- .1 Heat materials as follows to produce mortar temperature between 4°C and 50°C:
 - .1 When air temperature is between 4°C and 0°C, heat either sand or water to produce specified mortar temperature.
 - .2 When air temperature is below 0°C, heat both sand and water to produce specified mortar temperature.
 - .3 Do not heat water or sand above 50°C.
 - .4 Produce mortar batches subsequent to the first within plus 6°C of the first.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Mortar and grout: Comply with CAN/CSA A179-04.
- .2 Portland cement: to CSA A3001-08, Type 10. For exposed mortar, maintain uniformity of cement manufacturer and batch for colour uniformity.
- .3 Hydrated lime: to ASTM C207-06(2011), Type S.
- .4 Sand: to CAN/CSA A179-04.
- .5 Mortar pigment:

- .1 Mortar colours shall contain pure, concentrated mineral pigments especially processed for mixing into mortar and complying with ASTM C979-05.
- .2 Allow for blended mortar pigment colours to match each type of masonry veneer.
 - .1 Colours: to be selected by Consultant.
 - .1 Colours shall be selected from full pricing range.
 - .2 Loading (% of cementing material):
 - .1 3% (half loading).
 - .2 6% (full-loading).
- .3 Acceptable manufacturers:
 - .1 Davis Colors 'True Tone Sweet 16 Cement Colors'.
 - .2 Lanxess Corporation 'Bayferrox Iron Oxide Pigments'.
 - .3 Solomon Colors, Inc. 'Concentrated Mortar Colors'.

2.2 MATERIAL SOURCE

- .1 Mortar and grout shall be factory prepared premix including sand and colour. Site mixing of bags and sand will not be accepted. Use mortar and grout as supplied by silo batched systems.
- .2 Maintain uniformity of mortar material manufacturers, mortar materials and source of aggregate throughout the Work.

2.3 MORTAR TYPES

- .1 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: Type S.
- .2 Mortar for exterior masonry above grade:
 - .1 Loadbearing: Type S.
 - .2 Non-loadbearing: Type N.
 - .3 Mortar for exterior exposed masonry veneer: Type N, Portland Cement/Lime/Sand mix.
- .3 Mortar for interior masonry:
 - .1 Loadbearing: Type S.
 - .2 Non-loadbearing: Type N.

2.4 MORTAR COLOUR

- .1 Mortar colour; for use as indicated:
 - .1 Except where pigmented mortar is specified or indicated: Control mortar materials and workmanship to produce uniform grey colour (non-pigmented).

2.5 GROUT TYPES

- .1 Grout for masonry: Grout to CAN/CSA A179-04.
 - .1 Compressive strength:
 - .1 20 MPa minimum unless otherwise indicated.
 - .2 Beneath bearing plates: 35 MPa.
 - .2 Slump: 200 mm (8") unless otherwise indicated.
- .2 Grout for hollow metal frames: Fine grout to CAN/CSA A179-04.
 - .1 Compressive strength: 15 MPa minimum.

PART 3 - EXECUTION

3.1 MASONRY PROCEDURES

- .1 Masonry procedures shall be in accordance with Section 04 05 00 as supplemented herein.
- .2 Comply with CAN/CSA A179-04, except where indicated otherwise.

3.2 MEASUREMENT AND MIXING

- .1 Mix mortars and grout as specified in CAN/CSA A179-04. Use only dry aggregate. Test for bulking to determine accurate proportioning.
- .2 Adjust water in mortar mix to suit absorption rates of masonry units.
- .3 Concrete grout: mix as required to achieve specified compressive strength.

3.3 GROUT

- .1 Place and grout reinforcing and bearing in accordance with Section 04 05 00, CAN/CSA A371-04, and as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Provide mortar for strength testing in accordance with CAN/CSA A179-04 and Section 01 45 00.

3.5 PROTECTION

- .1 Provide protection where required at mixing areas to prevent damage attributed to materials of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Masonry reinforcing and anchorage.
 - .2 Connectors for anchorage of masonry veneer to the following support assemblies:
 - .1 Concrete unit masonry.
 - .2 Wind bearing metal studs.
 - .3 Horizontal reinforcing for masonry block wall and partition assemblies.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 and Section 04 05 00.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 General: in accordance with building code and CAN/CSA A370-15.
- .2 Corrosion protection; metal materials: in accordance with building code and CAN/CSA A370-15:
 - .1 Hot dipped after fabrication to ASTM A1064/A1064M-15, and ASTM A153/A153M-09 Class B2 (457 g/m2).
 - .1 Interior to air barrier location: Use mill galvanized.
 - .2 For metal located exterior to the air barrier membrane: Stainless steel Type 304/316.
 - .3 Joint reinforcement: Acceptable manufacturers:
 - .1 Blok-Lok
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .1 Exterior wall assemblies: 4.75 mm (3/16") wire, welded rod, ladder design unless otherwise indicated.
 - .2 Interior wall assemblies: 9 gauge mill galvanized wire ladder reinforcement.
 - .4 Exterior masonry veneer connectors for connection to concrete masonry unit back-up:
 - .1 Description: Stainless steel ASTM A666-15 Type 304 or 316 formed plate construction, wire V-TIE or TRI-TIE masonry veneer connector (4.76 mm (3/16") cold drawn stainless steel Type 304 or 316 to ASTM A580/A580M-15), stainless steel or polyethylene insulation securement plates for insulation sheathing:
 - .2 Acceptable Products:
 - .1 Fero 'Slotted Block Tie (Type 1)'.
 - .5 Masonry veneer connectors; stud back-up (installed on top of air barrier membrane and sheathing material):

- .1 Description: Stainless steel ASTM A666-15 Type 304 or 316 plate construction, wire V-TIE or TRI-TIE masonry veneer connector (4.76 mm (3/16") cold drawn stainless steel Type 304 or 316 to ASTM A580/A580M-15), stainless steel or polyethylene insulation securement plates for insulation sheathing:
- .2 Acceptable Products:
 - .1 Blok-Lok 'BL-407'.
 - .2 Fero 'Slotted Rap-Tie'.
- .3 Fasteners: minimum of 2 screws per tie, No. 12, Climaseal coated galvanized steel, self-drill type, #10 minimum.

PART 3 - EXECUTION

3.1 CONTROL JOINTS

- .1 Stop reinforcing 25 mm (1") short of each side of control joints unless otherwise indicated.

3.2 HORIZONTAL REINFORCING

- .1 Joint reinforcement:
 - .1 Install horizontal joint reinforcement in cavity walls, solid walls, and partitions in accordance with CAN/CSA A371-04 and as indicated in the Contract Documents, the more stringent requirements shall govern.
 - .2 Place reinforcement continuously in horizontal joints at vertical spacing not exceeding 400 mm (16"), beginning with course 400 mm (16") above bearing, unless otherwise indicated.
 - .3 Do not carry reinforcement through intersections where lateral support anchors are installed, at intersections of walls and partitions with solid piers and at block control joints.
 - .4 Reinforcement shall be lapped 300 mm (12"), minimum, with laps staggered 750 mm (30"), minimum, from course to course. Any cross wires in the lap length of the lapped reinforcement shall be removed.

3.3 MASONRY VENEER CONNECTORS

- .1 Tie masonry veneer to structural backing in accordance with CAN/CSA A370-15 with masonry veneer connectors at following maximum spacing:
 - .1 Maximum spacing unless otherwise indicated: 600 mm (24") vertically x 820 mm (32") horizontally.
 - .2 Stud back-up assemblies: 600 mm (24") vertically and 400 mm (16") horizontally. Ties are permitted be staggered horizontally on alternating studs provided the stud spacing does not exceed 410 mm (16") o.c. and the resulting horizontal tie spacing does not exceed 820 mm (32") o.c. The stagger shall be arranged so that all studs have ties including the top row of ties.
 - .3 At openings in masonry walls: 600 mm (24") apart around opening, and not more than 300 mm (12") from edge of opening.

- .4 At tops and bottoms of walls: 300 mm (12") from edge of top of wall, and 400 mm (16") from edge of bottom support.
- .5 At movement joints: 300 mm (12") from joint.

3.4 REINFORCED MASONRY

- .1 Reinforce masonry lintels and bond beams as indicated. Make joints in lintels and bond beams to match adjacent walls.
- .2 Reinforce masonry walls as indicated on the structural drawings.
- .3 Place and grout reinforcing in accordance with CSA S304.1-04. Use concrete of 20 MPa strength in accordance with Section 03 30 00.
- .4 Provide minimum 150 mm (6") bearing on supports for lintels.
- .5 Place 100% solid block at each jamb under lintels.

3.5 BOLTS AND ANCHORS

- .1 Embed bolts and anchors solidly in mortar or grout to develop maximum resistance to design forces.

3.6 LATERAL SUPPORT AND ANCHORAGE

- .1 Install lateral support and anchorage in accordance with CAN/CSA A370-15 and as indicated on the structural drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Control joint filler at masonry veneer.
 - .2 Weep vents at cavity masonry veneer. Deflection space filler at top of non-fire rated masonry partitions.
 - .3 Deflection space filler at top of fire-rated masonry partitions.
 - .4 Preformed control joint filler at concrete walls/partition assemblies.
 - .5 Slip-sheet membrane for steel lintel bearing over masonry to allow lintel movement (thermal expansion/contraction).

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 and Section 04 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Control joint filler at masonry veneer: sealant and backer rod in accordance with Section 07 92 00.
- .2 Weep vents: Full height of masonry unit, designed to keep weep hole open for passage of air and water, UV stabilized polypropylene.
 - .1 Size: Height of head joint x depth of masonry unit x thickness of mortar joint.
 - .2 Colour: to later selection by Consultant from manufacturer's full range.
 - .3 Acceptable Product:
 - .1 Advanced Building Products, Inc. 'Mortar Maze Cell-Vents.
 - .2 Blok-Lok Limited 'Cell-Vent'.
 - .3 Mortar Net Solutions 'CellVent'.
 - .4 Wire-Bond 'Cell-Vent'.
 - .5 Or equivalent.
- .3 Deflection space filler (non-fire rated walls):
 - .1 Acceptable Product:
 - .1 Johns Manville 'MinWool Sound Attenuation Fire Batts'.
 - .2 Roxul "AFB".
 - .3 Or equivalent.
- .4 Deflection space filler (fire rated walls):

- .1 Mineral type in accordance with Section 07 84 00.
- .5 Control joint filler; concrete block wythes:
 - .1 PVC, designed to fit into sash grooves.
 - .2 Acceptable Product: Blok-Lok 'VS Series' or equivalent.
- .6 Slip-sheet flashing membrane (for lintel bearing locations):
 - .1 Minimum 0.5 mm (0.020") thick, PVC membrane, low temperature flexible to 40°C below zero.
 - .2 Acceptable Products:
 - .1 Blok-Lok 'Flex-Flash'.
 - .2 Lexcor F20.
 - .3 Or equivalent.

PART 3 - EXECUTION

3.1 MASONRY INSTALLATION AND PROCEDURES

- .1 Masonry installation and procedures shall be in accordance with Section 04 05 00, as supplemented herein.

3.2 CONTROL JOINTS

- .1 Keep control joints clear for application of joint sealants.
- .2 Install control joint filler in accordance with manufacturer's recommendations.

3.3 VENTS

- .1 Install weep vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at uniform and consistent horizontal spacing not exceeding 610 mm (24"). Do not locate vents within 610 mm (24") adjacent to corners of buildings.

3.4 MASONRY FLASHING

- .1 General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- .2 Install flashing as follows unless otherwise indicated:
 - .1 Install flashings in masonry in accordance with CAN/CSA A371-04.
 - .2 Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through- wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal laps and

penetrations in flashing watertight in accordance with manufacturer's installation instructions.

- .3 At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and project face of sheathing or inner wythe minimum of 150 mm (6"); with upper edge tucked under air/vapour barrier membrane and fully adhered to substrate unless otherwise indicated, lap joints minimum of 100 mm (4").
- .4 At lintels and shelf angles, extend flashing a minimum of 150 mm (6") into masonry at each end. At heads and sills, extend flashing minimum of 150 mm (6") at ends and turn up 50 mm (2") minimum to form end dams.
- .5 Flashings shall be installed to shed water in masonry cavity to exterior. Make flashings watertight.
- .6 Install masonry flashing to perform as dampproof course in walls that extend below grade except walls which are not exposed to moisture or protected by moisture retarding materials. Locate more less than 150 mm (6") above finished grade.

3.5 DEFLECTION SPACE FILLER

- .1 Non-fire rated walls: Fill deflection space with deflection space filler. Where deflection space is exposed, tamp filler into deflection space 25 mm (1").
- .2 Fire-rated walls: Refer to requirements of Section 07 84 00.

3.6 SLIP SHEET AT METAL LINTELS

- .1 Install at loose lintel locations between bearing area of lintel and bed. Trim away exposed slip sheet.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Clay brick.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 and Section 04 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Manufacture: Manufacture total required brick in one continuous batch, for maximum colour and texture uniformity.
- .2 Clay brick:
 - .1 Exterior kiln fired clay brick veneer: CAN/CSA A82.1-M87.
 - .1 Grade SW.
 - .2 Type: FBX.
 - .2 Size: Modular: 57 mm x 92 mm x 194 mm (2-1/4" x 3-5/8" x 7-5/8").
 - .3 Acceptable Product: 'Endicott Manganese Ironspot Velour' complete with pigment mortar, as distributed by Thames Valley.

PART 3 - EXECUTION

3.1 LAYING

- .1 Lay masonry in accordance with good practice, and CAN/CSA A371-04 and as accepted in mock-up sample wall and as specified in Section 04 05 00.
- .2 Review locations of coursing alignment and layout with Consultant, and seek approval, prior to commencement of the work of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Concrete masonry units:
 - .1 Normal weight units.
 - .2 Ultra light weight units.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 and Section 04 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Concrete masonry units:
 - .1 Comply with CAN/CSA A165 SERIES-04.
 - .2 Include shapes, such as end, bond, sash groove, ledge and lintel units, required to complete the Work, with uniform appearance.
 - .1 Provide open end blocks where vertical reinforcing occurs in walls.
 - .2 Provide knock-out blocks where horizontal reinforcing bars occur in walls.
 - .3 Solid concrete masonry units may be used where grouted block is indicated, whenever reinforcing is not indicated, in lieu of grouted solid installation method.
 - .4 Size: metric.
 - .3 Normal weight units:
 - .1 Hollow units: H/15/A/M, H/20/A/M, and H/30/A/M.
 - .2 Semi-solid units: SS/15/A/M, SS/20/A/M, and SS/30/A/M.
 - .3 Full solid units: SF/15/A/M, SF/20/A/M, and SF/30/A/M.
 - .4 Colour: grey.
 - .5 Profiles: as indicated.
 - .4 Ultra light weight units:
 - .1 Hollow units: H/15/D/M.
 - .2 Semi-solid units: SS/15/D/M.
 - .3 Full solid units: SF/15/D/M.
 - .4 Colour: grey.
 - .5 Profiles: as indicated.
 - .6 Acceptable Products:

- .1 Richvale Block 'Ultra Lite'
- .2 Permacon 'Super Lightweight'.

2.2 SOURCE QUALITY CONTROL

- .1 Perform tests on masonry units to determine compressive strength as required by Authorities Having Jurisdiction in accordance with CAN/CSA A165 SERIES-04.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Before commencing masonry work, verify that conditions at the Place of the Work will allow construction of masonry within required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support, and compressive strengths of masonry units and mortars.

3.2 MASONRY PROCEDURES

- .1 Lay masonry in accordance with good practice, and CAN/CSA A371-04, as accepted in mock-up sample wall and in accordance with Section 04 05 00.

END OF SECTION

- .1 The foundation soil shall be excavated or filled as required to the grades and dimensions shown on the Contract Drawings. The foundation soil shall be proof rolled and examined by the inspecting Engineer / Testing Company Representative to ensure it meets the minimum strength requirements indicated in the Contract Documents. If unacceptable foundation soil is encountered, the Contractor shall excavate the material out to the satisfaction of the Engineer/ Testing Company Representative and replace with suitable material under the direction of the Engineer/ Testing Company Representative.
- .2 Spread the granular base evenly over the sub-grade and compact as indicated on the Contract Drawings and specifications.

- .3 Level the granular base to level of underside of base block to +/- 3 mm [+/- 1/8 in.] of approved final base grade elevations. Care should be taken to ensure the base material is level front to back and side to side.
- .4 Do not allow water to drain or accumulate under stone.
- .5 Place the stone as indicated. Care should be taken to ensure the stone is aligned correctly and in complete contact with the base material.
- .6 Install stone to the elevations shown on the grading plan and details.
- .7 Grind any sharp, exposed corners/ edges to a smooth, rounded edge to the satisfaction of the Consultant.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

- .1 Provide all labour, materials and equipment to complete the fastening into cast-in-place concrete and masonry indicated on the Drawings and as specified herein.

1.2 Reference Standards

- .1 Comply with The Building Code Act, as amended, the 2012 Ontario Building Code (OBC) as amended and Regulations and by-laws of other authorities having jurisdiction, including latest amendments thereto; all hereafter referred to as the "Building Code".
- .2 All codes, standard specifications and by-laws referred to in this Specification shall be current editions including all latest revisions, addenda and supplements, unless otherwise noted in the Building Code.
- .3 Conform to the following CSA Standards:
 - .1 CSA A23.3 Design of Concrete Structures.
- .4 Conform to the following Standards:
 - .1 ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
 - .2 ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary
 - .3 ASTM A123/A123M Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- .5 In the event of conflict between reference standards, codes, drawings and specifications, the Contractor shall request clarification by the Consultant. The Consultant's decision as to which requirements govern shall be final and binding. Generally the more stringent provision shall govern. No extras to the Contract will be approved due to such clarification.
- .6 Conform to the Occupational Health and Safety Act, R.S.O. 1990, c. O.1, last amendment.

1.3 Quality Assurance

- .1 Prior to commencement of work, the Contractor shall arrange for a field representative of the manufacturer of post-installed concrete or masonry anchors to provide installation training for all products to be used. Only trained installers shall perform post-installed anchor installations. A record of training shall be kept on site and be made available to the structural Consultant or Independent Inspection and Testing Company representative when requested. Training to consist of a review of the complete installation process for the specific post-installed anchors, and must include but not be limited to the following applicable items:
 - (a) Hole drilling procedure.
 - (b) Hole preparation and cleaning technique.
 - (c) Adhesive injection technique and dispenser training/maintenance.
 - (d) Rebar dowel preparation and installation.
 - (e) Proof loading/torquing.
- .2 Adhesive anchors supporting sustained tension loads shall be installed by a certified Adhesive Anchor Installer (AAI) as certified by ACI/CRSI. Proof of current certification shall be submitted to the Structural Consultant prior to commencement of the installation of anchors.

PART 2 – PRODUCTS

2.1 Materials

- .1 POST-INSTALLED CONCRETE ANCHORS
 - .1 Mechanical anchors shall have been tested and qualified for use in accordance with ACI 355.2 and ICC-ES AC193 for cracked and uncracked concrete, as well as seismic applications, unless noted otherwise.
 - .2 Adhesive anchors shall have been tested and qualified for use in accordance with ACI 355.4 and ICC-ES AC308 for cracked and uncracked concrete, as well as seismic applications, unless noted otherwise.
- .2 POST-INSTALLED MASONRY ANCHORS
 - .1 Mechanical anchors shall have been tested and qualified for use in accordance with ICC-ES AC01 OR AC106.
 - .2 Adhesive anchors shall have been tested and qualified for use in accordance with ICC-ES AC58.

.3 POWER DRIVEN FASTENERS

- .1 Power driven fasteners shall have been tested and qualified for use in accordance with ICC-ES AC70.

PART 3 – EXECUTION

3.1 General

- .1 Post installed anchors shall be used only where specified on structural drawings.
- .2 The installation of post installed anchor for missing or misplaced cast-in-place anchors is not allowed unless approved by the Structural Consultant.
- .3 The capacity of post installed anchors used in the design has been based on the technical data published by the manufacturer. Substitution requests for alternate anchors must be approved in writing by the Structural Consultant prior to use. The Contractor shall provide calculations stamped by a licensed professional engineer demonstrating that the alternative anchor is capable of achieving the performance values of the specified product. Substitutions will be evaluated for compliance with the relevant building code and CSA A23.3 Standard. Adhesive anchor evaluations will also consider creep, in-service temperature and installation temperature.
- .4 The existing reinforcement in the concrete structure or embedded conduits may conflict with the specified anchor locations. Existing reinforcing bars in the concrete structure shall not be cut unless approved by the Structural Consultant.
- .5 The Contractor shall locate the existing reinforcement and conduits at the proposed locations of the anchors by approved non-destructive methods such as Ground Penetrating Radar (GPR) or X-Rays. Modify the structural anchor details as required to avoid cutting rebar or conduits, and submit the revised details for review by the Structural Consultant prior to proceeding with the work.
- .6 The review of the X-ray or scan results by the Structural Consultant is limited only to the location of the proposed cores or drilled holes through the existing structure and it is based on the assumption that the X-ray or scan results locating slab reinforcement and embedded services are complete and accurate. The Contractor shall be responsible for the accuracy of the X-ray or scan results.
- .7 All anchors shall be installed in strict accordance with the Manufacturer's Printed Installation Instructions (MPII) in conjunction with the edge distance, spacing and embedment depth indicated on the structural drawings.
- .8 Adhesive anchors must be installed in concrete aged a minimum of 21 days.

3.2 Quality Control

- .1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- .2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and give recommendations in writing.
- .3 The Consultant 's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Consultant are both undertaken to inform the Consultants of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility. The Contractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.

3.3 Notification

1. Prior to commencing significant segments of the work, give the Consultant and Independent Inspection and Testing Companies appropriate notification so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective. Advise the Inspection and Testing Company at least twenty-four (24) hours in advance of each fabrication and/or erection sequence.

3.4 Inspection and Testing

1. The Owner will appoint an Independent Inspection and Testing Company(ies) to make inspections or perform tests as the Consultant directs. The Independent Inspection and Testing Company(ies) shall be responsible only to the Consultant, and shall make only such inspections or tests as the Consultant may direct. The representative of the Inspection and Testing Company(ies) shall NOT be required to supervise or instruct the Contractor.
- .2 The following are responsibilities of the Contractor regarding the Inspection and Testing Company(ies):
 - .1 Co-operate with the representatives of the Inspection and Testing Company(ies).
 - .2 Co-ordinate a program of inspection and testing with the Inspection and Testing Company(ies), and advise the Consultant accordingly.

3.5 Defective Materials and Work

- .1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength, made and the like, in order to help determine whether the work must be

corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, even if the work is deemed acceptable by the Consultant.

- .2 All testing shall be conducted in accordance with the requirements of The Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- .3 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

- .1 When members are specifically designated as “Architecturally Exposed Structural Steel” or “AESS” in the Contract Documents, the requirements in this section shall apply in addition to Section 05 21 19.
- .2 AESS members or components shall be fabricated and erected with the care and dimensional tolerances that are stipulated in this Section.
- .3 Refer to Structural Drawings for “Key Plan” showing locations and Categories of AESS finishes. All AESS members must also be identified by their Category on the Architectural Design Documents.

1.2 Definition Categories

- .1 Categories are listed in the AESS Matrix shown in Table 1 where each Category is represented by a set of Characteristics. Refer to the CISC Code of Standard Practice Appendix I for additional information. The following Categories shall be used when referring to AESS:

AESS 1: Basic Elements

Suitable for “basic” elements which require enhanced workmanship.

AESS 2: Feature Elements viewed at a Distance > 6 m

Suitable for “feature” elements viewed at a distance greater than six meters. The process involves basically good fabrication practices with enhanced treatment of weld, connection and fabrication detail, tolerances for gaps, copes.

AESS 3: Feature Elements viewed at a Distance \leq 6 m

Suitable for “feature” elements – where the designer is comfortable allowing the viewer to see the art of metalworking – welds are generally smooth but visible, some grind marks are acceptable. Tolerances are tighter than normal standards. The structure is normally viewed closer than six meters and is frequently subject to touch by the public.

AESS 4: Showcase Elements

Suitable for “showcase or dominant” elements – used where the designer is comfortable allowing the viewer to see the art of metalworking – welds are generally smooth but visible, some grind marks are acceptable. Tolerances are tighter than normal standards. The structure is normally viewed closer than six meters and is frequently subject to touch by the public.

AESS C: Custom Elements

Suitable for elements that require a different set of characteristics as specified in Categories AESS 1, 2, 3 or 4.

1.3 Related Documents

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 “Specifications” Section, apply to this Section.
- .2 Related Sections:
 - .1 Division 1 “Quality Control” Section for independent testing agency procedures and administrative requirements.
 - .2 Division 5 “Steel Joist” Section.
 - .3 Division 5 “Metal Decking” Section for erection requirements relating to exposed steel decking and its connections.
 - .4 Division 9 “Painting” Section for finish coat requirements and coordination with primer and surface preparation specified in this Section.

1.4 Reference Standards

- .1 Comply with The Building Code Act, as amended, the 2012 Ontario Building Code (OBC) as amended and Regulations and by-laws of other authorities having jurisdiction, including latest amendments thereto; all hereafter referred to as the “Building Code”.
- .2 All codes, standard specifications and by-laws referred to in this Specification shall be current editions including all latest revisions, addenda and supplements, unless otherwise noted in the Building Code
- .3 Refer to and comply with all standards referred to in Section 05 21 19 of this specification, and in addition conform to the following:
 - .1 ASTM A6/A6M Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - .2 ASTM A780/A780M Standard Practice for Repair of Damaged and Uncoated areas of Hot-Dip Galvanized Coatings.

1.5 Submittals

- .1 Submit each item below according to the Conditions of the Contract and Division 1 “Specifications” Section.
- .2 Shop Drawings detailing fabrication of AESS components:
 - .1 Provide erection drawings clearly indicating which members are considered as AESS members and identify by the Categories listed in Table 1.

- .2 Include details that clearly identify all of the requirements listed in Sections 2.3 "Fabrication" and 3.3 "Erection" of this specification. Provide connections for AECS consistent with concepts, if shown on the Structural Design Documents.
- .3 Indicate welds by standard CWB symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined herein.
- .4 Indicate type, finish of bolts. Indicate which side of the connection bolt heads should be placed.
- .5 Indicate any special tolerances and erection requirements;
- .6 For Category AECS C, the AECS Matrix included in Table 1 shall be used to specify the required treatment of the element.
- .7 Any variations from the AECS Categories listed must be clearly noted. These variations could include machined surfaces, locally abraded surfaces, and forgings. In addition:
 - .1 If distinction is to be made between different surfaces or parts of members the transition line/plane must be clearly identified/defined on the Shop detail, arrangement and erection drawings.
 - .2 Track welds, temporary braces, fixtures used in fabrication are to be indicated on shop drawings.
 - .3 All architecturally sensitive connection details will be submitted for approval by the Architect/Engineer prior to completion of shop detail drawings.

1.6 Quality Assurance

- .1 **FABRICATOR QUALIFICATIONS:** In addition to those qualifications listed in other sections of Division 5 "Structural Steel and Open Web Steel Joist Framing" Section 05 21 19, engage a firm with a minimum 5 years of experience in fabricating AECS similar to that indicated for this Project and with sufficient production capacity to fabricate the AECS elements.
- .2 **ERECTOR QUALIFICATIONS:** In addition to those qualifications listed in other sections of Division 5 "Structural Steel and Open Web Steel Joist Framing" Section 05 21 19, engage a competent Erector who has a minimum 5 years of experience carrying out comparable AECS work.
- .3 Comply with applicable provisions of the following specifications and documents:
 - .1 CISC Code of Standard Practice, latest edition.

- .4 Visual samples when specified may include any of the following:
 - .1 3-D rendering of specified element.
 - .2 Physical sample of surface preparation and welds.
 - .3 First off inspection: First element fabricated for use in finished structure subject to alterations for subsequent pieces.
 - .4 Mockups: As specified in Structural Design Document. Mockups are either scaled or full scale. Mockups are to demonstrate aesthetic effects as well as qualities of materials and execution:
 - .1 Mockups may have finished surface (including surface preparation and paint system).
 - .2 Architect's approval of mockups is required before starting fabrication of final units.
 - .3 Mockups are retained until project is completed.
 - .4 Approved full-scale mockups may become part of the completed work.

1.7 Delivery, Storage and Handling

- .1 Ensure that all items are properly prepared, handled and/or package for storage and shipping to prevent damage to product.
- .2 Erect finished pieces using softened slings or other methods such that they are not damaged. Provide padding as required to protect while rigging and aligning member's frames. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Architect.

PART 2 - PRODUCTS

2.1 Materials

- .1 General: Meet requirements of sections of Division 5 "Structural Steel and Open Web Steel Joist Framing" Section 05 21 19.
- .2 Specialty bolts must be specified.

2.2 Special Surface Preparation

- .1 Primers: Primers must be specified.

2.3 Fabrication

.1 GENERAL FABRICATION

- .1 For the special fabrication characteristics, see Table 1 – AECS Category Matrix.
- .2 Fabricate and assemble AECS in the shop to the greatest extent possible. Locate field joints in AECS assemblies at concealed locations or as approved by the Architect.
- .3 Fabricate AECS with surface quality consistent with the AECS Category and visual samples if applicable.
- .4 The fabricator is to take special care in handling the steel to avoid marking or distorting the members, as follows:
 - .1 All slings will be nylon type or chains with softeners or wire rope with softeners.
 - .2 Care is also taken to minimized damage to any shop paint or coating.
 - .3 If temporary braces or fixtures are required during fabrication, during shipment, or to facilitate erection, care must be taken to avoid and/or repair any blemishes or unsightly surfaces resulting from the use or removal of such temporary elements.
 - .4 Tack welds are ground smooth.

.2 UNFINISHED, REUSED OR WEATHERING STEEL: Members fabricated of unfinished, reused or weathering steel that are to be AECS may still have erection marks, painted marks or other marks on surfaces in the completed structure. Special requirements shall be specified as Category AECS C.

.3 TOLERANCES FOR ROLLED SHAPES: The permissible tolerances for depth, width, and out of square, camber and sweep of rolled shapes shall be as specified in CSA G40.20/21 and ASTM A6. The following exceptions apply:

- .1 For Categories AECS 3 and 4 and otherwise specified in the Contract Documents: The matching of abutting cross-sections shall be required.
- .2 For Categories AECS 2, 3 and 4: The as-fabricated straightness tolerance of a member is one-half of the standard camber and sweep tolerance in CSA G40.20/21.

.4 TOLERANCES FOR BUILT-UP MEMBERS: The tolerance on overall profile dimensions of members made up from a series of plates, bars and shapes by welding is limited to the accumulation of permissible tolerances of the component parts as provided by CSA W59 and ASTM A6. For Categories AECS 2 and 3, use camber and sweep tolerances in CSA W59.

- .5 JOINTS: For Categories AESS 3 and 4, all copes, miters and butt cuts in surfaces exposed to view are made with uniform gaps, if shown to be open joint, or in uniform contact if shown without gap.
- .6 SURFACE APPEARANCE: For Categories AESS 1, 2 and 3, the quality surface as delivered by the mills should be acceptable. For Category AESS 4, the steel surface imperfections should be filled and sanded.

2.4 Shop Connections

- .1 BOLTED CONNECTIONS: Make in accordance with Section 05 21 19. Provide bolt type and finish as specified and place bolt heads as indicated on the approved shop drawings.
- .2 WELDED CONNECTIONS:
 - .1 Comply with CSA W59 and Section 05 21 19. Appearance and quality of welds shall be consistent with the Category and visual samples if applicable. Assemblies and weld built-up sections by methods that will maintain alignment of members to the tolerance of this section.
 - .2 For corrosive environments, all joints should be seal welded. In addition:
 - .1 For Categories AESS 1, 2 and 3, a smooth uniform weld will be acceptable. For AESS Category, the weld will be contoured and blended.
 - .2 For Categories AESS 1, 2, 3 and 4, all weld spatter is to be avoided/removed where exposed to view.
 - .3 For Categories AESS 1 and 2, weld projection up to 2 mm is acceptable for butt and plug welded joints. For Categories AESS 3 and 4, welds will be ground smooth/filled.
 - .3 WELD SHOW-THROUGH: It is recognized that the degree of weld show-through, which is any visual indication of the presence of a weld or welds on the opposite surface from the viewer, is a function of weld size and material thickness.

PART 3 – EXECUTION

3.1 Examination

- .1 The erector shall check all AESS members upon delivery for twist, kinks, gouges or other imperfections, which might result in rejection of the appearance of the member. Coordinate remedial action with fabricator prior to erecting steel.
- .2 STANDARD OF ACCEPTANCE: The standard for acceptance of delivered and erected member shall be equivalent to the standard employed at fabrication.

3.2 Preparation

- .1 Provide connections for temporary shoring, bracing and supports only where noted on the approved shop erection drawings. Temporary connections shown shall be made at locations not exposed to view in the final structure or as approved by the Architect. Handle, lift and align pieces using padded slings and/or other protection required to maintain the appearance of the AESS through the process of erection.

3.3 Erection

- .1 Set AESS accurately in locations and to elevations indicated, and according to CSA S16.
- .2 The Erector must plan and execute all operations in such a manner that allows the architectural appearance of the structure to be maintained.
- .3 In addition to the special care used to handle and erect AESS, employ the proper erection techniques to meet the requirements of the specified AESS Category:
 - .1 AESS Erection tolerances: Erection tolerances shall meet the requirements of standard frame tolerance for structural steel per CSA S16.
 - .2 All slings will be nylon strap or chains with softeners.
 - .3 If temporary braces or fixtures are required to facilitate erection, care must be taken to avoid and/or repair any blemishes or unsightly surfaces resulting from the use removal of such temporary elements.
 - .4 Removal of field connection aids: Run-out tabs, erection bolts and other steel members added to connections to allow for alignment, fit-up and welding in the field shall be removed from the structure. Welds at run-out tabs shall be removed to match adjacent surfaces and ground smooth. Holes for erection bolts shall be plug welded and ground smooth where specified. All backing bars will be removed and ground smooth.
 - .5 Filling of connection access holes: Filling shall be executed with proper procedures to match architectural profile, where specified.

- .6 Bolt Head Replacement: All bolt heads shall be placed as indicated on the structural design document. Where not noted, the bolt heads in a given connection shall be on the same side, as specified, and consistent from one connection to another.
- .7 Field Welding: Weld profile, quality, and finish shall be consistent with Category and visual samples, if applicable, approved prior to fabrication.
- .8 Tack welds shall be ground smooth and holes shall be filled with weld metal or body filler and smoothed by grinding or filling to the standards applicable to the shop fabrication of the materials.

3.4 Erection Tolerances

- .1 Unless otherwise specified in the Contract Documents, members and components are plumbed, leveled and aligned to a tolerance equal to the tolerance permitted for structural steel.

3.5 Field Connections

- .1 BOLTED CONNECTIONS: Make in accordance with Section 05 21 19. Provide bolt type and finish as specified and place bolt heads as indicated on the approved shop drawings.
- .2 WELDED CONNECTIONS:
 - .1 Comply with CSA W59 and Section 05 21 19. Appearance and quality of welds shall be consistent with the Category and visual samples if applicable. Assemble and weld built-up sections by methods that will maintain alignment of members to the tolerance of this Section.
 - .2 Assemble and weld built-up sections by methods that will maintain alignment of axes. Verify that weld sizes, fabrication sequence, and equipment used for AESS will limit distortions to allowable tolerances.

3.6 Adjustable Connections

- .1 Specifically designated more stringent erection tolerances for AESS require that the Owner's plans specify/allow adjustable connections between AESS adjoining structural elements, in order to provide the Erector with means for adjustment and/or specify the method to be used to achieve the desired dimensions. Any proposed adjustment details desired by the Erector shall be submitted to the Architect and Engineer for review.

3.7 Architectural Review

- .1 The Architect shall review the AESS steel in place and determine acceptability based on the Category and visual samples (if applicable). The Fabricator/Erector will advise the Consultant of the schedule of the AESS Work.

3.8 Protection

- .1 In addition to requirements of Division 5 "Structural Steel and Open Web Steel Joist Framing" Section 05 21 19, protect AESS steel in accordance with table below.

Environment	Structural Member	Preparation	Protection	Remarks
Protected (Inside vapour barrier)	Structural Steel and Joists	SSPC-SP6 Commercial Blast Cleaning	CISC/CPMA 2-75	
Unprotected (outside vapour barrier) but not exposed to chlorides.	Structural Steel and joists	SSPC-SP6 Commercial Blast Cleaning	Inorganic zinc-rich primer (SSPC Paint 20, type I) and epoxy paint (SSPC Paint 22)	Provide topcoat SSPC Paint 36, Level 3, when exposed to sunlight
Unprotected (outside vapour barrier) exposed to chlorides.	Structural Steel and Joists	SSPC-SP10 Near White Blast Cleaning	Inorganic zinc-rich primer (SSPC Paint 20, type I) and epoxy paint (SSPC Paint 22)	Provide topcoat SSPC Paint 36, Level 3, when exposed to sunlight

Notes:

- (a) Submit proposed coating system for approval of Consultant prior to application.

3.9 Adjusting and Cleaning

- .1 Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint shall be completed to blend with the adjacent surfaces of AESS. Such touch up work shall be done in accordance with manufacturer's instructions.
- .2 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

3.10 Quality Control

- .1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- .2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and give recommendations in writing.
- .3 The Consultant 's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Consultant

are both undertaken to inform the Consultant of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility. The Contractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.

3.11 Notification

- .1 Prior to commencing significant segments of the Work, give the Consultant and Independent Inspection and Testing Companies appropriate notification so as to afford them reasonable opportunity to review the Work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.

3.12 Inspection and Testing

- .1 The Owner will appoint an Independent Inspection and Testing Companies to make inspections or perform tests as the Consultant directs. The Independent Inspection and Testing Companies shall be responsible only to the Consultant, and shall make only such inspections or tests as the Consultant may direct. The representative of the Inspection and Testing Company shall NOT be required to supervise or instruct the Contractor.

3.13 Defective Materials and Work

- .1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength, made and the like, in order to help determine whether the work must be corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, even if the work is deemed acceptable to the Consultant.
- .2 All testing shall be conducted in accordance with the requirements of The Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- .3 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

Table 1 – AESS Category Matrix

	Category	AESS C	AESS 4	AESS 3	AESS 2	AESS 1	SSS
Id	Characteristics	Custom Elements	Showcase Elements	Feature Elements (Viewed at a Distance ≤ 6 m)	Feature Elements (Viewed at a Distance > 6 m)	Basic Elements	Standard Structural Steel (CSA S16)
1.1	Surface preparation to SSPC-SP 6		X	X	X	X	
1.2	Sharp edges ground smooth		X	X	X	X	
1.3	Continuous weld appearance		X	X	X	X	
1.4	Standard structural bolts		X	X	X	X	
1.5	Weld spatters removed		X	X	X	X	
2.1	Visual Samples		Optional	Optional	Optional		
2.2	One-half standard fabrication tolerances		X	X	X		
2.3	Fabrication marks not apparent		X	X	X		
2.4	Welds uniform and smooth		X	X	X		
3.1	Mill marks removed		X	X			
3.2	Butt and plug welds ground smooth and filled		X	X			
3.3	HSS weld seam oriented for reduced visibility		X	X			
3.4	Cross sectional abutting surface aligned		X	X			
3.5	Joint gap tolerances minimized		X	X			
3.6	All welded connections		Optional	Optional			
4.1	HSS seam not apparent		X				
4.2	Welds contoured and blended		X				
4.3	Surfaces filled and sanded		X				
4.4	Weld show-through minimized		X				
C.1			X				
C.2			X				
C.3			X				
C.4			X				

See Notes corresponding to Id (Next Page)

Notes to Table 1

- 1.1 Prior to blast cleaning, any deposits of grease or oil are to be removed by solvent cleaning, SSPC-SP 1.
- 1.2 Rough surfaces are to be deburred and ground smooth. Sharp edges resulting from flame cutting, grinding and especially shearing are to be softened.
- 1.3 Intermittent welds are made continuous, either with additional welding, caulking or body filler. For corrosive environments, all joints should be seal welded. Seams of hollow structural sections shall be acceptable as produced.
- 1.4 All bolt heads in connections shall be on the same side, as specified, and consistent from one connection to another.
- 1.5 Weld spatter, slivers, surface discontinuities are to be removed. Weld projection up to 2 mm [1/16"] is acceptable for butt and plug welded joints.
- 2.1 Visual samples are either a 3-D rendering, a physical sample, a first off inspection, a scaled mock-up or a full-scale mock-up, as specified in Contract Documents.
- 2.2 These tolerances are required to be one-half of those of standard structural steel as specified in CSA S16.
- 2.3 Members marked with specific numbers during the fabrication and erection processes are not to be visible.
- 2.4 The welds should be uniform and smooth indicating a higher level of quality control in the welding process.
- 3.1 All mill marks are not to be visible in the finished product.
- 3.2 Caulking or body filler is acceptable.
- 3.3 Seams shall be oriented away from view or as indicated in the Contract Documents.
- 3.4 The matching of abutting cross-sections shall be required.
- 3.5 This characteristic is similar to 2.2 above. A clear distance between abutting members of 3 mm [1/8"] is required.
- 3.6 Hidden bolts may be considered.
- 4.1 HSS seams shall be treated so they are not apparent.
- 4.2 In addition to a contoured and blended appearance, welded transitions between members are also required to be contoured and blended.
- 4.3 The steel surface imperfections should be filled and sanded.
- 4.4 The back face of the welded element caused by the welding process can be minimized by hand grinding the backside of the weld. The degree of weld-through is a function of weld size and material.
- C. Additional characteristics may be added for custom elements.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

- .1 The Contractor shall ensure that no asbestos containing materials are used in connection with the work of this Section.

1.2 Reference Standards

- .1 Comply with The Building Code Act, as amended, the 2012 Ontario Building Code (OBC) as amended and Regulations and by-laws of other authorities having jurisdiction, including latest amendments thereto; all hereafter referred to as the "Building Code".
- .2 All codes, standard specifications and by-laws referred to in this Specification shall be current editions including all latest revisions, addenda and supplements, unless otherwise noted in the Building Code.
- .3 Conform to the following CSA Standards:
 - .1 S16 Design of Steel Structures.
 - .2 W59 Welded Steel Construction (Metal Arc Welding).
 - .3 W47.1 Certification of Companies for Fusion Welding of Steel.
 - .4 G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 S136 North American Specification for the Design of Cold-Formed Steel Structural Members.
- .4 Conform to the following ASTM Standards:
 - .1 A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - .2 A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings for Iron and Steel Products.
 - .3 A563 Standard Specification for Carbon and Alloy Steel Nuts.

- .4 F436/436M..... Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
- .5 F1554 Standard Specification for Anchor Bolts, Steel, 36, 44 and 105 ksi Yield Strength.
- .6 F3125/F3125M Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
- .5 Conform to:
 - .1 CISC/CPMA 1-73a..... A Quick-Drying One-Coat Paint for Use on Structural Steel.
 - .2 CISC/CPMA 2-75 A Quick-Drying Primer for Use on Structural Steel.
- .6 In the event of conflict between reference standards, codes, drawings and specifications, the Contractor shall request clarification by the Consultant. The Consultant's decision as to which requirements govern shall be final and binding. Generally the more stringent provision shall govern. No extras to the Contract will be approved due to such clarification.
- .7 Conform to the Occupational Health and Safety Act, R.S.O. 1990, c. O.1, last amendment.

1.3 Architectural Exposed Structural Steel (AESS)

- .1 Where finished surfaces of steel are designated as AESS on the Drawings, refer to Section 05 12 13 "Architecturally Exposed Structural Steel" for additional requirements.

1.4 Source Quality Assurance

- .1 The following is MANDATORY;
 - .1 The steel fabricator and erector shall have a minimum of five (5) years of experience on projects of similar size and scope. If requested, the fabricator and erector shall provide documentation with references including contact names and phone numbers.
 - .2 Submit two (2) certified copies of mill reports covering chemical and physical properties of steel used in this work.

1.5 Design of Details and Connections

- .1 Design details, new connections and open web steel joists by a Professional Engineer, to requirements of CSA-S16 or CSA-S136 to resist forces, moments and shears indicated on or implied by the Drawings.
- .2 Unless otherwise noted, beam connections shall be designed for a minimum of 50% of the shear capacity of the beam.
- .3 Conform to the Fire Rated Assembly Design specified for the project.
- .4 Bolts in the following types of connections are to be **pretensioned** in accordance with the requirements of S16:
 - .1 Slip-critical connections.
 - .2 Connections governed by seismic requirements.
 - .3 Connections for all elements resisting crane loads.
 - .4 Connections for members directly supporting running machines or other live loads that produce impact or cyclic load.
 - .5 Connections where bolts are subject to tensile loads.
 - .6 Connections using oversized or slotted holes unless specifically designed to accommodate moment.
- .5 The following types of connections are to be designed as **slip-critical connections**:
 - .1 Connections where slippage cannot be tolerated, including:
 - 1. All moment connections (unless end plate type moment connections are used.
 - 2. Connections where welds and bolts share in transmitting shear forces at a common faying surface.
 - .2 Connections that utilise oversized holes.
 - .3 Connections subject to fatigue or frequent load reversals.
- .6 OPEN WEB STEEL JOISTS
 - .1 Design steel joists and bridging to carry loads indicated or implied by the drawings in accordance with CSA-S16 or CSA-S136. In addition, design joints for any concentrated loads resulting from piping which runs parallel with the joists. Bottom chords shall be designed for a minimum point load of 2 kN at any location, except for bottom chords of joists directly above

mechanical, electrical or equipment areas which shall be designed for a minimum point load of 4 kN at any location.

- .2 Design joists and anchorages for uplift forces as indicated.
- .3 Ensure joists are manufactured to consider load effects due to fabrication, erection and handling.
- .4 Limit floor joist deflection due to specified live load to 1/360 of span.
- .5 Limit roof joist deflection due to specified live load to 1/300 of span.
- .6 For joist spans adjacent to rigid supports (e.g. bearing walls, rigid beams or trusses, or intermediate columns), gradually increase the stiffness of the joists in the vicinity of the rigid support such that the differential live load deflection between adjacent joists spaced at a distance "S" is within 1/360 of 2*S and 1/300 of 2*S, for floor joists and roof joists, respectively.
- .7 Joists which will be permanently exposed shall be neat and uniform in appearance to the approval of the Architect.

1.6 Submissions

- .1 Refer also to **Source Quality Assurance**.
- .2 Refer also to **Quality Control**.
- .3 Prior to submission of SHOP DRAWINGS, submit calculations and sketches for review that bear the stamp and signature of the Professional Engineer responsible for the design. The following are MANDATORY REQUIREMENTS:
 - .1 TYPICAL MOMENT CONNECTIONS.
 - .2 VERTICAL BRACINGS.
 - .3 COLUMN TO BASE PLATE CONNECTIONS.
 - .4 BEAM TO COLUMN SHEAR CONNECTIONS.
 - .5 BEAM TO BEAM CONNECTIONS.
 - .6 COLUMN TO COLUMN "VERTICAL" AND "FUTURE" CONNECTIONS.
 - .7 NON-STANDARD CONNECTIONS.
 - .8 OPEN WEB STEEL JOISTS.
- .4 Submitted Shop Drawings shall cross reference to reviewed and approved calculations and sketches.
- .5 **Shop Drawings**

- .1 Provide erection drawings having a scale no less than the structural framing plans and detail drawings of individual members and complete information necessary for fabrication and erection.
- .2 Copies of Structural Framing Plans and Sections utilized as erection drawings are not permitted unless permission is first sought from and granted by the structural Consultant.
- .3 Submit shop drawings for review as directed.
- .4 All shop drawings shall bear a Professional Seal and Signature.
- .5 OPEN WEB STEEL JOISTS:
 - .1 Provide layout drawings showing location of open web steel joists, and design calculations for joists, covering each case of joist total loading.
 - .2 Drawings and calculations must be prepared using **METRIC** units. If both imperial and metric units are shown, only metric units will be reviewed in context of the rubber stamp placed on each drawing.
 - .3 All steel joists shall be designed by a Professional Engineer experienced in this type of design and all drawings and calculations shall bear a Professional Seal and Signature.
 - .4 OWSJ shop drawings and calculations submitted for review and **NOT BEARING** the stamp of the Professional Engineer responsible for the OWSJ design, and **NOT ACCOMPANIED** by stamped calculations, will **NOT BE REVIEWED** and will be returned to the Contractor.
- .6 Fabrication shall not commence until shop drawings are reviewed.
- .7 Allow ten (10) Working Days for the review of drawings and supply as many copies for review and distribution as directed. Shop drawings shall be checked in detail by the Contractor and shall bear the checker's initials before submission.
- .8 Drawings which fail to meet these requirements shall be returned marked **NOT REVIEWED** and must be re-submitted after correction.
- .9 The review of shop drawings shall not relieve the Contractor of the responsibility of seeing that this work is complete, accurate and in conformity with the Drawings and this Specification.
- .10 Only shop drawings bearing the review stamps shall be kept at the Site.

PART 2 – PRODUCTS

2.1 Materials

.1 MATERIALS

- .1 Structural steel sections and plates and all connection angles and plates shall conform to CSA Standard G40.20/G40.21 as follows:

W shapes – Grade 350W.

S shapes – Grade 300W.

HSS Shapes – Grade 350W (Class C unless noted).

Channels, Angles, Plates and Rod – Grade 300W.

Note that ASTM A500 grade C HSS columns are NOT an acceptable direct substitution for CSA G40.21.

- .2 Welding materials: to conform to CSA Standard W59.
- .3 High Strength Fasteners: Bolts, Nuts, and Washers to conform to ASTM F3125/3125M, grade A325 or A325M.
- .4 Anchor Rods: to conform to ASTM F1554, Grade 36, unless otherwise noted on the drawings
- .5 Sag Rods: to conform to CSA G40.20/G40.21.
- .6 Strap Anchors: to conform to CSA G40.20/G40.21.
- .7 Shear Stud Connectors: to conform to ASTM A108, $F_y = 345 \text{ MPa}$ [50 ksi].
- .8 PAINT:

- .1 General Steel: Shop Primer and Field “touch-up” Paint to conform to SSPC-PAINT 20 (Type I)

- .2 For exterior exposed steel where surfaces are to be primed provide a Corrosion Resistant and Field “touch-up” Primer as follows:

Acceptable product:

- .1 CARBOZINC 11, (Solvent based inorganic zinc)

- .2 Colour, 0300 (GREEN) or 0700 (GRAY)

- .3 Steel Surface Preparation:

A minimum, non-immersion SSPC-SP6 and obtain a 25 to 75 micrometres [1 – 3 mils] Angular Blast Profile.

- .4 Dry Film Thickness:
50 to 75 micrometres [2 – 3 mils] applied by spray (airless or conventional) with constant agitation.
- .5 Field Touch-Up:
Areas less than 0.1 m² [1 ft²]: clean (SSPC SP-1) , manually abrade (SSPC SP-2 or SP-3) and touch-up with Carbozinc 859 (organic zinc, SSPC Paint 20, type II).
Areas more than 0.1 m² [1 ft²]: Tape, re-blast to SSPC SP-6 and spray apply Carbozinc 11 (Inorganic Zinc, SSPC Paint 20, Type I).
- .3 Where an epoxy paint (SSPC Paint 20) is specified in combination with a zinc-rich primer, provide a compatible epoxy paint as follows:

Acceptable product:
 - 1. CARBOGUARD 890 (Cycloaliphatic Amine Epoxy)
 - 2. Dry Film thickness: 100 to 150 micrometres [4.0-6.0 mils]
- .4 For field “touch-up” of galvanized surfaces provide same product as touch-up primer.
- .9 GALVANIZING: For connections at all members specified to be galvanized, provide galvanized nuts, bolts, washers, clip angles and plates etc.

PART 3 – EXECUTION

3.1 Fabrication

- .1 Fabricate structural steel and joists to CSA S16 and W59, and in accordance with reviewed shop drawings.
- .2 Provide drain holes in closed HSS Sections to prevent moisture build-up within the member.
- .3 SHEAR STUDS
 - .1 Install Shear Studs as specified in accordance with CSA W59.
 - .2 Failure of any studs during bending of the studs to an angle of 30 degrees (towards the nearest column for composite beams) will be cause of rejection of the stud welding, and may require further testing at the consultant’s discretion and at the contractor’s expense.
 - .3 A 10% or greater failure rata at the welds of the tested studs will be cause for rejection of all the studs installed by the welder.

- .4 Replacement of failed or rejected studs shall be at the Contractor's expense.

3.2 Protection

- .1 Refer to Section 05 12 13 "Architecturally Exposed Structural Steel" for protection requirements of Architecturally Exposed Structural Steel.
- .2 Cleaning Steel
 - .1 Clean structural steel and joists in accordance with the table below.
 - .2 Clean surfaces within 50 mm (2") of any field weld location of materials which would prevent proper welding or produce objectionable fumes while welding is being completed.
- .3 Painting
 - .1 Shop paint or galvanize structural steel in accordance with the table below. Refer also **Galvanized Sections** for additional requirements.
 - .2 Apply coating under cover, on dry surfaces only and when surface and air temperatures are above 5°C [41°F].
 - .3 Maintain dry conditions and 5°C [41°F] minimum temperature until coating thoroughly dry.
 - .4 Joints which are to be field welded shall be kept free of primer or other coating that could be detrimental to achieving sound weldment.
 - .5 FIELD TOUCH-UP for welds, scrapes, etc.
 - .1 General Interior Surfaces:..... With specified coating
 - .2 Exterior Exposed Surfaces: .. With specified coating
 - .3 Galvanized Surfaces:..... GALVAFROID or equivalent

Environment	Structural Member	Preparation	Protection	Remarks
Dry environment with structural steel encased in concrete, or masonry, or covered in non-corrosive contact type fire proofing	Structural Steel and joists	SSPC-SP3 Power Tool Cleaning	Leave Unpainted	
Protected (Inside vapour barrier)	Structural Steel not exposed to view	SSPC-SP3 Power Tool Cleaning	CISC/CPMA 1-73a OR [Leave Unpainted]	
	Joists not exposed to view	SSPC-SP2 Hand Tool Cleaning	CISC/CPMA 1-73a or SSPC Paint 15	
	Structural Steel or Joists exposed to view, but not designated as AESS	SSPC-SP7 Brush-Off Blast Cleaning	CISC/CPMA 2-75	
Unprotected (outside vapour barrier and/or unconditioned space) but not exposed to chlorides. (See note (a))	Structural Steel	SSPC-SP7 Brush-Off Blast Cleaning + SSPC-SP8 Pickling	Hot Dip Galvanize	Note additional requirements for galvanizing in specification sections.
	Joists	SSPC-SP7 Brush-Off Blast Cleaning + SSPC-SP8 Pickling	Hot Dip Galvanize	Note additional requirements for galvanizing in specification sections.
Unprotected (outside vapour barrier and/or unconditioned space) exposed to chlorides.	Structural Steel and Joists	SSPC-SP10 Near White Blast Cleaning	Inorganic zinc-rich primer (SSPC Paint 20, type I) and epoxy paint (SSPC Paint 22)	Provide topcoat SSPC Paint 36, Level 3, when exposed to sunlight

Notes:

- (a) This includes canopies, outdoor screens, exterior mechanical support framing, shelf angles (including supporting brackets) and lintels in exterior walls.
- (b) Submit proposed coating system for approval of Consultant prior to application.

3.3 Galvanized Sections

- .1 Apply galvanizing to all steel members as noted in clause 3.2.
- .2 Fabricate all framing prior to galvanizing providing all required vent holes and cap plates to ensure complete internal and external coverage is required.
- .3 Galvanize in accordance with A123/A123M to minimum coating of 610 g/m² [2 oz/ft²].
- .4 All bolts, nuts, washers, connector plates, clips, etc. at member connections shall be galvanized.
- .5 Galvanize members after shop welding has been completed.
- .6 When welding after galvanizing is in place, grind away galvanizing at areas to be welded and touch-up with two coats of coating complying with SSPC PAINT 20, type II.
- .7 In cases where galvanized framing is in contact with plain carbon steel locally provide two coats of coating to the plain steel complying with SSPC PAINT 32 where members are in contact.
- .8 Where the galvanizing process of members may cause distortion of the structural framing, submit procedures for review by the Consultant and make good to tolerances noted in the Contract Documents.
- .9 For joists, a 25 mm spacing between chord members is recommended. Provide larger spacing as required to suit the specified surface preparation.
- .10 Identify at time of tender any splices or additional fabrication requirements due to the size, length or weight constraints imposed by the galvanizing process.
- .11 **FINISH PAINTING**

Where finish painting is specified for galvanized surfaces, the galvanizer is to eliminate any after-galvanizing treatment that would normally be applied to the coating that will adversely affect paint adhesion.

3.4 Joist Bridging & Bottom Chord Roof Bracing

- .1 All bridging, bracing and anchorages to be as required by the Drawings and CSA S16.

3.5 Joist Bearing Anchorage

- .1 Conform to Specification, Typical Details and Notes on Drawings unless specifically noted otherwise.
- .2 Joists bearing on steel shall be anchored with welds as shown on Drawings and typical details. Welds shown are minimum.

- .3 Joists bearing on masonry shall be welded to Wall Plates as shown on Drawings and typical details. Welds shown are minimum.
- .4 It is anticipated, in order to accommodate the roof slopes, (refer to Architectural Plans and Details) that it will be necessary to modify OWSJ shoes and/or to provide steel shims to achieve level and sound bearings. The Contractor is to provide all necessary shims, plates etc. in order to maintain uniform slopes, and sound bearing and anchorage.
- .5 Anchors in Masonry for Wall Plates:
 - .1 Unless otherwise shown provide a minimum:
 - .1 For Floor Joists: Refer to typical details on Drawings.
 - .2 For Roof Joists: Two (2) 20 mm [3/4"] diameter anchor rods by 600 mm [24"] long.
 - .2 Embed all anchors vertically and grout in solid.

3.6 Bearing/Wall Plates for Beams

- .1 Provide a minimum of two (2) anchors, 12 mm [1/2"] diameter by 300 mm [12"] long with 50 mm [2"] hook, for all bearing plates on masonry shall be embedded vertically and grouted in solid unless specifically noted otherwise on the Drawings.
- .2 Weld beams to plates with a minimum of two (2) 3 mm x 25 mm [3/16" x 1"] fillet welds unless noted otherwise.

3.7 Relation to Other Trades

- .1 Give all necessary directions for setting anchor rods, bearing plates and other members required to be built in with the work of other trades.
- .2 Verify the location and condition of all bearing surfaces placed by others. All such surfaces shall be at the elevations called for on the Drawings and shall be truly level.
- .3 Commencement of erection implies acceptance of the work of other Sections which affect the work of this Section.
- .4 No claim for relief from contractual responsibility or for extras to the Contract will be allowed unless such claim is made in writing prior to commencement of the work.
- .5 Ensure the proper bearing surface and amount of bearing is available to support steel members including open web steel joists.

- .6 Supply materials and all necessary directions for installation of all anchor rods and bearing plates, and also clips, angles and weld plates for steel deck if and as required. Co-ordinate with steel deck supplier for their actual requirements.
- .7 Weld approved anchor slots at 600 mm [24"] on center for adjustable masonry anchors, on all steel surfaces to be built into masonry.
- .8 Supply and install wall anchors, ceiling extensions, and header supports for trimming openings for all OWSJ.
- .9 Provide and reinforce to the approval of the Consultant, openings through beams required by other trades. Obtain approval of the Consultant for location of the holes. The cost for this work shall be paid for by the trade requiring the openings. Reinforce openings to maintain required design strength.
- .10 Provide at any time before the Drawings are approved, punched holes from 11 mm to 27 mm [0.43" to 1.1"] diameter for the convenience of other trades as requested by them. Holes shall be placed so as not to cause any appreciable reduction in the strength of such members.
- .11 Co-ordinate with the Mechanical and Electrical Drawings and Trades to ensure that there is no interference between ductwork, suspended lighting fixtures and hangers, and the open web steel joists and bridging, or other structural steel members.
- .12 Wherever items are suspended from OWSJ, the securement shall be from the top chords of the joists at panel points only. Unless specific permission is given by the Structural Consultant.
- .13 Refer to Drawings for CONCRETE FILLED COLUMNS.

3.8 Lintels

- .1 Generally lintels will be supplied only by this section and be placed by the General Contractor.
- .2 Lintels shall conform to the Lintel Schedules, Notes and Typical Details on the Structural Drawings.
- .3 While every effort has been made to show all lintels which occur in load bearing masonry walls, it is the Contractor's responsibility to ensure that the correct size and quantity of lintels are provided.
- .4 Lintels in non-load bearing walls and partitions are generally NOT SHOWN ON THE DRAWINGS. All such lintels shall be provided as required and shall conform to the Notes & Typical Details on the structural drawings.
- .5 Refer also to **Galvanizing** earlier in this section.

3.9 Erection

- .1 Commencement of erection implies acceptance of the work of other Sections which affect the work of this Section.
- .2 No claim for relief from contractual responsibility or for extras to the contract will be allowed unless such claim is made in writing prior to commencement of the work.
- .3 Conform to the requirements of CSA S16.
- .4 Provide a competent and experienced supervisor.
- .5 Provide all necessary temporary bracing to keep structure safe and plumb. Bracing on structural drawings is for the finished building only.
- .6 Report all lack of fit to the Consultant before correction.
- .7 Provide and install all necessary packing under open web steel joist shoes. Packing to be of steel so placed as to distribute the joist reaction uniformly on the bearing.
- .8 Obtain written approval from the Consultant prior to field cutting or altering structural steel framing or open web steel joists or bridging.
- .9 Touch-up shop primer to bolts, welds, burned or scraped surfaces at completion of erection.
- .10 Provide proper coordination between the structural steel Subcontractor, the mechanical and electrical Subcontractors to ensure that all required openings through structural steel members or OWSJ are approved and are clearly detailed on the Shop Drawings before fabrication and erection. (Openings are to be reinforced to maintain the required design strengths.) The costs of such openings and/or for the provision of openings installed in the field, are to be borne by the Contractor or the trade requiring the opening, and are not extra to the Contract.

3.10 Tolerances

- .1 Conform to CSA S16 and to the Typical Notes on the drawings.

3.11 Quality Control

- .1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- .2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and give recommendations in writing.
- .3 The Consultant 's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Consultant

are both undertaken to inform the Consultants of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility. The Contractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.

- .4 The structural steel fabricators shall be certified by the Canadian Welding Bureau to the requirements of CSA W47.1, division 1 or 2.
- .5 Searching visual inspection aided by a magnifying glass shall be carried out regularly on all joints during the course of welding and after completion by the fabricators designated welding supervisor, and also by the inspection company's representative. Emphasis shall be placed upon visual inspection to establish correct "Fit-Up" and "Pre-heating".
- .6 All welds are to be stamped with the operator's number or symbols and the fabricator's number assigned by the Canadian Welding Bureau with the requirements of CSA Standard W59.
- .7 Finished shop work must be inspected and approved before shipping to Site and field work must be inspected and approved before the removal of erection equipment from the Site.

3.12 Notification

- .1 Prior to commencing significant segments of the Work, give the Consultant and Independent Inspection and Testing Companies appropriate notification so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective. Advise the Inspection and Testing Company at least twenty-four (24) hours in advance of each fabrication and/or erection sequence.

3.13 Inspection and Testing

1. The Owner will appoint an Independent Inspection and Testing Companies to make inspections or perform tests as the Consultant directs. The Independent Inspection and Testing Companies shall be responsible only to the Consultant, and shall make only such inspections or tests as the Consultant may direct. The representative of the Inspection and Testing Company shall NOT be required to supervise or instruct the Contractor.
- .2 The following are responsibilities of the Contractor regarding the Inspection and Testing Company:
 - .1 Co-operate with the representatives of the Inspection and Testing Company.
 - .2 Provide the Inspection and Testing Company with a copy of Specification, Structural Drawings and reviewed copies of shop drawings.
 - .3 Co-ordinate a program of inspection and testing with the Inspection and Testing Company, and advise the Consultant accordingly.

3.14 Defective Materials and Work

- .1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength, made and the like, in order to help determine whether the work must be corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, even if the work is deemed acceptable by the Consultant.
- .2 All testing shall be conducted in accordance with the requirements of The Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- .3 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

- .1 The Contractor shall ensure that no asbestos containing materials are used in connection with the work of this section.

1.2 Reference Standards

- .1 Comply with The Building Code Act, as amended, the 2012 Ontario Building Code (OBC) as amended and Regulations and by-laws of other authorities having jurisdiction, including latest amendments thereto; all hereafter referred to as the "Building Code".
- .2 All codes, standard specifications and by-laws referred to in this Specification shall be current editions including all latest revisions, addenda and supplements, unless otherwise noted in the Building Code.
- .3 Conform to the following CSA Standards:
 - .1 S136 North American Specification for the Design of Cold Formed Steel Structural Members.
 - .2 W47.1 Certification of Companies for Fusion Welding of Steel.
 - .3 W59 Welded Steel Construction (Metal Arc Welding).
- .4 Conform to the following ASTM Standards:
 - .1 A653/A 653M Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .5 Conform to the following Canadian Sheet Steel Building Institute Standards:
 - .1 CSSBI 10M Standard for Steel Roof Deck.
 - .2 CSSBI B13 Design of Steel Deck Diaphragms.
- .6 Comply with any Fire Rated Assembly Design specified for the project.
- .7 In the event of conflict between reference standards, codes, drawings and specifications, the Contractor shall request clarification by the Consultant. The Consultant's decision as to which requirements govern shall be final and binding. Generally the more stringent provision shall govern. No extras to the Contract will be approved due to such clarification.

- .8 Conform to the Occupational Health and Safety Act, R.S.O. 1990, c. O.1, last amendment.

1.3 Design Requirements

- .1 Design steel deck using limit states design in accordance with CSA S136 and CSSBI 10M.
- .2 Wherever structural framing permits, steel deck shall be designed and fabricated to span continuously over at least four (4) supports (3 spans).
- .3 Provide an adequate increase in thickness of metal to compensate for continuity wherever fewer supports may occur.
- .4 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, and uplift as indicated.
- .5 Deflection of roof deck under specified live or snow load not to exceed 1/300 of span.

1.4 Shop Drawings

- .1 Submit erection drawings
- .2 Fabrication shall not commence until drawings are reviewed.
- .3 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.
- .4 Shop drawings are to bear the Seal and Signature of the Licensed Professional Engineer responsible for the design.
- .5 When requested submit design calculations complete with Stamp and Signature of the responsible Professional Engineer.
- .6 Allow ten (10) Working Days for the review of shop drawings and supply as many copies for review and distribution as directed. Shop drawings shall be checked in detail by the Contractor before submission. Drawings which fail to meet this requirement shall be returned marked NOT REVIEWED.
- .7 The review of such drawings shall not relieve the Contractor of the responsibility of seeing that this work is complete, accurate and in conformity with the Drawings and the Specification.

PART 2 – PRODUCTS

2.1 Materials

- .1 STEEL SHEET to ASTM A653/A653M (Structural quality) minimum grade 230 MPa [33 ksi] with a base nominal thickness (BNT) as noted on the Drawings.
- .2 ZINC COATING
 - .1 Unless otherwise noted, provide a ZF75 (galvanneal) coating as designated by ASTM A653/A653M.
 - .2 Where specified on drawings as GALVANIZED DECK, provide a Z275 coating as designated by ASTM A653/A653M.
 - .3 Deck surfaces which are designated for finish painting (Refer to Architectural Drawings and Finish Schedules) shall not receive chemical treatment that will adversely affect paint application.
- .3 TYPES OF DECKING:
 - .1 Roof deck: Shall be single fluted element with ribs of depth as shown on the Drawings.
 - .2 Acoustic deck: shall be single fluted element with ribs of depths shown on the drawings and with perforations on the vertical faces of the flutes, complete with a sound absorbing strip (fiberglass density 17.6 kg/m³ [1.1 lb. / ft²]) supplied by the deck fabricator for installation by the roofing Subcontractor.
 - .3 Pre-finished deck: where designated is to be pre-painted, provide:
 - .1 Colorite HMP
 - .2 10000 Series
 - .3 Metallic Series
 - .4 Barrier Series
 - .5 Weather X

Colour to be selected later by the Architect from the manufacturer's standard colour chart.
 - .4 Versa-Dek:
 - .1 Where designated shall be VERSA-DEK 3.5 LS as supplied by CSi Metal Deck Group/The Canam Steel Corp.
 - .2 Galvanized sheet steel to A653/A653M minimum grade 230 MPa [33 ksi] with Z275 zinc coating, pretreated and shop painted to CSi Metal Dek Group Versa-Steel System.
 - .3 Colour: Manufacturer's standard primer, white.

- .5 Deck shall have interlocking side joints between panels.
- .4 FASTENERS FOR PRE-FINISHED DECK: (See also VERSA-DEK Standard)
 - .1 Unless otherwise noted, provide self-drilling or self-tapping corrosion resistant fasteners.
Acceptable type: #14 TEK screws or an equivalent.
- .5 CLOSURES:
 - .1 Provide cover plates, edge stiffeners, cell closures and flashings from sheet steel similar to decking with a base nominal thickness of 0.76 mm [0.03"] (22 gauge). (Refer to Architectural Drawings).
 - .2 Provide and install closures at the top of all walls. Type to match the profile and finish of selected decking.
- .6 PRIMER: conform to CAN/CGSB-1.181
 - .1 Acceptable product: CARBOZINC II by Carboline.
- .7 METAL UPSTANDS/CURBS:
 - .1 Where required by the Architectural Drawings provide and install 1.6 mm [0.063"] (16 gauge) galvanized metal upstands.

PART 3 – EXECUTION

3.1 Preparation

- .1 Verify the location and condition of all bearing surfaces placed by others. All such surfaces shall be at the elevation called for on the Drawings.
- .2 Commencement of erection implies acceptance of the work of other Sections, which affect the work of this Section.
- .3 No claim for relief from contractual responsibility or for extras to the Contract will be allowed unless such claim is made in writing prior to commencement of the work.
- .4 Protect steel deck during shipping and handling in accordance with CSSBI standards.
- .5 The steel deck welder must be certified to CSA W47.1 for fusion welding of steel deck.

3.2 Fabrication & Erection

- .1 Conform to CSA S136, CSA W59, CCSBI 10M.

- .2 Erect steel decking as indicated to manufacturer's direction and to reviewed shop drawings.
- .3 No hangers or brackets supporting mechanical and electrical services, artwork, ceilings, bulkheads, lighting, etc. shall be hung directly from the floor or roof deck. All point loads must be applied directly to structural steel framing unless otherwise shown or approved by the structural Consultant.
- .4 Accurately align the deck and lap at supports. Use 50 mm [2"] minimum lap.
- .5 Supply and place steel packing as required to produce an even bearing pressure at supports.
- .6 Any material which has been damaged shall be replaced at no expense to the Owner.
- .7 Provide for ribs to bear on beams parallel to flutes when tops of such beams are at same elevation as deck bearing.
- .8 Provide reinforcing stiffeners for unsupported edges of metal deck.
- .9 Install 50 x 50 x 6 mm [2" x 2" x ¼"] steel angles or formed channels perpendicular to flutes, welded to 2 flutes each side of opening for deck openings from 150 to 450 mm [6" to 18"] in size. No reinforcement required for openings cut in the deck that are smaller than 150 mm [6"] square.
- .10 For deck openings over 450 mm [18"] and for areas of concentrated load, reinforce in accordance with structural framing details.
- .11 Install closures and upstands as shown on Drawings and reviewed shop drawings.
- .12 After alignment and levelling and unless otherwise noted on the Drawings, the minimum attachment of the deck to the bearing surfaces and the minimum side lap connections between deck units shall be:
 - .1 For 38 mm deck profiles, connect the first, third, fifth and seventh low corrugations (36/4 configuration), and each support parallel to flute direction at 300 mm [12"] maximum centers. Connections shall be made using either an arc spot weld with 20 mm [¾"] nominal top diameter, or mechanically fastened using Hilti powder actuated fasteners (X-HSN24, HILTI X-ENP19, or equivalent).
 - .2 For 76 mm deck profiles, connect the first, third and fifth low corrugations (24/3 configuration), and each support parallel to flute direction at 300 mm [12"] maximum centers. Connections shall be made using either an arc spot weld with 20 mm [¾"] nominal top diameter, or mechanically fastened using Hilti powder actuated fasteners (X-HSN24, HILTI X-ENP19, or equivalent).

- .3 Side laps of adjacent nestable units shall be crimped together at 900 mm [36"] centres, or fastened with Hilti M HWH screws (SLCO1, SLC02, or equivalent) at 900mm [36"] on centre.
- .13 Immediately after decking is permanently secured in place, where top and/or bottom surfaces have been burned by welding or where surface coating has been damaged during transit or in erection.
 - .1 Touch-up galvanized surfaces with coating complying with SSPC-PAINT 20.
- .14 VERSA-DEK Attachement
 - .1 End and Intermediate Supports: 16 mm [5/8"] arc spot (puddle) welds in each rib maximum 300 mm [12"] centres.
 - .2 Perimeter Side Supports: 16 mm [5/8"] arc spot (puddle) welds at each support line and at maximum 300 mm [12"] centres.
 - .3 Deck to Deck (side-laps): Minimum 38 mm [1½"] long welds at each support and at a maximum 900 mm [36"] centres.

3.3 Quality Control

- .1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- .2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and give recommendations in writing.
- .3 The Consultant's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Consultant are both undertaken to inform the Consultants of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility. The Contractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.

3.4 Notification

- 1. Prior to commencing significant segments of the Work, give the Consultant and Independent Inspection and Testing Companies appropriate notification so as to afford them reasonable opportunity to review the Work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.

3.5 Inspection and Testing

1. The Owner will appoint an Independent Inspection and Testing Companies to make inspections or perform tests as the Consultant directs. The Independent Inspection and Testing Companies shall be responsible only to the Consultant, and shall make only such inspections or tests as the Consultant may direct. The representative of the Inspection and Testing Company shall NOT be required to supervise or instruct the Contractor.
- .2 The following are responsibilities of the Contractor regarding the Inspection and Testing Company:
 - .1 Co-operate with the representatives of the Inspection and Testing Company.
 - .2 Provide the Inspection and Testing Company with a copy of Specification, Structural Drawings and reviewed copies of shop drawings.

3.6 Defective Materials and Work

- .1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength, made and the like, in order to help determine whether the work must be corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, even if the work is deemed acceptable to the Consultant.
- .2 All testing shall be conducted in accordance with the requirements of The Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- .3 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Work of this section includes metal fabrications and related metals including, but not limited to, the following:
 - .1 Pipe rails.
 - .2 Handrails, guards, balustrades, toe guards, steel guardrail mesh.
 - .3 Bollards.
 - .4 Loose steel lintels.
 - .5 Steel angles.
 - .6 Roof access ladders.
 - .7 Four-fold door frames.
 - .8 Overhead door frames.
 - .9 Steel posts for patio fence.
 - .10 Steel pedestals.
 - .11 Steel caging.
 - .12 Single Compartment Scullery Sink

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Submit list of fabrications to be Provided as part of the work of this Section.
- .3 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.
- .4 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Include plans, sections and large scale details, and shall indicate components and methods of assembly, materials and their characteristics, fastenings, metal finishes, welds, and their structural characteristics relative to their purpose, and other fabrication information required.
 - .3 Indicate proposed Site connections and methods.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors: The work of this Section shall be executed only by a Subcontractor who has adequate plant, equipment, and skilled tradespersons to perform

work expeditiously, and is known to have been responsible for satisfactory installations similar to that required in the Work during a period of at least the immediate past 5 years.

- .2 Licensed professionals: retain a Professional Engineer to design the work of this Section; to prepare, seal and sign shop drawings; and to perform field review. Shop drawings shall show both design and installation requirements.
- .2 Requirements of regulatory agencies: the work of this Section that functions to resist forces imposed by dead and live loads shall conform to requirements of Authorities Having Jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Label, tag or otherwise mark metal fabrications supplied for installation by other Sections to indicate its function, location in building and shop drawing designation.
- .2 Protect work from damage during delivery, storage and handling.
- .3 Deliver work to location at the Place of the Work designated by Contractor and to meet requirements of the construction schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Design, fabricate, and install work of this Section in accordance with the Building Code and requirements of all other Authorities Having Jurisdiction.
- .2 Welding:
 - .1 Weld structural components in steel to conform to requirements of CSA W59-15, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-09(2014) and CSA W55.3-08 (R2013) as applicable.
- .3 Design assemblies and connections to withstand own dead load, live loads, super-imposed dead loads, and fabrication forces, without permanent distortions or deformation, to maximum allowable deflection of L/360, within the following construction tolerances:
 - .1 Maximum variation from plumb in vertical lines:
 - .1 3.2 mm (1/8") in 3 m (10 ft)
 - .2 Maximum variation from level:
 - .1 3.2 mm (1/8") in 9 m (30 ft).
 - .3 Maximum variation from straight:
 - .1 3.2 mm (1/8") in 3 m (10 ft) under a 3 m (10 ft) straight edge.
 - .4 Maximum variation from angle indicated:
 - .1 10 seconds.
 - .5 Tolerances shall be non-cumulative.
- .4 Design of metal fabrications to be by a Professional Engineer, except work designed on structural drawings. Professional Engineer to be experienced in this type of engineering and in accordance with Section 01 33 00.

2.2 MATERIALS

.1 General:

- .1 Unless detailed or specified otherwise, standard Products will be acceptable if construction details and installation meet intent of the Contract Documents.
- .2 Include materials, Products, accessories, and supplementary parts necessary to complete assembly and installation of work of this Section.
- .3 Incorporate only metals that are free from defects that are visible, or that impair strength or durability. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharply defined profiles.
- .4 The Professional Engineer responsible for the production of the shop drawings is responsible for structural design, member sizes, arrangement, connections and anchoring of work of this Section. Coordinate and maintain materials, dimensions, layout and appearance to meet intent of the Contract Documents.

.2 Metals:

- .1 Steel, structural shapes, plate, bars: hot-rolled, CSA G40.21-04, Grade 300W.
- .2 Steel, hollow structural sections: hot-formed, seamless, CSA G40.21-04, Grade 350W, Class H.
- .3 Steel (mild), sheet and strip, hot rolled, ASTM A1011/A1011M-10.
- .4 Steel, sheet: cold rolled, stretcher levelled, fully pickled, ASTM A1008/A1008M- 11, Grade CS Type A exposed, matte finish, dry, unless otherwise indicated.
- .5 Steel pipe: ASTM A53 / A53M - 10, Type E or S, Grade A or B, standard weight, Schedule 40 seamless black or AISI MT 1010/1015, or equivalent.

2.3 ACCESSORIES

.1 Fasteners:

- .1 Fasteners: Exposed fasteners to match the material surface on which they occur.
- .2 Fasteners for stainless steel to be stainless steel 300 Series or stainless steel 400 Series.
- .3 Fasteners in contact with aluminum to be stainless steel 300 Series, stainless steel 400 Series, cadmium plated or aluminum.
- .4 Bolts and anchor bolts: to ASTM A307-14.
- .5 High strength bolts: to ASTM A325-14.
- .6 Use embedded epoxy set anchors for anchorage to concrete at exterior locations exposed to weather, unless otherwise indicated; installation and embedment depth shall be as per manufacturer's instructions, embedment depth shall not be greater than 80% of concrete thickness.
- .7 Other types of fasteners as appropriate to meet design requirements.

.2 Welding materials:

- .1 Steel: to CSA W59-15.
- .3 Grout:
 - .1 Epoxy grout; non-shrink, non-expanding:
 - .1 Hilti 'HY-150'.
 - .2 Sika 'Sika AnchorFix 3001'.
 - .3 W.R. Meadows 'REZI-WELD 3/2 EPOXY GROUT/PATCH'.
 - .4 Or equivalent.
 - .2 Cementitious grout: non-shrink, non-expanding to ASTM C1107/C1107M-14a:
 - .1 Sika 'Sika Grout 212' or 'Sika M-Bed Standard'.
 - .2 W.R. Meadows 'Sealtight CG-86 Construction Grout'.
 - .3 Or equivalent.
- .4 Dielectric separator: Best grade, quick drying non-staining alkali resistant bituminous paint to CAN/CGSB 1.108-M89, or membrane type to acceptance of Consultant.

2.4 FINISHES

- .1 Shop primer; steel: CISC/CPMA 2-75 or SSPC-Paint 20, Paint Specification No. 20: Zinc-Rich Primers (Type I "Inorganic" and Type II "Organic").
- .2 Shop primer; galvanized steel in pool or arena environments: in accordance with Section 09 91 00.
- .3 Zinc rich paint; steel: Two-component zinc-rich coating, zinc powder to ASTM D520 Type III, SSPC-Paint 20, Type 1 Inorganic or single-component zinc-rich coating to SSPC-Paint, Type 2 Organic, CAN/CGSB 1.181-M99, VOC content <100 g/l to ASTM- D1475.
 - .1 Acceptable Products:
 - .1 Aervoe Industries, Inc. 'Low VOC Cold Galvanize Coating 93% Zinc'.
 - .2 ZRC Worldwide 'ZRC Zero-VOC Galvanizing Compound'.
 - .3 Or equivalent.
- .4 Hot dip galvanizing: for irregular sections, conforming to CAN/CSA G164-M92, minimum zinc coating of 600 g/m². Use air cooling method (no water or chromate dipping treatment permitted).

2.5 FABRICATION

- .1 General:
 - .1 Fabricate metal fabrications with machinery and tools specifically designed for the intended manufacturing processes and by skilled tradesmen.
 - .2 Fit and assemble metal fabrications in shop. When this is not possible, make a trial shop assembly.

- .3 Incorporate anchors at 610 mm (24") on centre or as otherwise required for secure attachment for metal fabrications located in cast-in-place concrete and concrete masonry units.
- .4 Incorporate means for fastenings of other work secured to work of this section.
- .5 Do welding work in accordance with CSA W59-15 as applicable, unless specified otherwise.
- .2 Construction:
 - .1 Fabricate with materials, component sizes, metal gauges, reinforcing, anchors, and fasteners of adequate strength to withstand intended use, and within allowable design factors imposed by jurisdictional authorities. Fabricate items from steel unless otherwise noted.
 - .2 Ensure that metal fabrications will remain free of warping, buckling, opening of joints and seams, distortion, and permanent deformation.
 - .3 Construct items that are part of floor construction, such as gratings and trench covers, to support the same live loads for which surrounding floors are designed unless indicated otherwise.
 - .4 Drill drainage holes at exterior exposed tubular fabrications to permit drainage of moisture to exterior of metal fabrications.
- .3 Assembly:
 - .1 Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.
 - .2 Provide smooth welds with splatter removed where exposed to view.
 - .3 Allow for differential movements within assemblies and at junctions of assemblies with surrounding Work.
 - .4 Field welding of hot dipped galvanized members permitted only when other fastening methods are not possible. Locations of field welds to be clearly identified on reviewed shop drawings.
 - .5 Incorporate holes and connections for work installed under other sections.
 - .6 Cleanly and smoothly finish exposed edges of materials including holes.
 - .7 Cap open ends of sections exposed to view, such as pipes, channels, angles, and other similar work.
- .4 Shop prime painting:
 - .1 Clean loose mill scale, rust, dirt, weld flux and spatter from the work after fabrication.
 - .2 Prepare and prime paint in accordance with manufacturer's installation instructions. Prepare steel by methods specified in CISC/CPMA 2-75 or SSPC SP3.
- .5 Galvanizing:
 - .1 Galvanize metal fabrications following fabrication.
 - .2 Paint damage galvanized surfaces with zinc rich paint, immediately following damage to galvanized protection. Prepare substrate to remove oil and grease to SSPC-SP1, rust scale to SSPC-SP3, mill scale to SSPC-SP6.

- .3 Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes in exterior fabrications, by plugging with zinc solder and filing off smooth.

2.6 SINGLE COMPARTMENT SCULLERY SINK

- .1 Single Compartment Scullery Sink shall be Franke Kindred Canada Limited Classic Series Model SL2448-5 or equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Take measurements at the Place of the Work to ensure that metal fabrications are fabricated to fit surrounding construction, around obstructions and projections in place, or as indicated, and to suit service locations. The Contractor is responsible for confirming all Site dimensions.

3.2 INSTALLATION

- .1 Install metal fabrications plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding work.
- .2 Include in work of this Section anchor bolts, high tensile bolts, washers and nuts, expansion bolts, toggles, straps, sleeves, brackets, clips, and other items necessary for secure installation as required by loading and Authorities Having Jurisdiction. Weld to CSA-S16-09.
- .3 Attach metal fabrications to interior concrete and masonry with corrosion resistant expansion bolts to support load with a safety factor of 3.
- .4 Attach metal fabrications to exterior concrete and masonry with non-shrink epoxy cement to support load with a safety factor of 3.
- .5 Insulate between dissimilar metals or between metal, and masonry or concrete with bituminous paint to prevent electrolytic action.
- .6 Where indicated, grout metal posts, pickets, balusters, and the like, in metal sleeves cast into concrete, with non-shrink quick setting epoxy anchor cement, unless detailed otherwise. Fabricate sleeves of 75 mm (3") minimum in depth.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

3.3 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

3.4 ADJUSTING AND CLEANING

- .1 After erection, touch up primed surfaces that are burned, scratched or otherwise damaged with prime paint to match shop paint.
- .2 Clean and repair areas of bare metal and welds on galvanized surfaces with zinc rich paint. Welded area of members to be masked to minimize overpainting of adjacent undamaged surfaces. Prepare substrate to remove oil and grease to SSPC-SP1, rust scale to SSPC-SP3, mill scale to SSPC-SP6.
- .3 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.

3.5 PROTECTION

- .1 Maintain protection of work of this section from time of installation until final finishes are applied or to final cleanup.
- .2 Protect finished surfaces from damage.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

- .1 Post Guard polyethylene plastic pipe sleeves for steel pipe bollards

1.2 SYSTEM DESCRIPTION

- .2 Performance Requirements
 - .1 High molecular weight material. Designed for optimum balance of density, molecular weight and molecular weight distribution demonstrating maximum property advantages for large products that require high impact resistance.
 - .2 Ultraviolet Protection Additive. Five (5) Year UV stabilizer package. Warranty 5 Years.
 - .3 Thickness Nominal wall thickness will be 0.125 inch
 - .4 Abrasion Resistant
 - .5 Environmental Stress Cracks Resistant
 - .6 Reflective Tape: Each Post Guard has two strips of 3M Series Reflective tape recessed on the part 5.875 inches apart
 - .7 Flexural Modulus: 200,000 psi
 - .8 Tensile Strength: 4,000psi

1.3 DELIVERY, STORAGE & HANDLING

- .1 The Contractor shall place order in a timely fashion to ensure construction schedule is not adversely impacted.
- .2 Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact

PART 2 - PRODUCTS

2.1 BOLLARD SLEEVES

- .1 Manufacturer:
 - .1 Encore Commercial Products, Inc - Sure Guard
 - a. Contact information: 5 Shirley Ave. Kitchener Ontario N2B 2E6.
 - i. Tel: 519-772-1976, Toll Free: 1-800-756-3537, Fax: 519-570-4333
 - ii. Email: info@sureguard.ca
 - iii. website: www.sureguard.ca;
 - .2 Or equivalent.

2.2 MATERIALS

- .1 HDPE and LDPE Polyethylene

- .1 Size: as required for all bollards.
- .2 Colours: to be selected from manufacturer's full range.
- .3 Tape colors: to be selected from manufacturer's full range.

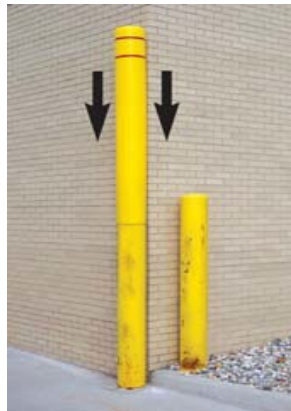
PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify the steel pipe cores are set true, correctly aligned and well anchored in below grade concrete encasement.
- .2 Fill cores with concrete and strike level across the top of pipe.

3.2 INSTALLATION

- .1 Centre two foam strips (included) over bollard. Slide the Post Guard over the bollard and foam will expand for a snug fit.



END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 The work of this section includes, but is not necessarily limited to, the following:
 - .1 Plywood backing panels.
 - .2 Wood grounds, nailers, blocking and sleepers.
 - .3 Wood roof blocking.
 - .4 Wood panel sheathing.
 - .5 Wood studs.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings:
 - .1 Clearly indicate details of construction, profiles, jointing, fastening and other related details.
- .3 Certificates:
 - .1 Pressure treated lumber and plywood shall be accompanied by supplier's certificate of conformance with this specification.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

PART 2 - PRODUCTS

2.1 WOOD MATERIALS

- .1 General requirements:
 - .1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content not greater than 19% at time of installation, in accordance with following standards:
 - .1 CSA O141-05.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds:
 - .1 Use S2S material.
 - .2 Dimension lumber sizes: in compliance with Section 12 of the NLGA.
 - .3 Dimension lumber species and grades:

- .1 Spruce-Pine-Fir.
- .2 Light framing to NLGA Construction grade, S-Dry.
- .3 Planks to NLGA No. 2 grade, S-Dry.
- .4 Boards to NLGA No. 4 Common grade, S-Dry.
- .3 Curbs, nailers, plywood for roofing: Spruce species, NLGA construction grade, sound and free of imperfections or deficiencies making unsuitable for use. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- .1 Pressure treat with wood preservative.
- .4 Studs and framing: S-P-F Species Group, S-Dry or kiln dried, Stud Grade or No. 2 Grade unless otherwise indicated.

2.2 WOOD TREATMENT

- .1 Wood preservative pressure treatment:
 - .1 Wood shall be pressure treated with wood preservative treatment to CAN/CSA O80. Treat end cuts with compatible end cut preservative.

2.3 PANEL MATERIALS

- .1 Softwood plywood (CSP): to CSA O151-09.
- .2 Douglas Fir plywood (DFP): to CSA O121-08.

2.4 SHEATHING MATERIALS

- .1 Exterior sheathing:
 - .1 Exterior grade plywood, thicknesses as follows:
 - .1 Walls: 12.7 mm (1/2") minimum, unless otherwise indicated.
 - .2 Roofs: 15.9 mm (5/8") minimum, unless otherwise indicated.

2.5 FASTENINGS AND HARDWARE

- .1 General:
 - .1 Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 38 mm (1-1/2") into wood substrate.
 - .2 Anchors to concrete and unit masonry: Capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M-15, conducted by a qualified independent testing and inspecting agency.
 - .3 Use surface fastenings of following types, except where specific type is indicated.
 - .1 To hollow masonry, plaster and panel surfaces use 9 mm (11/32") expansion bolts or other acceptable anchor.
 - .2 To solid masonry and concrete use expansion bolts.

- .3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws, or welded stud-bolts.
- .4 To steel deck use bolts through drilled hole or power driven self-drilling screws.
- .4 Fastener materials:
 - .1 Hot-dip galvanized fasteners: ASTM A153/A153M-09 Class A or B1 G185 (CAN/CSA G164-M92 minimum zinc coating of 600 g/m²) and connectors meeting ASTM A653/A653M-11 Class G-185 sheet (CAN/CSA G164-M92 minimum zinc coating of 600 g/m²) or better.
 - .2 For pressure-preservative-treated wood, use stainless-steel Type 304 fasteners.
- .5 Hardware materials:
 - .1 Hot-dipped galvanized to CAN/CSA G164-M92 with minimum zinc coating of 600 g/m² or hot-dipped galvanized fasteners complying with ASTM A153/A153M-09, Class A or B1, and connectors complying with ASTM A653/A653M-11, Class G185.
- .2 Sheathing fasteners: Bugle head, corrosion resistant steel, power driven type, minimum length of 3 times thickness of sheathing.
- .3 Sill plate anchors: 15.9 mm (5/8") diameter bolts, spaced not more than 1.6 m (5'-1/4") o.c. Embed anchor bolts 150 mm (6") minimum into foundation wall so that they may be tightened without withdrawal from concrete. Washers: 2.5 times size of bolt and HEX nuts.

2.6 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Layout work carefully and to accommodate work of others. Cut and fit accurately. Erect in position indicated. Align, level, square, plumb, and secure work permanently in place.
- .2 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolt head and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of work.
- .3 Cooperate with work of other sections to ensure that unity of actions will ensure orderly progress to meet construction schedule.
- .4 Include in work of this section rough hardware such as nails, bolts, nuts, washers, screws, clips, and connectors required for complete and proper installations; and operating hardware required on work of this section for temporary use.
- .5 Do not attach work by wood plugs or blocking in concrete or masonry.
- .6 Do not regard nailers, blocking, and such other fastening provision indicated as exact or complete. Install required provisions for fastening, located and secured to suit Place of the Work conditions, and adequate for intended support.

- .7 Cut work into lengths as long as practical and with square ends. Erect work plumb, in true planes, and fastened rigidly in place.
- .8 Verify that grounds required for fastening of components and equipment are located correctly, and sized for adequate support.
- .9 Secure wall sheathing horizontally perpendicular to studs, with ends staggered, over firm bearing.

3.2 CURBS, SUPPORTS, AND BLOCKING AT ROOFING ASSEMBLIES

- .1 Install wood curbs, upstands, supports and blocking and securely attach to structure, trimmed and levelled to receive flashings and applied roofing materials.
- .2 Slope solid wood caps at parapets to provide positive moisture drainage toward roofing membrane unless otherwise indicated.
- .3 Provide wood nailers of minimum 38 mm (1-1/2") thick solid wood members for anchorage of fasteners.
- .4 Securely attach wood members to substrate by anchoring and fastening as indicated, complying with the following:
 - .1 Attach each item in the build-up with fasteners or anchors at spacing not exceeding the following:
 - .1 Wood to wood:
 - .1 Screws: 450 mm (18").
 - .2 Nails: 300 mm (12").
 - .2 Wood to metal:
 - .1 Screws: 450 mm (18").
 - .2 Bolts/washers: 1220 mm (48").
 - .3 Wood to concrete/concrete block:
 - .1 Tapcon type screws: 450 mm (18").
 - .2 Expansion/toggle bolts/washers: 1220 mm (48").
 - .2 Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces.
 - .3 Size fasteners for embedment into substrate in accordance with manufacturer's installation instructions.
- .5 Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood.

3.3 EQUIPMENT BACKBOARD

- .1 Provide backboards for mounting equipment as required. Use 19 mm (3/4") Softwood Plywood.
- .2 Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28 for requirements for electrical backboards.

END OF SECTION

PART 1- GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Work of this section includes architectural woodwork including, but not limited to, the following:
 - .1 Standing and running trim.
 - .2 Cabinetry and hardware.
 - .3 Plastic wood benches and fabrications.
 - .4 Solid surfacing countertops and fabrications.
 - .5 Wood wall panels.
 - .6 Factory and site finishing of architectural woodwork.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

- .1 Coordinate with other work for satisfactory and expeditious completion of the work of this section. Coordinate with partition accessories, electrical, communications, and finish components to ensure that proper provisions are made for the installation of the work of this section and for work by others.
- .2 Where woodwork is to be fitted to other construction, check actual dimension of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delays in the Work.
- .3 Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the work of this section and set in place. Instruct applicable Subcontractors as to their locations.
- .4 Provide cut-outs for raceways, sleeves, grommets and other manufactured accessories which are required for the work of this section and for work by others.

1.3 SUBMITTALS

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Product data sheets:

- .1 Submit manufacturer's Product data for each type of Product and process proposed for use in the work of this section and incorporated into items of architectural woodwork.

.3 Shop drawings:

- .1 Submit shop drawings for the work of this section complying with the Architectural Woodwork Standards, Edition 1, 2009 requirements.
- .2 Indicate quality standards and grades.

- .3 Include full scale drawings of all exposed-to-view edge conditions.
- .4 Include plans, sections and large scale details, and indicate components and methods of assembly, fastenings, and other fabrication information required for the work of this section. Indicate assembly joint lines.
- .5 Include materials and their characteristics and finishes as applicable including the following:
 - .1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.
 - .2 Adhesive types to be used and locations.
 - .3 Finishing requirements including Architectural Woodwork Standard finish system number, sheen, and required application steps.
- .6 Submit coordination drawings indicating locations of concealed grounds, cut- outs, plates, and other required fabrications.
- .7 Show relation to adjoining construction, details of outside and inside corners and door openings.
- 4 Verification samples:
 - .1 Submit samples for purpose of verification of compliance with specified requirements.
 - .2 Submit 3 sets of 200 mm x 200 mm (8" x 8") samples, or 200 mm (8") long as applicable, of each specified Product, material and finish, including but not limited to the following:
 - .1 Shop finished materials, showing each type of finish and colour.
 - .2 Samples of each specified Product, in each specified colour and finish.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Architectural woodwork shall be manufactured by a firm having a minimum of 5 years experience on work of similar size and quality.
 - .2 Shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.

- .3 Fabricator solid surfacing: Fabrication to be performed by a solid surface manufacturer's certified fabricator Submit certification letter prepared by the solid surfacing manufacturer.
- .2 Installers / applicators / erectors: engage an installer who has successfully completed 2 architectural woodwork projects similar in scope, materials and design to this Project within the last 5 years.
- .2 Quality standard:
 - .1 Work shall be in accordance with the Architectural Woodwork Standards, Edition 2, 2014, Premium Grade, or the highest grade available for performance and appearance characteristics of materials in Sections 3 – 5 used that apply to Product fabrication and installation requirements governed by Sections 6 – 12.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Protect architectural woodwork during transit, delivery, storage and handling to prevent damage, spoilage, and deterioration.
- .2 Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate architectural woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified under paragraph Field Conditions.
- .3 The Contractor shall be solely responsible to make certain that architectural woodwork is not delivered until the building and storage areas are sufficiently dry so that the architectural woodwork will not be damaged by excessive changes in moisture content. The Contractor shall coordinate the delivery of the woodwork with the architectural woodwork manufacturer.

1.7 FIELD CONDITIONS

- .1 Environmental conditions:
 - .1 During storage and installation: Obtain and comply with Architectural Woodwork Standard's for optimum temperature and relative humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained. Woodwork shall be acclimatized for a minimum of 72 hours prior to commencing woodwork installation.
 - .2 During finishing: Comply with Architectural Woodwork Standard's temperature and humidity requirements before, during, and after application of finishes.
 - .3 During service life of woodwork: Obtain and comply with woodwork manufacturer's advice for optimum temperature and humidity conditions for woodwork. Note that building humidity control is not in operation 24 hours per day or 365 days per year and system is intermittent during winter and summer months. As a result, fabrication of wood components should anticipate major changes in humidity levels.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Casework integrity shall meet the minimum acceptance levels in accordance with SEF 8- 1999 as outlined in the Architectural Woodwork Standards, Edition 2, 2014 and additional or greater loading capacities as specified throughout the Architectural Woodwork Standards.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the Architectural Woodwork Standards, Edition 2, 2014 based on shelf thickness indicated or scheduled.
- .3 Welding:
 - .1 Weld components in steel to conform to requirements of CSA W59-15, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-09(2014) and CSA W55.3-08 (R2013) as applicable.
 - .2 Weld components in aluminum to conform to requirements of CSA W59.2-M1991 (R2013), and by a fabricator certified by the Canadian Welding Bureau to conditions of CSA W47.2-12.
 - .3 Weld stainless steel components to conform to requirements of CSA W59-15 and ANSI/AWS D1.6/D1.6M as applicable, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-09(2014).

2.2 GENERAL

- .1 Single-source manufacturing and Installation responsibility: Engage a qualified manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

2.3 WOOD MATERIALS

- .1 Lumber:
 - .1 Hardwood for concealed blocking and framing: Economy grade, any species that, when painted, will not show any defects.
 - .2 Moisture content: Provide kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.
 - .3 Solid hardwood painted finish.
 - .1 Species:
 - .1 White Birch.
 - .2 Cut:
 - .1 Rift.

- .2 Wood veneers:
 - .1 Allowable wood veneer face grade characteristics shall comply with Architectural Woodwork Standards, Edition 2, 2014 referenced grade and referenced standards.
 - .1 Species
 - .1 White Birch.
 - .2 Veneer cut:
 - .1 Rotary.
 - .3 Veneer leaf matching:
 - .1 Random.
 - .2 Edgeband exposed panel edges with 6 mm (1/4") thick solid hardwood trim, unless otherwise indicated.
- .3 Medium density fibreboard (MDF):
 - .1 To ANSI A208.2-2009, 720 kg/m³ (45 lbs/ft³) minimum density and as follows:
 - .1 Grade:
 - .2 Grade 130.
 - .2 Formaldehyde emission: F21 for panel thicknesses greater than 8mm 8 mm (5/16") and F13 for panels equal to or thinner than 8 mm (5/16").
 - .3 Acceptable *Products*:
 - a. Uniboard Canada Inc
 - b. Finish: Riva - H52
 - c. or equivalent

2.4 PANEL MATERIALS

- .1 Panel material schedule; except where indicated otherwise in the Contract Documents:
 - .1 Thickness: 19 mm (3/4") minimum.
 - .2 Core panels:
 - .1 At veneered work: MDF, except at shelving use veneer core plywood.
 - .2 Plywood backing; countertops, backsplashes, and where indicated: Veneer core plywood with Type II adhesive, sanded good one side or good two sides (when both sides exposed or to receive applied finish materials) plywood, with no added urea-formaldehyde used in composition.
 - .3 Maximum moisture content at time of installation: 10% to 12%.
- .2 Plywood:
 - .1 Veneer core plywood non telegraphing grain:
 - .1 Softwood plywood: to ANSI/HPVA HP-1-2009.
 - .2 Douglas Fir plywood: to US Plywood Standard APA PS-1-09.

.3 Medium density fibreboard (MDF):

.1 To ANSI A208.2-2009, 720 kg/m³ (45 lbs/ft³) minimum density and as follows:

.1 Grade:

.1 Grade 130.

.2 Formaldehyde emission: F21 for panel thicknesses greater than 8mm 8 mm (5/16") and F13 for panels equal to or thinner than 8 mm (5/16").

.3 Acceptable *Products*:

a. Uniboard

b. Finish: Riva - H52

c. Or equivalent

.4 Engineered stone; quartz-based fabricated stone surfacing:

.1 Composition: 93% crushed quartz aggregate combined with resins and pigments and fabricated into slabs using a vacuum vibro-compaction process, and as follows:

.1 Thickness: as indicated.

.2 Colour:

.1 Type 1: Caesarstone #2141.

.3 Finish:

.1 Polished.

.4 Acceptable Product: CaesarStone Quartz Surfacing, by U.S. Quartz Products Inc.

.5 Flame Spread Value (FSV): Maximum 25.

.6 Smoke Developed Value (SDV): Maximum 50.

.5 Shower benches and boards for coat hooks:

.1 Plastic wood; as manufactured by Trex or equivalent, colour to later selection by the Consultant from the manufacturer's full range.

2.5 FASTENERS AND ADHESIVES

.1 Wood screws: FF-S-111D Amendment 1 (1989), type, size, material and finish as required for the condition of use.

.2 Nails: FED FF-N-105, type, size material and finish as required for the condition of use.

.3 Anchors: Type, size material and finish as required for the condition of use.

.4 Fastening devices shall be set or countersunk flush with surface of framing member. No exposed fasteners permitted. Where accepted by the Consultant, exposed fasteners shall be flat head hex socket cap screws and matching joint connector sex bolts (also known as Chicago screws or post and screw) by Murakoshi, distributed by Richelieu or equivalent, Spaenaur Joint Connector bolt with decorative head, hex drive series; finish as selected by the Consultant.

.5 At butt joints in railing caps and counter surfaces, employ assembling bolts to ensure tight structural joint.

- .6 Adhesives: Type II water resistant, except use Type I waterproof in wet environments.

2.6 HARDWARE

- .1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.
 - .1 As far as practical, use one manufacturer's products for all Products specified, indicated, or scheduled.
 - .2 All costs associated with the Products of this Section are not covered by cash allowance and shall be included in the Contract Price.
 - .3 Cabinet and auxiliary hardware: Where casework hardware is not specified or indicated on drawings or scheduled, casework hardware shall comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the Architectural Woodwork Standards, Edition 1, 2009.
 - .4 Stainless steel hat and coat hook: Specified under Section 10 28 00 for installation as part of the work of this section.

2.7 FINISHES – INTERIOR ARCHITECTURAL WOODWORK

- .1 Paint and stain finish, as indicated or scheduled: in accordance with Section 09 91 00.

2.8 FABRICATION

- .1 Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises pre-cut, where possible, to receive hardware and other items of work.
- .2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, provide ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.
- .3 Provide woodwork, solid tops and other indicated materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and Provide proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.
- .4 Provide lumber framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.
- .5 Reinforcing shown is minimum. Provide additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.
- .6 Do fabrication from field measurements with provisions for scribing as required to meet built-in conditions.
- .7 Provide balancing sheets as required, and specified, complying with the Architectural Woodwork Standards, Edition 1, 2009.
- .8 Provide surface mount blocking & strapping necessary to support the work of this section. Such blocking shall not be exposed upon completion of work.

- .9 Prefinish work at the factory, except where specified or indicated otherwise.
- .10 Solid wood edging: No end grain shall be visible; mitre external corners; house internal corners.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Condition woodwork to average prevailing humidity conditions in installation areas before installing.
- .2 Ensure that environmental conditions have been provided as requested and specified.
- .3 Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.
- .4 Provide all grounds, nailers and other required fabrications which are to be built into other work when required.
- .5 Ensure that wall and ceiling variations are not in excess of 6.4 mm (1/4") in 3658 mm (144") and that floors are not in excess of 12.7 mm (1/2") in 3658 mm (144") of being plumb, level, flat, straight, square, of the correct size. Variations shall be corrected prior to installation of work of this section.
- .6 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install woodwork to comply with Architectural Woodwork Standards, Edition 1, 2009 for same grade specified in Part 1 of this section for type of woodwork involved.
- .2 Install woodwork plumb, level, true, and straight with no distortions.
- .3 Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- .4 Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- .5 Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.
- .6 Plastic wood:
 - .1 Install plastic wood in accordance with manufacturer's instructions and recommendations.
 - .2 Install with the following minimum expansion/contraction gaps, wider as recommended by manufacturer:
 - .1 Width-to-width: 9.5 mm (3/8").
 - .2 End-to-end: 3.2 mm (1/8").

- .3 Perimeter and abutting solid objects: 6.4 mm (1.4").
- .3 Screw-down installation: Use manufacturer's recommended screws, exterior grade. Install screws at least 25 mm (1") in from board edges.

3.3 INSTALLATION – TOLERANCES

- .1 Install to a tolerance of 3 mm in 2400 mm (1/8" in 8'-0") for plumb and level (including tops) and with no variations in flushness of adjoining surfaces unless otherwise acceptable in accordance with the Architectural Woodwork Standards, Edition 1, 2009.

3.4 ADJUSTING AND CLEANING

- .1 Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork.
- .2 Clean, lubricate, and adjust hardware.
- .3 Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 PROTECTION

- .1 Protect architectural woodwork during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.
- .2 Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that woodwork is without damage or deterioration at time of Substantial Performance of the Work.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Sheet waterproof membrane at locations as indicated and as follows:
 - .1 Throughwall membrane flashing: either Type 1 or Type 2 sheet membrane is acceptable.
 - .2 In shower compartments: only Type 1 sheet membrane is acceptable.
 - .3 Damp Proof Course (DPC): only Type 2 sheet membrane is acceptable.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.

1.4 QUALITY ASSURANCE

- .1 Execute the work of this section only by a Subcontractor who has adequate plant, equipment and skilled workers to perform it expeditiously, is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years, and has been approved in writing by the self-adhered waterproofing system manufacturer for the installation of their Product.
- .2 Mock-Up:
 - .1 Construct area of typical waterproofing installation for approval. Locate at the Place of the Work as part of final installation.
 - .2 Do not proceed until mock-up has been reviewed and accepted by Consultant.

1.5 FIELD CONDITIONS

- .1 Provide forced air circulation during curing period for enclosed applications.
- .2 Apply only when air and surface temperatures are maintained above 4°C, have been so for 48 hours, and are not likely to fall lower until the work of this Section is completed, unless otherwise approved.

- .3 The work of this Section may proceed at temperatures below 4°C only with mutual documented agreement of inspection and testing company, manufacturer and applicator that, with materials and methods used, specified installation will be achieved.
- .4 Ensure application temperature and humidity recommended by material manufacturer are maintained before, during and after installation.
- .5 Provide forced air circulation or adequate natural ventilation during installation and curing periods for enclosed application.
- .6 Do not expose materials vulnerable to water or sun damage in quantities greater than can be installed the same day.
- .7 Install waterproofing on dry surfaces, free of snow and ice and during weather that will not introduce moisture into waterproofing system.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .2 Store solvent-base liquids and surface conditioner away from excessive heat and open flame. Post "NO SMOKING" signs in areas where solvent-base materials are used and stored.
- .3 Store surface conditioner at temperature above 5°C.
- .4 Pallets of waterproofing membrane shall not be double stacked.

PART 2 - PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Waterproofing system shall provide watertight protection to prevent the passage of water under hydrostatic pressure.

2.2 MATERIALS

- .1 Waterproofing membrane Type 1:
 - .1 Standard ethylene propylene diene monomer (EPDM sheet membrane), to CGSB 37-GP-52M-1984, Type 1, Class A, 1.6 mm (1/16") thick, non-reinforced.
- .2 Waterproofing membrane Type 2:
 - .1 Self adhering polymeric waterproofing membrane.
 - .2 Thickness:
 - .1 Film: 4 mils.
 - .2 Polymeric membrane: 56 mils.
 - .3 Tensile strength: to ASTM D412-06a (2013).
 - .4 Film: 40.71 MPa (5,900 psi) minimum.

- .5 Polymeric membrane: 4.07 MPa (590 psi) minimum.
- .6 Elongation: to ASTM D412-06a (2013).
- .7 Polymeric membrane: 455 percent minimum.
- .8 Water vapour transmission: to ASTM E96/E96M-10, Method B: 0.05 grains/ft²/ hour.
- .9 Water absorption: to ASTM D570-98(2010) e1, 0.1%, 72 hours maximum.
- .10 Resistance to hydrostatic head: equivalent to 45.72 m (150 ft) of water.
- .11 Puncture resistance: to ASTM E154/E154M-08a (2013) e1, 67 pounds.
- .12 Acceptable Products:
- .13 Bakor 'WP 200'.
- .14 Colloid Environmental Technologies Company (CETCO) 'Envirosheet', as distributed by DRE Industries Inc.
- .15 Tremco 'Permaquik PQ 7100'.
- .16 Soprema 'Colphene 3000'.
- .17 W.R. Meadows 'Mel-Roll'.
- .18 Or equivalent.
- .3 Primer/surface conditioner: In accordance with membrane manufacturer's printed installation instructions.
- .4 Adhesives: In accordance with membrane manufacturer's printed installation instructions.
- .5 Mastic; self-adhered membrane systems: Single component, utility grade, rubber based sealant. Use manufacturer's proprietary mastic.
- .6 Sealers:
 - .1 For sheet membrane Type 1: use sealant Type 6 in accordance with Section 07 92 00 in accordance with manufacturer's recommendations.
 - .2 For sheet membrane Type 2:
 - .1 With Blueskin WP200, use Polybitume 570-05, as manufactured by Bakor or equivalent.
 - .2 With Per-A-Barrier Wall Membrane, use Bituthene Mastic, as manufactured by Grace Construction Products or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Comply with manufacturer's Product data, including Product application and installation instructions, as well as manufacturer's shipping and storage recommendations.
- .2 Examine conditions of substrates and other conditions under which the work of this Section is to be performed and notify the Consultant, in writing, of circumstances detrimental to the proper completion of the Work. Do not proceed with the work of this Section until unsatisfactory

conditions are corrected and are acceptable for compliance with manufacturer's written recommendations.

3.2 PREPARATION - TYPICAL

- .1 Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing Products during installation operations.
- .2 Concrete surfaces shall be smooth, clean, dry and free of any foreign matter that would otherwise hinder either adhesion or regularity of waterproofing membrane installation.
- .3 Remove fins, ridges, and other protrusions levelled and smoothly finished to match monolithic concrete surface. Completely fill honeycomb, aggregate pockets, holes and other voids with non-shrink cementitious grout levelled and smoothly finished to match monolithic concrete surface.
- .4 Priming:
 - .1 Condition surfaces to receive waterproofing membrane using primer/surface conditioner applied by spray or roller in accordance with manufacturer's mixing and application instructions.
 - .2 Allow primer/surface conditioner to dry adequately before proceeding with waterproofing membrane. Avoid pooling and excess of primer/surface conditioner. Primed surfaces not covered by waterproofing membrane on the same day must be re-primed.
 - .3 Metal surfaces need not be primed, but should be free of grease, oil, dirt, loose paint, rust or any other contaminants.

3.3 MEMBRANE INSTALLATION

- .1 Apply waterproofing membrane system in accordance with manufacturer's instructions.
- .2 Provide a chalk line or alternate means of establishing a square start location. Align first sheet of membrane with straight edge and after removing first few feet of release paper from roll lay membrane into place. Continue to pull release paper from roll thereby adhering the membrane onto the substrate. Proceed at a rate that allows opportunity to prohibit air from becoming entrapped between membrane and substrate.
- .3 Continue with subsequent rolls aligning each with previous along lap lines provided on membrane. Maintain a minimum overlap of 64 mm (2-1/2").
- .4 End laps as encountered at roll ends and splices should overlap the previous membrane a minimum of 150 mm (6"). Stagger end laps. Point exposed edges and terminations with pointing mastic to prevent water from travelling under membrane. Lap to shed water.
- .5 Lay membrane carefully to ensure a uniform application and to minimize fishmouths (wrinkles extending to membrane's edge).
- .6 Horizontal to vertical inside corner transition areas are to be pre-treated with manufacturer's proprietary fillet extending 19 mm (3/4") vertically and horizontally from the corner. Apply a minimum 225 mm (9") strip of membrane centred at the joint.
- .7 Immediately following placement, roll membrane in its entirety to ensure continuous adhesion to the substrate. For verticals, use membrane roller as recommended by manufacturer.
- .8 On vertical and horizontal applications membrane terminations shall receive an edge dressing of waterproofing mastic to protect against undermining effects of ponded water or vertical drainage.

- .9 Install DPC across the width of the foundation wall and install throughwall membrane flashing in masonry in accordance with the manufacturer's recommendations and as follows:
 - .1 Install membranes under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings. Install membranes under weep hole courses as indicated.
 - .2 In cavity and veneered walls, carry throughwall membrane flashing from front edge of masonry, under outer wythe, then up backing not less than 250 mm (10") and as follows:
 - .1 For masonry backing, embed membrane a minimum of 25 mm (1") in joint of backing masonry.
 - .2 For frame backing, bond to plywood sheathing using manufacturer's recommended adhesive.
- .10 Detail work:
 - .1 Over non-working joints or cracks up to a maximum of 5 mm (3/16"), apply a reinforcing strip of waterproofing membrane, not less than 225 mm (9") in width centered over the joint/crack.
 - .2 Non-working joints or cracks greater than 5 mm (3/16") in width, notify Consultant. Joints shall be filled flush to the level of the surrounding deck surface prior to the placement of a 225 mm (9") reinforcing strip of waterproofing membrane. Waterproofing liquid membrane should be used to fill voids of this nature.
 - .3 Cold pour joints: Grind or chip as required to smooth joint/crack prior to field membrane application. Treat in same manner as non-working joints/cracks less than 5 mm (3/16") wide.
 - .4 Inspect vertical and horizontal inside/outside corner locations to ensure smoothness and regularity. Outside corners should be continuous and free of sharp edges. Inside corners should be free of rough edges resulting from formwork placement. Repair as required.
 - .5 Install a reinforcing ply of waterproofing membrane over outside corners. Use a width of membrane not less than 225 mm (9") centred over the corner and press into full contact with the substrate. Reinforcing strips shall be installed prior to field membrane application.

3.4 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Semi-rigid insulation; cavity walls.
 - .2 Rigid insulation; cavity wall insulation.
 - .3 Rigid insulation; below grade insulation at vertical conditions.
 - .4 Rigid insulation; below grade insulation at horizontal conditions.
 - .5 Foamed-in-place (gap filler) insulation.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit data and installation instructions for materials and prefabricated devices, providing descriptions sufficient for identification at the Place of the Work.
 - .3 Submit data from manufacturer's or independent laboratory indicating compatibility and adhesive results of proposed materials.
- .3 Samples: Submit representative samples of each specified insulation material, insulation clips, adhesives, fasteners, tapes and other material for review.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Execute work of this section using a Subcontractor who has adequate plant, equipment and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- .1 Batt insulation; except where acoustic batt is indicated or scheduled:
 - .1 Unfaced, mineral-fibre batts, to CAN/ULC S702-09, Type 1.
 - .2 Acceptable manufacturers:
 - .1 Fibrex.
 - .2 Johns Manville.
 - .3 Owens Corning.

- .4 Roxul.
- .5 or equivalent.
- .2 Batt insulation; except where acoustic batt is indicated or scheduled:
 - .1 Unfaced, mineral-fibre batts, formaldehyde-free, to CAN/ULC S702-09, Type 1.
 - .2 Acceptable manufacturers:
 - .1 Johns Manville.
 - .2 Or equivalent.
 - .3 Insulation Type 2: semi-rigid insulation, within cavity walls:
 - .1 Mineral-fibre to CAN/ULC S702-09, Type 1, 72 kg/m³ (4.5 lb/ft³) minimum density to ASTM C612-10 for basalt rock and steel slag mineral-fibre insulation.
 - .2 Acceptable Products:
 - .1 Roxul 'CavityRock MD'.
 - .2 Or equivalent.
 - .4 Insulation Type 3; rigid, below grade insulation at vertical conditions:
 - .1 Extruded polystyrene, closed-cell, smooth skin, to CAN/ULC S701-11, Type 4, 30 psi compressive strength.
 - .2 Acceptable Products:
 - .1 'Styrofoam SM' as manufactured by Dow Chemical.
 - .2 'Celfort 300' as manufactured by Owens Corning.
 - .3 Or equivalent.
 - .5 Rigid insulation; below grade insulation at horizontal conditions:
 - .1 Extruded polystyrene, closed-cell, smooth skin, to CAN/ULC S701-11, Type 4.
 - .2 Compressive Strength, ASTM D1621-10, 275 kPa (40 psi) minimum (measured at 5% deformation or at yield, whichever occurs first).
 - .3 Acceptable Products:
 - .1 'Styrofoam Highload 40' as manufactured by Dow Chemical.
 - .2 'Foamular 400' as manufactured by Owens Corning.
 - .3 Or equivalent.
 - .6 Foamed-in-place (gap filler) insulation:
 - .1 One-component CFC-free polyurethane foam to CAN/ULC S710.1-05.
 - .2 Two-component CFC-free polyurethane foam to CAN/ULC S711.1-05.

2.2 ACCESSORY MATERIALS

- .1 Adhesive: solvent based polymer modified liquid applied membrane, compatible with insulation to be applied, type as manufactured for the attachment of insulation. Acceptable Product: Bakor Airbloc 21 or 230-21 or equivalent.
- .2 Insulation fasteners: Impaling clip of galvanized steel with washer retainer, to be adhered to surface to receive board insulation with adhesive, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- .3 Batt insulation restraint: Zinc coated woven wire and mechanical fasteners.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Comply with requirements of Section 01 45 00.
- .2 Install materials in accordance with manufacturer's installation instructions.

3.2 EXAMINATION

- .1 Take measurements at the Place of the Work to ensure that work is fabricated to fit structure; surrounding construction; around obstructions and projections in place, or as indicated; and to suit locations of services.
- .2 Verify that backup construction is aligned for proper installation of work before commencing erection.

3.3 INSTALLATION – GENERAL

- .1 Surfaces to receive insulation shall be dry and free of dew, frost, voids, loose material, oil, grease, asphalt curing compounds and other matter detrimental to bond of adhesive. Adhesive shall be compatible with waterproofing on walls.
- .2 Apply adhesives, and install insulation in accordance with manufacturer's printed recommendations. Apply at rate as required to prevent displacement of insulation boards during construction operations.
- .3 Butt joints tightly and offset vertical joints to form an unbroken thermal envelope. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .4 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces. Unless otherwise specified, apply insulation in single layer of thickness indicated.
- .5 Ensure integrity and continuity of insulation at juncture with different types of materials and seal in an acceptable manner.
- .6 Do not enclose insulation until it has been reviewed and accepted by Consultant.

3.4 INSTALLATION – BATT INSULATION

- .1 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .2 Do not over compress insulation to fit into spaces.
- .3 Install continuous woven wire restraint mechanically fastened to steel studs to hold insulation against exterior sheathing materials.
- .4 Insulation equal to that specified shall be placed in jamb and header assemblies that will be inaccessible after their installation into wall. Ensure that insulation is kept dry and not compressed.
 - .1 Where applicable, fasten insulation using masonry tie securement plates provided under Section 04 05 19.
 - .2 In locations where insulation clips are not practical or available with masonry connectors, mechanically fasten insulation at maximum spacing of 400 mm (16") on centre, using fasteners to suit substrate condition.

3.5 INSTALLATION – SEMI-RIGID INSULATION

- .1 Install at masonry assembly locations in accordance with Section 04 05 00.
 - .1 Where applicable, fasten insulation using masonry tie securement plates provided under Section 04 05 19.
 - .2 In locations where insulation clips are not practical or available with masonry connectors, mechanically fasten insulation at maximum spacing of 400 mm (16") on centre, using fasteners to suit substrate condition.

3.6 INSTALLATION – RIGID INSULATION APPLICATION

- .1 Edge butter rigid insulation joints with adhesive and trowel flush with insulation face at wall cavity insulation locations to provide a full and continuous seal.
- .2 Butter masonry tie penetrations with adhesive at wall cavity insulation locations.
- .3 Secure rigid insulation boards to substrate at rate of 6 each 610 x 1220 mm (24" x 48") board minimum, with corrosion resistant mechanical fasteners complete with 25 mm (1") plastic washers.
- .4 Below grade insulation:
 - .1 Adhere rigid insulation to face of below grade perimeter walls with adhesive.
 - .2 Perimeter below grade application: extend boards minimum 600 mm (24") vertically below bottom of finish floor slab, installed on face of perimeter foundation walls.
- .5 Below grade insulation; underslab:
 - .1 Install in accordance with insulation manufacturer's written specifications and in accordance with requirements of 3.3 – General Installations of this section.

3.7 INSTALLATION – FOAMED-IN-PLACE INSULATION

- .1 Install one-component foam in accordance with CAN/ULC S710.2-05 application standard.
- .2 Install two-component foam in accordance with CAN/ULC S711.2-05 application standard.
- .3 Install at exterior building envelope assemblies to locations as indicated, to cavity and gaps surrounding metal frames.
- .4 Refer also to foamed-in-place insulation as specified in Section 08 41 00.

3.8 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

3.9 PROTECTION

- .1 Comply with manufacturer's printed recommendations respecting protection.
- .2 Protect polystyrene insulation from extended exposure to sunlight.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Above-grade vapour barrier.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit sample of proposed Products for review by Consultant.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Provide work of this Section, executed by competent installers with minimum 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Mock-up:
 - .1 Construct 10 m² (100 ft²) area of typical installation for each type of Product.
 - .1 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.
 - .2 Locate at the Place of the Work as part of final installation. Space installation to include exterior wall panel incorporating window and insulation.
 - .3 Do not proceed until mock-up has been reviewed by Consultant.
 - .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work.

PART 2 - PRODUCTS

2.1 SHEET VAPOUR BARRIER

- .1 Polyethylene film: CAN/CGSB 51.34-M86 (amended 1988), Type 1, 0.15 mm (6 mil) thick, with a water vapour permeance of not greater than 45 ng/(P•s•m²), flame spread rating of less than 150 to CAN/ULC-S102-10.

2.2 ACCESSORIES

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 75 mm (3") wide.

- .2 Lap sealant; butyl sealant: CGSB 19.21-M87.
 - .1 Acceptable products:
 - .1 Pecora 'BA98'.
 - .2 Tremco 'Acoustical Sealant'.
 - .3 QuietSeal 'Acoustic Sealant QS-350'.
 - .4 Or approved equivalent.
- .3 Staples and fasteners: minimum 6.4 mm (1/4") leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of sheet vapour barrier.
- .2 Install sheet vapour barrier on interior side of insulation at exterior wall and ceiling assemblies prior to installation of gypsum board to form continuous application.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect sheets for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 ATTACHMENT

- .1 Seal vertical joints in sheet vapour barrier over framing by lapping no fewer than two studs.
- .2 Fasten sheet vapour barrier to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 400 mm (16") o.c.

3.3 EXTERIOR SURFACE OPENINGS

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.4 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour barrier as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm (6") and press into sealant bead.
 - .4 Install fasteners through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.6 ELECTRICAL BOXES

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
 - .1 Install moulded box vapour barrier or double wrap boxes with film sheet providing minimum 305 mm (12") perimeter lap flange.
 - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.7 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Below-grade vapour barrier; located beneath concrete slabs.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products to be for used in the work of this Section.
- .3 Samples:
 - .1 Submit sample of proposed Products for review by Consultant.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Provide work of this Section, executed by competent installers with minimum 5 years' experience in application of Products.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Vapour barrier membrane:
 - .1 Performance criteria:
 - .1 Permeance, as tested after conditioning: not greater than 0.5700 ng/(Pa*s *m²)(0.010 perms (gm/ft²/in-Hg)) to ASTM E1745-11 paragraphs 7.1.2 through 7.1.5.
 - .2 Strength: Class A to ASTM E1745-11.
 - .3 Thickness of plastic:
 - .1 0.38 mm (15 mils) minimum.
 - .2 Acceptable Products:
 - .1 Stego Industries 'Stego Wrap Vapor Barrier', thickness specified above.
 - .2 W.R. Meadows 'PERMINATOR', thickness specified above.
 - .3 Or equivalent.
- .2 Vapour barrier membrane joint tape:
 - .1 Description: High density polyethylene tape, pressure sensitive, 100 mm (4") wide, product as per vapour barrier membrane manufacturer's installation instructions.
- .3 Penetration flashing:

- .1 Vapour barrier membrane material and vapour barrier joint tape in accordance with manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install vapour barrier membrane in accordance with manufacturer's instructions and ASTM E1643-11.
- .2 Extend vapour barrier to the perimeter of the slab and seal to perimeter and penetration conditions. Seal around penetrations such as utilities and columns in order to create a monolithic membrane between the surface of the slab and moisture sources below the slab and at the slab perimeter.
- .3 Install vapour barrier membrane using largest practicable sheet size to minimize joints over compacted fill.
- .4 Inspect vapour barrier membrane sheets for continuity. Repair punctures and tears in vapour barrier membrane with sealing tape before work is concealed.
- .5 Vapour barrier membrane installation shall be continuous and vapour tight.
- .6 Overlaps vapour barrier membrane joints 150 mm (6") minimum and tape seal with vapour barrier joint tape.
- .7 Unroll vapour barrier membrane with longest dimension parallel with direction of concrete placement.
- .8 Lap vapour barrier membrane up foundation walls a minimum of 100 mm (4") and tape seal with vapour barrier joint tape.
- .9 Centre vapour barrier joint tape over vapour barrier membrane laps and joints. Keep area of tape adhesion free of dust, dirt, and moisture.
- .10 Cut slit around pipes, ductwork, rebar, and wire penetrations to place the initial layer of vapour barrier membrane.
 - .1 Cut a piece of vapour barrier membrane minimum width of 300 mm (12"). The length should be 1 1/2 times the pipe circumference. With a roofer's knife or scissors, cut "fingers" half the width of the film.
 - .2 Wrap vapour barrier membrane around and tape the collar onto the pipe and completely tape fingers to the bottom layer of vapour barrier membrane with vapour barrier joint tape.
- .11 In the event that vapour barrier membrane is damaged during or after installation, repairs shall be made. Cut a piece of vapour barrier membrane large enough to cover damage by minimum overlap of 150 mm (6"). Clean adhesion areas of dust, dirt, and moisture. Tape down edges using vapour barrier joint tape.

3.2 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Air barrier membrane for masonry wall assemblies and for frame construction.
 - .2 Sheet-Applied Self-Adhesive Air / Vapour Barrier Membrane.

1.2 REFERENCES

- .1 Definitions:
 - .1 Air barrier material: A building material that is designed and constructed to provide primary resistance to airflow through air barrier system.
 - .2 Air barrier system: The collection of air barrier materials and auxiliary materials applied to substrate, including joints and junctions to abutting construction, to control air movement through the building envelope.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Compatibility statement:
 - .1 Submit manufacturer's compatibility statement validating compatibility of air barrier system materials with substrates and adjacent materials.

1.4 QUALITY ASSURANCE

- .1 Qualifications: Provide the work of this Section, executed by competent installers with a minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Mock-up:
 - .1 Construct minimum 10 m2 (100 ft2) area of each typical wall assembly installation for each type of Product.
 - .2 Locate at the Place of the Work as part of final installation. Space installation to include exterior wall panel incorporating window, glazing system and insulation.
 - .3 Do not proceed until mock-up has been reviewed by Consultant.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .2 Store flammable solvent-base liquids away from excessive heat and open flame. Primer contains solvent. Do not use near open flame.
- .3 Store surface conditioner at temperature above 5°C to facilitate handling.
- .4 Store roll materials on end.

1.6 FIELD CONDITIONS

- .1 Provide forced air circulation during curing period for enclosed applications.
- .2 Low temperature application:
 - .1 Perform adhesion test for membrane when ambient temperature is below -5°C.
 - .2 Proceed with work when temperature is (or predicted) to fall below -5°C ambient temperature only with the mutual documented agreement of inspection and testing company, manufacturer and applicator.
- .3 Do not perform installation during rainy or inclement weather or on wet or frost covered surfaces.
- .4 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

1.7 EXTENDED WARRANTY

- .1 The work of this Section shall meet the specified building envelope performance requirements during the warranty period.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Air barrier system shall perform as continuous air barrier and as liquid-water drainage plane flashed to discharge to exterior of building envelope incidental condensation or water penetration.
- .2 At wall and roof cladding transitions, air barrier system shall perform as continuous air barrier and as liquid-water drainage plane flashed to discharge to exterior of building envelope incidental condensation or water penetration by creation of unobstructed drainage plane that extends across the cladding transition or by flashing to discharge to exterior of building envelope incidental condensation or water penetration.
- .3 Air barrier system shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration which permits air and water leakage exceeding the following specified limits and requirements, or interruption of the drainage plane:
 - .1 Air permeance of air barrier material: Maximum 0.02 L/s.m² at 75 Pa (0.004 cfm/ft² at 1.57 psf) to ASTM E2178-13.

- .2 Rate of air leakage of air barrier system: Maximum 0.15 L/s.m² at 75 Pa (0.030 cfm/ft² at 1.57 psf) to ASTM E283-04(2012).
 - .3 Water vapour transmission for air / vapour barriers: Maximum 5.7 ng/Pa.m².s. (0.1 perms).
 - .4 Water vapour transmission for vapour permeable air vapour barriers: Minimum 570 ng/Pa.m² s. (10 perms).
 - .5 Air barrier membrane system structural performance while maintaining air barrier performance for air leakage: Air barrier system shall transfer wind loads to structure and shall resist 100% of design wind load in accordance with the building code.
 - .6 Low temperature performance: Minimum -30°C (-22°F).
 - .7 Compatibility: Air barrier system materials shall be compatible with substrate and adjacent materials with material manufacturers and show no performance deterioration during service conditions.
 - .8 Self-sealability: ASTM D1970/D1970M-15.
- .4 Air barrier system shall be joined in an airtight and flexible manner to air barrier material of adjacent building envelope air barrier systems, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
- .1 Foundation and walls.
 - .2 Walls and openings (windows, doors, louvres, and other wall penetrations).
 - .3 Wall and roof systems.
 - .4 Wall and roof over unconditioned space.
 - .5 Walls, floor and roof across construction, control, and movement joints.
 - .6 Walls, floors and roof to utility, pipe and duct penetrations.

2.2 MATERIALS – GENERAL

- .1 Single source responsibility: Materials shall be sourced from one manufacturer including sheet membranes, air barrier sealants, primers, mastics and adhesives.

2.3 SHEET-APPLIED, VAPOUR IMPERMEABLE SELF-ADHESIVE AIR / VAPOUR BARRIER MEMBRANE SYSTEM

- .1 Description: Composite preformed modified bituminous membrane system consisting of SBS modified asphalt for low temperature flexibility and polyethylene scrim reinforcing, with physical properties as follows:
 - .1 Single source responsibility: Components required for complete air barrier system and through wall flashing membrane behind the opaque wall assemblies to be obtained from single manufacturer. Coordinate with Section 07 27 00.
 - .2 Thickness: 1.0 mm (40 mils)
 - .3 Application temperature: in accordance with product installation instructions.

- .4 Primer: in accordance with product installation instructions.
- .5 Termination and penetration sealing mastic: in accordance with product installation instructions.
- .6 Acceptable product systems:
 - .1 Henry Company 'Bakor Blueskin SA' and 'Blueskin SA LT'.
 - .2 Carlisle Coatings & Waterproofing 'CCW 705'.
 - .3 Grace Construction Products 'Perm-A-Barrier Wall Membrane'.
 - .4 IKO 'AquaBarrier AVB' and AquaBarrier AVB Low Temp'.
 - .5 Soprema 'Sopraseal Stick 1100 Summer Grade' and Sopraseal Stick 1100 Winter Grade'.
 - .6 Tremco 'ExoAir 110 and 110LT'.
 - .7 W.R. Meadows 'Air Shield' and 'Low Temperature Air Shield'.
 - .8 Or equivalent.

2.4 SHEET-APPLIED, VAPOUR PERMEABLE SHEATHING MEMBRANE AIR BARRIER SYSTEM

- .1 Description: Flexible sheet material with high vapour permeability to CAN/CGSB 51.32- M77, for breather type sheathing membranes.
- .2 Air barrier tape: as per manufacturer's printed installation instructions.
- .3 Fasteners:
 - .1 For steel frame construction: as per manufacturer's printed installation instructions, rust resistant screws with 50 mm (2") diameter plastic cap.
 - .2 For wood frame construction: as per manufacturer's printed installation instructions, nails with large heads or plastic washers. Wide staples with a 25 mm (1") minimum crown may be used if applied on wood sheathing.
- .4 Acceptable Products:
 - .1 Dupont 'Tyvek CommercialWrap'.
 - .2 Fabrene Inc. 'Air-Gard XL'.
 - .3 Dow 'Styrofoam WeatherMate Plus'.
 - .4 Fiberweb 'Tygar Metrowrap'.
 - .5 Or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- .1 Surfaces to receive air barrier systems shall be smooth, dry and free from conditions that will adversely affect execution, permanence, or quality of the work of this Section.

- .2 Air barrier system shall be continuous in the building envelope. Lap and seal air barrier systems in accordance with product manufacturer's installation instructions to construction, control, and expansion joints, across junctions between different building assemblies, and around penetrations through the building assembly.
- .3 Wrap into jamb, head and sill of building envelope window openings, door openings, and other openings with air barrier system membrane by returning membrane to inside face of opening unless otherwise indicated.
- .1 Coordinate air / vapour barrier terminations of work of this section with air / vapour barrier membrane in Section 08 41 00.

3.2 INSTALLATION – SHEET APPLIED, VAPOUR IMPERMEABLE, SELF-ADHESIVE MEMBRANE

- .1 Apply self-adhering membrane continuous to prepared and primed substrate in an overlapping shingle fashion to shed moisture towards exterior and in accordance with manufacturer's recommendations and written instructions. Stagger vertical joints 200 mm (8").
- .2 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 50 mm (2") overlap at end and side laps. Promptly roll laps and membrane with a counter top roller to affect the seal.
- .3 At the end of each day's work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
- .4 Seal projections with application of liquid air seal mastic.
- .5 Apply self-adhering membrane continuous across junctions between different building assemblies, and around penetrations through the building assembly. Provide 100 mm (4") overlap unless otherwise indicated, or required by manufacturer's installation instructions.
- .6 Inspect membrane for punctures, misaligned seams and fishmouths, apply additional layer of membrane over affected area, extending minimum of 150 mm (6") beyond damaged area in all directions.

3.3 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Perform pull adhesion tests for project substrates in accordance with ASTM D4541-09e1.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Exterior porcelain wall panel system.

1.2 Administrative Requirement

- .1 Coordination:
 - .1 Coordinate with installers of wall mounted items, equipment, and mechanical and electrical work so that installation will not subvert the integrity of the cladding system.
 - .2 Coordinate interface, transition, lapping, flashings and compatibility of membranes with work of Section 07 27 00.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this Section.
- .3 Shop drawings:
 - .1 Submit engineered shop drawings bearing seal and signature of the Professional Engineer.
 - .2 Indicate panel layout, elevations, dimensions, attachment and anchoring materials and methods, trim and closure pieces, detail and location of joints, sealants and gaskets; include joints necessary to accommodate thermal movement, flashing, accessories and related work of this Section.
 - .3 Indicate methods to achieve watertight assembly, including sealants, penetration seals, drainage path of moisture from within assembly to exterior of envelope.
 - .4 Indicate materials, thicknesses, finishes, and colours.
- .4 Samples:
 - .1 Submit duplicate samples of the following for each specified panel type and system:
 - .1 610 mm (24") long of support framing, trim and corner in each specified colour and finish.
 - .2 300 mm (12") x 300 mm (12") porcelain panel sample in each specified colour and finish.
 - .3 610 mm (24") x 610 mm (24") mounted porcelain panels of four equal sized panels showing four-way joint.
 - .4 300 mm (12") x 300 mm (12") corner panel assembly.

.5 Test reports and certification:

.1 Test reports:

- .1 Submit valid test reports from an independent testing laboratory certifying that tested porcelain panel wall system performs as a pressure equalized rainscreen wall cladding system in compliance with AAMA 508-07 testing.

.2 Certification:

- .1 Submit porcelain panel manufacturer's written certification to certify that porcelain panel system design, assembly and components supplied for the *Work* are the same as the porcelain panel wall system tested as pressure equalized rainscreen wall cladding system in accordance with AAMA 508-07.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.

.2 Maintenance data:

- .1 Submit manufacturer's maintenance instructions for inclusion in operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications: Provide work of this Section, executed by competent installers with minimum 10 years' experience in application of *Products*, systems and assemblies specified, and with approval and training of *Product* manufacturers.
- .2 Manufacturer: Company specializing in manufacturing *Products* specified in this Section, with minimum 10 years' experience.
- .3 Panel Lines and Angles: Sharp and True.

1.6 Delivery, Storage, and Handling

- .1 Delivery, storage, and handling of materials in accordance with panel manufacturer written instructions.

1.7 Field Conditions

- .1 Comply with panel manufacturer's written instructions.

1.8 Extended Warranty

- .1 Warrant the work of this Section in accordance with the Agreement between Owner and Contractor.
- .2 Special Product warranty: Standard form in which manufacturer agrees to repair finishes or replace porcelain panels that show evidence of product deterioration, including factory-applied finishes, staining, colour fading, within specified warranty period.
- .1 Warranty period: 10 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 Design:

- .1 System shall be engineered by a delegated Professional Engineer.
- .2 Design for expansion and contraction of component materials of the *Work* produced by an exterior surface temperature range of -35°C to +60°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .3 Design cladding system to accommodate and withstand the following without permanent deformation or damage to, or failure of, cladding system or building structure:
 - .1 Deflection of cladding system due to uniformly distributed specified loads shall not exceed L/360 of span for walls.
 - .2 Movement within cladding system, and between cladding system and building structure.
 - .3 Cladding system dead loads, snow loads, ice loads, and wind loads, and combinations thereof, in accordance with building code.
 - .1 Design wind loads shall be based on at least 1/50 hourly wind pressure values as indicated in Ontario Building Code and greater values as required, to maximum allowable deflection without permanent deformation.
- .4 Design shall allow positive drainage of condensation occurring within cladding system to exterior of building envelope or drainage outlet.
- .5 Design shall allow positive drainage of water to exterior of building envelope or drainage outlet.
- .6 Design wall system and secondary support structure as required to accommodate specified erection tolerances of structure.
- .7 Design system to meet tolerances specified in the Contract Documents.
- .8 Panel joinery: Dry-seal, rainscreen joints.
- .9 No visible fasteners, telegraphing or fastening on panel faces or any other compromise of neat and flat appearance.
- .10 All outside panel corners shall be reinforced, mitred and chamfered.

.2 Performance:

- .1 Comply with the following performance requirements:
 - .1 Metal fasteners shall be corrosion resistant.
 - .2 Provide drip detail over windows and door heads, copings, at edges of overhangs, to direct moisture to exterior.
 - .3 Wall system to utilize drain systems to positively drain water from within wall system to exterior.
 - .4 Wall system shall be designed and shall perform as pressure equalized rainscreen wall cladding system in compliance with AAMA 508-07 testing.

2.2 Porcelain Panel System

- .1 Acceptable *Products*:
 - .1 Ontario Penalization - Ceramitex 'Rear Ventilated Rainscreen (RVR) Porcelain Panel System'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 Porcelain panel and thickness: 6 mm (1/4") thick fibre mesh reinforced sintered porcelain ceramic panel, complete with fibre mesh reinforcement backing.
- .3 Reinforcing mesh and aluminum frame backing:
 - .1 Reinforcement: Fibreglass mesh reinforcement, consisting of resin and fibreglass mat backing on porcelain panel, as recommended by panel manufacturer.
 - .2 Extruded aluminum frame: Reinforced porcelain panel adhered to proprietary aluminum extrusion system with structural silicone adhesive as recommended by panel manufacturer.
- .4 Porcelain panel colour and finish:
 - .1 Colour: to later selection by the *Consultant* from manufacturer's full range.
 - .2 Finish: to later selection by the *Consultant* from manufacturer's full range.
- .5 Porcelain panel sizes: as indicated on the Drawings.
- .6 Concealed fastening clip and framing system:
 - .1 Proprietary clip and framing system as recommended by panel manufacturer.

2.3 Accessory Materials

- .1 Aluminum extrusions: Aluminum Alloy 6063-T6 to ANSI H35.1/H35.1M-2013.
- .2 Aluminum plate: Aluminum Alloy 6061-T6 to ANSI H35.1/H35.1M-2013.
- .3 Compression gaskets: Continuous extruded EPDM of 80 Durometer, A hardness.
 - .1 Colour: Gasket colour to match framing system colour.
- .4 Bond beaker tape or gasket: as recommended by panel manufacturer.
- .5 Isolation coating: Best grade, quick drying non-staining alkali resistant bituminous paint as recommended by panel manufacturer.
- .6 Metal fasteners: Stainless steel fasteners Type 300 Series.
- .7 Z-girt and sub-girts:
 - .1 Preformed Z275 galvanized metal sheet, 1.22 mm (18 gauges) minimum base steel nominal thickness, notched for drainage, to ASTM A653/A653M-11, Grade A.
 - .2 Adjustable clips: as required to suit the *Place of the Work* conditions.
 - .3 Thermal breaks: 3 mm (1/8") thick natural cork or neoprene.
- .8 Air barrier: in accordance with Section 07 27 00.
- .9 Semi-rigid insulation: in accordance with Section 07 21 00.
- .10 Sealants: in accordance with Section 07 92 00.

2.4 Metal Finishes

- .1 Aluminum; concealed: Mill finish, AA-M10, as fabricated mechanical finish, no other applied finish unless buffing is required to remove scratches, welding, or grinding produced in fabrication process.
- .2 Aluminum; exposed to view; anodized to AAMA 611:
 - .1 Clear anodized to AA Designation AA-M12C22A41.

2.5 Fabrication

- .1 Factory-fabricate and cut porcelain panel assemblies in accordance with panel manufacturer's written instructions and in accordance with reviewed shop drawings.
- .2 Fabricate work of this Section to profiles and sizes as indicated complete with rabbets, interlocks, cap and trim components, and filler sections as required to interface with work of other sections, conforming to reviewed shop drawings. Make provisions for thermal and structural movements.
- .3 Fabricate outside corner panel assemblies and panel assemblies at openings, with continuously mitred/chamfered and bonded porcelain panel edges.
- .4 Coordinate penetrations through panel assemblies to suit work of other Sections. Factory-fabricate openings for panel penetrations and provide additional reinforcing to suit opening size and configuration. Reinforce perimeter of penetration openings in accordance with panel manufacturer's recommendations and details.
- .5 Construct panel lines, breaks, and angles sharp and true, and surfaces free from crack, chip, warp and buckle.
- .6 Allow for structural movements within the system, and to accommodate thermal expansion and contraction between panels and structural members.
- .7 Fabricate system to prevent entry of water into building and from collection within system assembly.
- .8 Join intersecting parts together to achieve tight, accurately fitted joints with adjoining surfaces in true planes.
- .9 Fabricate panel system to conform to requirements of reference standards specified.
- .10 Cooperate with applicable Specification Sections to ensure coordination required for proper installation of the Work of this section in conjunction with and incorporated with other work.

2.6 Fabrication Tolerances

- .1 Fabricate porcelain panels square to difference of diagonal measurements of not more than 0.25 mm (0.0098").

PART 3 - EXECUTION

3.1 Examination

- .1 Take measurements at the *Place of the Work* to ensure that the work of this Section is fabricated to fit structure, surrounding construction, around obstructions and projections in-place.
- .2 Verify that backup construction is aligned for proper installation of wall panel system before commencing erection.

- .3 Report unsatisfactory conditions to the *Consultant* in writing. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 Air Barrier Membrane Application

- .1 Install in accordance with manufacturer's installation instructions and in accordance with Section 07 27 00.
- .2 Surfaces must be smooth, clean dry and free from loose contaminants. Brushing and/or scraping of block and concrete surfaces may be required to adequately prepare surface.
- .3 Apply primer for membrane work.
- .4 Wrap openings with membrane returning to inside face of openings.
- .5 Ensure air barrier seals into adjacent systems for complete air barrier to building envelope.

3.3 Insulation Installation

- .1 Install insulation in accordance with manufacturer's installation instructions and in accordance with Section 07 21 00.
- .2 Cut backs of pieces as required to fit over projecting anchors, fastenings or similar protrusions. Fit boards with tight joints around obstructions, openings, corners, and structural members.
- .3 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces.
- .4 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

3.4 Panel System Installation

- .1 Provide mounting hardware compatible with porcelain panel system, panel manufacturer's standard profiles, joint closures and perimeter trim as required for a complete system installation.
- .2 Apply heavy coat of isolation coating to concealed surfaces of dissimilar metals and metals in direct contact with concrete or masonry.
- .3 Install supporting framing required to support the work of this Section.
- .4 Install the work of this Section in accordance with panel manufacturer's written instructions and in accordance with reviewed shop drawings, installed plumb with intersecting parts joined together to achieve accurately fitted joints with adjoining surfaces in true planes. Attach components in manner not restricting thermal movement.
- .5 Align porcelain panels end-to-end to provide accurate fit with adjacent panels parallel and straight in hairline joints.
- .6 Cut, flash, and apply sealant to system penetrations. Seal around materials penetrating panel cladding system.
- .7 Install various components within cladding assembly to provide positive controlled drainage of moisture to exterior of building envelope or drainage outlet.
- .8 Do not install component parts that are observed to be defective, including warped, bowed, dented, cracked and broken members.

- .9 Install head and sill flashings, edge trim, cap pieces and other formed profiles as applicable and/or detailed.

3.5 Installation Tolerances

- .1 Variation in line over entire area: For positions shown in plan and continuous lines, do not exceed 1:1000 or 10 mm (3/8"), whichever is less.
- .2 Variation in plumb over entire area: Vertical lines, external corners and other vertical conspicuous lines, do not exceed 1:1000.
- .3 Variation in level, panel to panel: Horizontal bands, horizontal grooves, and other horizontal conspicuous lines, do not exceed 1:1000.
- .4 Variation in panel joint width: Do not exceed 1 mm (0.04").
- .5 Variation in plane between adjacent panels (lipping or step-in-face): Do not exceed 1 mm (0.04") difference between planes of adjacent panels.
- .6 Jog in alignment of edge of adjacent panels: Do not exceed 1 mm (0.04").

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

3.7 Adjusting and Cleaning

- .1 Remove protective film from panels.
- .2 After erection, touch up coatings removed or damaged during erection.
- .3 Remove damaged, defaced, defectively finished, or tool marked panel system components and replace with new.
- .4 Clean exposed panel system surfaces in accordance with panel manufacturer's written instructions.
- .5 Remove excess sealant with recommended solvent.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Aluminum panel cladding.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with installers of wall mounted items, equipment, and mechanical and electrical work so that installation will not subvert the integrity of the cladding system.
 - .2 Coordinate interface, transition, lapping, flashings and compatibility of membranes with work of Section 07 27 00.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Indicate panel layout, elevations, dimensions, attachment and anchoring materials and methods, trim and closure pieces, detail and location of joints, sealants and gaskets; include joints necessary to accommodate thermal movement, flashing, accessories and related work of this section.
 - .3 Indicate methods to achieve watertight assembly, including sealants, penetration seals, drainage path of moisture from within assembly to exterior of envelope.
 - .4 Indicate materials, finishes, and colours.
- .4 Samples:
 - .1 Submit 2 - 610 x 610 mm (24" x 24") size samples of panel material, of each colour specified.
- .5 Certificates:
 - .1 Submit certification from composite aluminum cladding system manufacturer that the manufacturing process and field installation procedure have been both carried out under an independent quality assurance program designed to confirm that the product and its application are consistent with the system as tested and listed in accordance with CAN/ULC S134-92.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors: Execute the work of this section only by a Subcontractor who has adequate plant, roll forming machinery, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.
 - .2 Execute work in accordance with manufacturing process and field installation procedures under an independent quality assurance program design to confirm that the product and its application are consistent with the system as tested and listed in accordance with CAN/ULC S134-92.
 - .3 Mock-up:
 - .1 Construct panels 10 m² (100 ft²) of typical wall cladding installation for acceptance as specified in Section 01 33 00. Locate on Site as part of final installation.
 - .2 Do not proceed until mock-up has been accepted by Contractor, Consultant and cladding inspection company.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Store materials at temperatures recommended by manufacturer.
- .2 Store roll materials on end.
- .3 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .4 Store flammable solvent-base liquids away from excessive heat and open flame. Primer contains solvent. Do not use near open flame.

1.6 FIELD CONDITIONS

- .1 Comply with manufacturer's instructions.

1.7 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.
- .2 Provide special product warranty; aluminum finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - .1 Failures to paint finish include, but are not limited to, the following:
 - .1 Color fading more than 5 Hunter units when tested according to ASTM D2244-15.
 - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - .2 Warranty period: 20 years.

- .3 The warranty is a total system warranty. The cladding system shall meet both the specified system and the building envelope performance requirements during the warranty period.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Design:
 - .1 System shall be engineered by delegated Professional Engineer.
 - .2 Design for expansion and contraction of component materials of the Work produced by an exterior surface temperature range of -35°C to +60°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
 - .3 Design cladding system to accommodate and withstand the following without permanent deformation or damage to, or failure of, cladding system or building structure:
 - .1 Deflection of cladding system due to uniformly distributed specified loads shall not exceed L/90 of the span for walls.
 - .2 Movement within cladding system, and between cladding system and building structure.
 - .3 Cladding system dead loads, snow loads, ice loads, and wind loads, and combinations thereof, in accordance with the building code.
 - .1 Design wind loads shall be based on at least 1/50 hourly wind pressure values as indicated in Ontario Building Code and greater values as required, to maximum allowable deflection without permanent deformation.
 - .4 Design to allow positive drainage of condensation occurring within cladding system to exterior of building envelope or drainage outlet.
 - .5 Design to allow positive drainage of water to exterior of building envelope or drainage outlet.
 - .6 Design wall system and secondary support structure as required to accommodate specified erection tolerances of the structure.
 - .7 Design system to meet tolerances specified.
 - .8 Panel joinery:
 - .1 Dry-seal, rainscreen joints.
 - .9 No visible fasteners, telegraphing or fastening on panel faces or any other compromise of neat and flat appearance.
- .2 Performance:
 - .1 Comply with the following performance requirements:
 - .1 Components for combustible cladding shall be tested and listed for CAN/ULC S134-92 standard and satisfy requirements of paragraph 3.1.5.5 (c) of building code.
 - .2 Metal fasteners shall be corrosion resistant.

- .3 Provide drip detail over windows and door heads, copings, at edges of overhangs, to direct moisture to exterior.
- .4 Wall system to utilize drain systems to positively drain water from within wall system to exterior.

2.2 MATERIALS – PANEL SYSTEM

- .1 System types:
 - .1 Concealed fastener with dry joints.
- .2 Aluminum panels; composite sheet type with thermosetting core:
 - .1 Acceptable Products:
 - .1 3A Composites USA 'Alucobond Plus'.
 - .2 Mitsubishi Chemical Functional Products Inc. 'Alpolic FR'.
 - .3 Ontario Panelization 'Alcotex ACM Panel System 3'
 - .4 Or equivalent.
 - .2 Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Panel system shall be listed for fire resistance rating.
 - .1 Bond integrity testing to adhere: ASTM D1781-98(2012).
 - .2 Fire test of exterior wall assemblies: CAN/ULC S134-92.
 - .3 Aluminum sheet: tempered, flattened aluminum sheet, 0.5 mm (0.019") face sheet thickness, 4 mm (0.157") thick panels in the following alloy:
 - .1 Painting quality: 3003-H14 to ANSI H35.1/H35.1M-2013.
 - .2 Anodizing quality: 5005-H34 to ANSI H35.1/H35.1M-2013.

2.3 ACCESSORIES

- .1 Extruded aluminum accessory components:
 - .1 Aluminum extrusions to ASTM B221-14, to the following minimum wall thickness and alloy:
 - .1 Thickness:
 - .1 2.28 mm (0.090").
 - .2 Support brackets: Steel brackets to be hot dipped galvanized with zinc coating (0.09 g/m (3.4 mil)) in accordance with CAN/CSA G164-M92.
 - .3 Fasteners: Self-tapping, purpose made stainless steel screws.
 - .4 Insulation:
 - .1 Semi-rigid insulation: rock wool type, in accordance with Section 07 21 00.
 - .5 Air barrier membrane:

- .1 Composite preformed 1.1 mm (43 mil) thick modified membrane system consisting of SBS modified asphalt for low temperature flexibility and glass scrim or polyethylene reinforcing.
- .2 Acceptable Products:
 - .1 Bakor 'Blueskin PE 200 HT'.
 - .2 W.R. Grace 'Ice & Water Shield'.
 - .3 Acceptable alternates by W.R. Meadows or Soprema or Vicshield.
 - .4 Or equivalent.
- .6 Sub-girts (z-girts): minimum 1.2mm (18 gauge) zinc-coated steel to ASTM A653/A653M-11 with Grade A coating Z275.
- .7 Isolation coating: Bituminuous paint.
- .8 Trim, coping, closures, and cap pieces:
 - .1 3.18 mm (0.125") aluminum, to match cladding system.
 - .2 Factory fabricate components, ready for installation.
- .9 Sealant: in accordance with Section 07 92 00.

2.4 FINISHES

- .1 Exposed aluminum surfaces: 70% Kynar 500 or Hylar 5000 fluoropolymer resin systems, ceramic pigments and other select inorganic pigments to AAMA Specification 2605.
- .1 Acceptable Products:
 - .1 PPG 'Duranar XL'.
 - .2 Valspar 'Fluoropon Classic'.
 - .3 Or equivalent.
- .2 Colour:
 - .1 Colour to later selection by Consultant from manufacturer's full range. Colour shall be:
 - .1 Solid.
 - .2 Pearlescent.
 - .3 Metallic.

2.5 FABRICATION

- .1 Form to profiles indicated on drawings and to conform with reviewed shop drawings.
- .2 Construct panel lines, breaks, and angles sharp and true, and surfaces free from warp and buckle.
- .3 Allow for structural movements within the systems, and to accommodate thermal expansion and contraction between panels and structural members.
- .4 Factory form panels with welded corners.

- .5 Fabricate systems to prevent entry of water into building and from collection within system assembly.
- .6 Join intersecting parts together to achieve tight, accurately fitted joints with adjoining surfaces in true planes.
- .7 Fabricate system to conform to requirements of reference standards specified.
- .8 Co-operate with applicable sections to ensure all co-ordination required for proper installation of work of this section in conjunction with and incorporated with other work.
- .9 Lay out panels to obtain uniform metal and paint grain finish. Mark direction of metal grain and paint application on back of panels.

2.6 FABRICATION TOLERANCES

- .1 Comply with the following maximum tolerances:
 - .1 Plumb:
 - .1 3.2 mm in 3 m (1/8" in 10'-0"); 6.4 mm in 12.2 m (1/4" in 40'-0").
 - .2 Level:
 - .1 3.2 mm in 3 m (1/8" in 10'-0"); 6.4 mm in 12.2 m (1/4" in 40'-0").
 - .3 Alignment:
 - .1 Where surfaces abut in line or are separated by reveal or protruding element up to 12.7 mm (1/2") wide, limit offset from true alignment to 1.6 mm (1/16").
 - .2 Where surfaces are separated by reveal or protruding element from 12.7 to 25.4 mm (1/2 to 1") wide, limit offset from true alignment to 3.2 mm (1/8").
 - .3 Where surfaces are separated by reveal or protruding element of 25.4 mm (1") wide or more, limit offset from true alignment to 6.4 mm (1/4").
 - .4 Variation from plane:
 - .1 3.2 mm in 3.6 m (1/8" in 12'-0"); 12.7 mm (1/2") over total length.
 - .5 Panels:
 - .1 Bow: 0.2% of panel dimensions up to 3.2 mm (1/8") maximum.
 - .2 Indicated size:
 - .1 Up to 1220 mm (4'-0"): plus/minus 0.76 mm (0.030").
 - .2 1220 mm to 3050 mm (4'-0" to 10'-0"): plus/minus 1.52 mm (0.060").
 - .6 Square or rectangular:
 - .1 Maximum 3.2 mm (1/8") difference between diagonal measurements.
 - .7 Variation from indicated position: plus/minus 3 mm (1/8").
- .2 Tolerances shall not be cumulative.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Take Site measurements to ensure that work of this Section is fabricated to fit structure; surrounding construction; around obstructions and projections in place, or as shown on Drawings; and to suit locations of services.
- .2 Verify that backup construction is aligned for proper installation of work of this Section before commencing erection.
- .3 Notify Consultant in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 AIR BARRIER MEMBRANE APPLICATION

- .1 Install in accordance with manufacturer's installation instructions.
- .2 Surfaces must be smooth, clean dry and free from loose contaminants. Brushing and/or scraping of block and concrete surfaces may be required to adequately prepare surface.
- .3 Apply primer for membrane work.
- .4 Wrap openings with membrane returning to inside face of openings.
- .5 Ensure air barrier seals into adjacent systems for complete air barrier to building envelope.

3.3 INSULATION

- .1 Carefully cut and fit insulation in pieces to fit surfaces of members to which insulation bears contact.
- .2 Cut backs of pieces as required to fit over projecting anchors, fastenings or similar protrusions. Fit boards neatly with tight joints around pipes, ducts, obstructions, openings, corners, and structural members.
- .3 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces.
- .4 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

3.4 INSTALLATION

- .1 Erect systems complete with flashings forming part of the system, clips, fasteners, closures and caulking to meet same design criteria as specified for fabrication.
- .2 Erect panels in straight lines that are true, level, square, and plumb.
- .3 Attachment system: Allow for free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -28.9°C to 82.2 °C (-20 °F to 180 °F). Buckling of panels, opening of joints, undue stress on fasteners, failure to sealants or any other detrimental effects due to thermal movement is not permitted. Allow for ambient temperature at time of fabrication, assembly and erection procedures.

- .4 Anchor cladding securely as per engineering recommendations and in accordance with reviewed shop drawings to allow for necessary thermal movement, wind loading and structural support.
- .5 Seal between work of this section and work of other sections to meet specified requirements of Section 07 92 00 and to achieve a watertight installation.
- .6 Cut, flash, and apply sealant to system penetrations. Seal around materials penetrating metal cladding watertight.
- .7 Install various components within cladding assembly to provide positive controlled drainage of moisture to exterior of building envelope or drainage outlet.
- .8 Conceal fasteners.
- .9 Do not install component parts that are observed to be defective, including warped, bowed, dented, and broken members.
- .10 Obtain panel symmetry whenever possible relative to openings in both vertical and horizontal plane.
- .11 Brake form metal flashings to profile required, in maximum lengths.
- .12 Install head and sill flashings, edge trim, cap pieces and other formed profiles as applicable and/or detailed.
- .13 Do not cut, trim, weld or braze component parts during erection in manner that would damage finish, decrease strength or result in a visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- .14 Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.
- .15 Protect surface of metals in contact with concrete, mortar, plaster or other cementitious surface with isolation coating.

3.5 INSTALLATION TOLERANCES

- .1 Comply with the following maximum tolerances:
 - .1 Plumb:
 - .1 3.2 mm in 3 m (1/8" in 10'-0"); 6.4 mm in 12.2 m (1/4" in 40'-0").
 - .2 Level:
 - .1 3.2 mm in 3 m (1/8" in 10'-0"); 6.4 mm in 12.2 m (1/4" in 40'-0").
 - .3 Alignment:
 - .1 Where surfaces abut in line or are separated by reveal or protruding element up to 12.7 mm (1/2") wide, limit offset from true alignment to 1.6 mm (1/16").
 - .2 Where surfaces are separated by reveal or protruding element from 12.7 to 25.4 mm (1/2 to 1") wide, limit offset from true alignment to 3.2 mm (1/8").
 - .3 Where surfaces are separated by reveal or protruding element of 25.4 mm (1") wide or more, limit offset from true alignment to 6.4 mm (1/4").
- .4 Variation from plane:

- .1 3.2 mm in 3.6 m (1/8" in 12'-0"); 12.7 mm (1/2") over total length.
- .5 Panels:
 - .1 Bow: 0.2% of panel dimensions up to 3.2 mm (1/8") maximum.
 - .2 Indicated size:
 - .1 Up to 1220 mm (4'-0"): plus/minus 0.76 mm (0.030").
 - .2 1220 mm to 3050 mm (4'-0" to 10'-0"): plus/minus 1.52 mm (0.060").
- .6 Square or rectangular:
 - .1 Maximum 3.2 mm (1/8") difference between diagonal measurements.
- .7 Variation from indicated position: plus/minus 3 mm (1/8").
 - .1 Tolerances shall not be cumulative.

3.6 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Inspection and testing company shall perform inspection for completed Work.
 - .1 Confirm that composite aluminum cladding system and its application are consistent with the system as tested and listed in accordance with CAN/ULC S134-92

3.7 ADJUSTING AND CLEANING

- .1 After erection, touch up coatings removed or damaged during erection.
- .2 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.
- .3 Wash down exposed interior and exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths. Wipe interior surfaces clean as part of final clean-up.
- .4 Remove excess sealant with recommended solvent.

3.8 PROTECTION

- .1 Protect panels during fabrication, transportation, storage at the Place of the Work and erection.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Two-ply styrene-butadiene-styrene (SBS) modified bituminous membrane roofing; as follows:
 - .1 Exposed membrane roofing system.
 - .2 Roofing insulation.
 - .3 Air and vapour barrier.
 - .4 Associated roofing accessories and products.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Divisions 21, 22, and 23 to ensure that roof drains are suitable for roofing system design.
 - .2 Coordinate with installers of roof mounted items, equipment, and mechanical and electrical work at roof so that installation will not subvert the integrity of the roofing system.
 - .3 Coordinate with installation of air barrier at walls to ensure complete continuity of air barrier system for building. Roofing air barrier membrane to lap by 75 mm (3") minimum and terminate with wall system air barrier membrane.
 - .4 The manufacturer shall meet with the necessary parties at the Site to review and discuss project conditions as it relates to the integrity of the roofing assembly.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for each type of product indicated.
- .3 Shop drawings; general details:
 - .1 Include plans, elevations, sections, details, and attachments to other work for the following:
 - .1 Base flashings, cants, and membrane terminations.
 - .2 Tapered insulation, including slopes.
 - .3 Crickets, saddles, and tapered edge strips, including slopes.
 - .4 Insulation fastening patterns.
- .4 Certificates:
 - .1 Installer certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

- .2 Manufacturer certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in Subsection 2.2 "Performance Requirements" below.
 - .1 Submit evidence of compliance with performance requirements.
- .5 Roofing manufacturer's warranty and design criteria:
 - .1 Submit copy of completed roofing manufacturer's pre-installation notification form at least 10 Working Days prior to commencement of roofing installation.
 - .2 Submit copy of roofing manufacturer's warranty specimen and warranty design criteria for roofing system prior to commencement of roofing installation.
- .6 Samples:
 - .1 Submit samples complete with manufacturer's labels intact, of materials to be used for work of this Section prior to commencement of work. Allowing ample time for review and acceptance by Consultant and roofing inspection company. Do not proceed with work until samples are accepted.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's maintenance instructions for incorporation into the operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers: Company specializing in manufacturing the Products specified in this section, with a minimum of 10 years' experience.
 - .2 Installers / applicators / erectors: Provide work of this section, executed by competent installers with minimum 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
 - .1 Work of this Section shall be installed by a Subcontractor that is a member in good standing of the Canadian Roofing Contractors Association (CRCA) and Ontario Industrial Roofing Contractors Association (OIRCA), who has been a member for at least 5 years.
 - .2 Roofing Subcontractor must be approved by the membrane manufacturer for the warranty program specified. Submit Subcontractor's certification letter prepared by the membrane manufacturer.
- .2 Execute work of this Section only under full time supervision of qualified Subcontractor's site supervisor.
- .3 Mock-up:

- .1 Prepare a 10 m² (100 ft²) mock-up of the work of this Section. Incorporate materials and methods of fabrication and installation identical with Project requirements.
- .2 Install mock-up at roof area location directed by the Consultant. Retain accepted mock-up of sufficient size and scope to show typical pattern of seams, fastening details, edge construction, and workmanship.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver roofing materials to Project site in original containers with seals unbroken and labelled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- .2 Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- .3 Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
- .4 Handle materials carefully to preclude damage. Follow manufacturer's written recommendations.
- .5 Package materials and identify on attached labels the manufacturer, brand, contents, weight as applicable, and Product and specification numbers.
- .6 Protect edges of roll goods from damage during handling, and store rolls on end to prevent flattening.
- .7 Do not store roofing materials on roof. Store them in a dry area protected from inclement weather while roofing installation is not in progress. Store above materials under opaque, breathable and waterproof tarpaulins or in sheds.
- .8 Prevent compression of insulation panels at any point and breakage of edges and corners. Discard wet, cupped, bowed, or otherwise damaged insulation from Place of the Work.
- .9 Protect edges and corners of precast concrete paving slabs to prevent damage.

1.7 FIELD CONDITIONS

- .1 Weather limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 EXTENDED WARRANTY

- .1 Provide Ontario Industrial Roofing Contractors Association (OIRCA) 2 year warranty for labour, materials, and workmanship.
- .2 Warrant work of this section in accordance with Section 01 78 36 for a period of 2-years.
- .3 In addition, roofing manufacturer shall provide total system warranty including the following:
 - .1 Roofing membrane manufacturer will issue a written document in the Owner's name, valid for duration listed below, for the repair of leaks in the roofing membrane to restore the

roofing system to dry and watertight condition, to the extent that membrane manufacturing or installation defects caused water infiltration. Include copy of required warranty with close out documentation.

- .2 Warranty shall cover entire cost of the repair(s) required to maintain dry and watertight roofing system during the full warranty duration.
- .3 Warranty shall include for labour, materials, and workmanship.
- .4 Warranty shall be non-prorated with no dollar limit (NDL) for duration of warranty.
- .5 10 year warranty duration.

PART 2- PRODUCTS

2.1 ROOFING SYSTEM MANUFACTURER

- .1 General:
 - .1 Single source responsibility: each roofing component to be by one manufacturer.
- .2 Acceptable roof system manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - .1 Firestone Building Products.
 - .2 GAF Materials Corporation.
 - .3 IKO Industries.
 - .4 Siplast.
 - .5 Soprema.
 - .6 Or equivalent.

2.2 PERFORMANCE/DESIGN REQUIREMENTS – GENERAL

- .1 Roofing system: The roofing system shall include roofing system materials required to achieve roofing membrane manufacturer's warranty.
- .2 Roofing materials, components, and assemblies shall resist environmental and wind (uplift) loads, and effects of those loads in accordance with the Ontario Building Code.
- .3 General performance: Installed roofing system and base flashings shall withstand wind uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and base flashings shall remain watertight.
- .4 Material compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- .5 Roofing system: Prevent water from entering building and roofing assembly through roofing membrane.
- .6 Roofing system design:

- .1 Roofing system assemblies shall have been successfully tested by a qualified testing agency to resist project roofing uplift pressures in accordance with the Ontario Building Code.
- .2 Roofing system shall meet roofing system manufacturer's 145 kph (90 mph) wind speed requirements or equivalent FM Class 60 Windstorm Classification for wind uplift pressures, and to cladding design wind loads indicated in wind study report, as applicable.
- .7 Roof covering classification: Roof assembly shall have a Class C classification as determined in conformance with CAN/ULC S107-10 "Standard Methods of Fire Tests of Roof Coverings".
- .8 Air barrier system shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding the following specified limits and requirements:
 - .1 Air permeance of air barrier material: Maximum 0.02 L/s m² at 75 Pa (0.004 cfm/ft² at 1.57 psf) to ASTM E2178-13.
 - .2 Rate of air leakage of air barrier system: Maximum 0.15 L/s m² at 75 Pa (0.030 cfm/ft² at 1.57 psf) to ASTM E283-04 (2012).
 - .3 Water vapour transmission for air / vapour barriers: Maximum 5.7 ng/Pa.m².s. (0.1 perms).
 - .4 Pull-off strength of liquid or sheet applied membrane and laps: Cohesive or substrate failure permitted when tested to specified wind load. Air barrier system shall transfer wind load to structure and shall resist 100% of design wind load or minimum of 2.15 kPa (45 psf), whichever is greater.
 - .5 Low temperature flexibility: to -30°C (-22°F) to CGSB 37-GP-56M-1985.
- .9 Air barrier system shall be joined in an airtight and flexible manner to air barrier material of adjacent building envelope air barrier systems, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
 - .1 Walls and openings.
 - .2 Across construction, control, and expansion joints.
 - .3 Penetrations.
- .10 Solar Reflectance: roof shall have a minimum SRI of 78.

2.3 PERFORMANCE/DESIGN REQUIREMENTS – FIRE PROTECTION

- .1 At the end of each Working Day, use a heat detector gun or equipment as recommended by membrane manufacturer to spot smouldering or concealed fire. Schedule the Work to ensure workers are still on location at least 2 hours after torch application.
- .2 Never apply the torch directly to any wood surfaces. Conform with fire safety recommendations of the manufacturer and the CRCA.
- .3 Throughout roofing installation, maintain the Place of the Work in a clean condition and have one approved ABC fire extinguisher within 6 m of each roofing torch. Torches must never be placed near combustible or flammable Products.

2.4 ROOFING MEMBRANE AND FLASHING SHEETS

- .1 Roof membrane base sheet and base sheet flashing: CGSB 37.56, SBS-modified asphalt membrane sheet.
 - .1 Reinforcement:
 - .1 180 gm/m2 non-woven polyester.
 - .2 Thickness:
 - .1 3 mm (0.160") minimum.
- .2 Roofing membrane cap sheet and cap sheet flashing: CGSB 37.56, SBS-modified asphalt membrane sheet with non-woven polyester reinforced elastomeric bitumen, protected by coloured granules.
 - .1 Reinforcement:
 - .1 180 gm/m2 non-woven polyester.
 - .2 Thickness:
 - .1 4 mm (0.140") minimum.

2.5 AUXILIARY ROOFING MEMBRANE MATERIALS

- .1 General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing system.
- .2 Mastic sealant: Polyisobutylene, plain or modified bitumen, non-hardening, non-migrating, non-skinning, and non-drying.
- .3 Metal flashing sheet: Metal flashing sheet is specified in Section 07 62 00.
- .4 Miscellaneous accessories: Provide miscellaneous accessories recommended by roofing manufacturer.
- .5 Aggregate surfacing: gravel with no foreign material, ASTM D1863/D1863M- 05(2011) e1, water washed, dry, free of dirt and dust, hard, dry, clean, and graded in sizes from 9 mm to 12 mm.

2.6 ASPHALT MATERIALS

- .1 Asphalt primer: CGSB 37-GP-9Ma-1983.
- .2 Roofing asphalt: CAN/CSA A123.4-04, Type 2 or Type 3.

2.7 SUBSTRATE BOARDS

- .1 Substrate board: ASTM C1177/C1177M-08, glass-mat, water-resistant gypsum substrate, factory primed.
 - .1 Thickness:
 - .1 12.7 mm (1/2").
 - .2 Acceptable Products:

- .1 Georgia Pacific 'Dens Deck Prime'.
- .2 Substitutions: in accordance with Section 01 25 00.

2.8 AIR AND VAPOUR BARRIERS

- .1 Glass fibre sheet: ASTM D2178/D2178M-15, Type IV, asphalt-impregnated, glass-fibre felt (to be used in conjunction with asphalt).
- .2 Aluminized bitumen sheet: Air / vapour barrier membrane shall be manufactured by coating an aluminum foil with oxidized bitumen. Water vapour resistance: 16 ng/Pa.s.m². Both surfaces lightly sanded.
- .3 SBS modified bitumen membrane, reinforced with a fibreglass mat in conformance with Prefabricated membrane, complying with CGSB 37-GP-56M-1985.

2.9 ROOF INSULATION

- .1 General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- .2 Rigid polyisocyanurate insulation board, inorganic felt faced:
 - .1 Description: Closed-cell polyisocyanurate foam core integrally laminated to heavy, durable and dimensionally stable inorganic coated-glass facers, CAN/ULC S704-03 Type 2 and Class 3, HCFC free, 138 kPa (20 psi) minimum compressive strength (at 10% deformation), CAN/ULC-S126-06, LTTR value to CAN/ULC S770-00.
 - .2 Board size:
 - .1 1220 mm x 1220 mm (4 ft x 4 ft).
 - .3 Tapered insulation: Provide factory-tapered insulation boards fabricated to slope of 1:48 (1/4 inch per 12 inches) unless otherwise indicated.
 - .4 Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, and no less than 1:48 (1/4 inch per 12 inches) in addition to roof structure slope or to tapered insulation slope as applicable.

2.10 INSULATION ACCESSORIES

- .1 General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with roofing assembly.
- .2 Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate and acceptable to roofing manufacturer.
- .3 Insulation adhesive:
 - .1 Modified asphaltic insulation adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

.4 Cant strips:

- .1 Insulation cant strips; perlite: ASTM C728-13, perlite insulation board, cut to provide 45 degree transition from horizontal to vertical surfaces.

.5 Cover board:

- .1 Cover board; cellulose fibreboard: Asphalt treated and coated fiberboard to CAN/ULC S706-02, 12.7 mm (1/2") thick.

- .1 Thickness: 12.7 mm (1/2").

- .6 Substrate joint tape: 150 mm (6") wide, coated, glass fibre.

2.11 FASTENERS AND RESTRAINTS

- .1 General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing system.
- .2 Factory-coated steel fasteners and plates complying with corrosion-resistance provisions in FM 4470, designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength and wind uplift resistance, and acceptable to roofing manufacturer.
- .3 Termination bars: Pre-punched aluminum bar 25 mm (1") wide x 1.5 mm (1/16") thick x 3048 mm (10 ft) long with 6.4 mm (1/4") x 9.5 mm (3/8") slotted holes on 200 mm (8") centres.

2.12 WALKWAY PAVERS

- .1 Precast paver slabs: CSA A231.1-14/A231.2-14, 610 mm (24") square x 45 mm (1-3/4") height, slip resistant textured finish, minimum 45 MPa (6526 psi) compressive strength, minimum 4.5 MPa (653 psi) (mean) flexural strength, minimum 4.5% (by mass) water absorption, maximum allowable average loss of mass of not greater than 50 g/m² (0.16 oz/ft²) after 28 cycles.
- .2 Precast support pads: 25 mm (1") thick, extruded expanded polystyrene insulation, to CAN/ULC S701-11, Type 4, Class B, self-extinguishing, 35 psi at 5% deflection compressive strength, thermal conductivity (k) factor of 0.029 at 23.8 °C.

2.13 EXPANSION JOINTS

.1 Description:

- .1 Manufactured from a proprietary copolymer with internal polyester reinforcement, monolithic seam vulcanization.
- .2 Movement and fabrication: Tri-directional movement capability, joint waterproofing system shall be factory fabricated in one piece for the entire contiguous expansion joint or where length of joint exceeds manufacturer's shipping and handling guidelines shall be lapped and vulcanized by manufacturer's mechanics on site, repair of damaged materials shall be performed by manufacturer's mechanics.
- .3 Compatible with adhesives and membranes associated with expansion joint construction in accordance with manufacturer's installation instructions.
- .4 Warranted by manufacturer to cover full warranty duration specified in this Section.

- .5 Hydrostatic pressure limit: Working pressure in column of water shall perform under static limit not to exceed 10 m (33 ft).
- .2 Acceptable Products; to suit type of roofing assembly and movement design requirements:
 - .1 Situra Inc. 'RedLINE'.
 - .2 Situra Inc. 'FlamLINE'.
 - .3 Substitutions: in accordance with Section 01 25 00.

2.14 FLASHINGS AND PENETRATION FLASHINGS

- .1 Prefinished metal flashings in accordance with Section 07 62 00.
- .2 Roof drains; Stainless steel bolts, leader diameter size maximized to suit existing drain outflow pipe, deck clamps, stainless steel control flow insert, ballast guard, bitumen coated flanges, vandalproof hinged access gate (Allen-key operable) complete with drain seals:
 - .1 Drain body construction:
 - .1 Aluminum.
 - .2 Lexcor 'Flash-Tite Superdrains-FSD-FLAT',
 - .3 Thaler Metal Industries 'RD-FLAT'.
 - .4 Or equivalent
- .3 Prefabricated plastic pans; insulation filler and sealer; designed and provided for roof penetrating component in each case and for specified roofing system. Use gooseneck types for wiring and conduit.
 - .1 Lexcor 'Roof Protrusion Flashing'
 - .2 Thaler Roofing Specialties 'Stack Jack Flashing'.
 - .3 Or equivalent

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions, with roofing installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - .1 Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 - .2 Verify that blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - .3 Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 23.
 - .4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing manufacturer's written instructions. Remove sharp projections.
- .2 Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 METHOD OF INSTALLATION

- .1 Prepare surfaces and complete waterproofing work in conformance with roofing manufacturer's printed installation instructions.
- .2 Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.
- .3 Roofing work must be completed in a continuous fashion as surfaces are readied and weather conditions permit.
- .4 Seal seams that are not covered by a cap sheet membrane in the same day. Do not install cap sheet when moisture is present at/in the base sheet seams.
- .5 Whenever membranes are torch-applied, a continuous and even bead of molten bitumen must be visible as the membrane is unrolled and torched.
- .6 Lay roofing membrane free from wrinkles, air pockets, fishmouths, tears, and prominent lap joints. Full bond cap sheet to base sheet. Seams shall be lapped and fully bonded.
- .7 Prior to installation of base sheet and cap sheet, allow sheet to relax after unrolling. Relax time to be as recommended by manufacturer based on concurrent ambient temperature.
- .8 Extend roofing to outer edges of roof and up vertical surfaces at least 200 mm (8") above horizontal roofing, and full height beneath counter flashing and top of curb flashing.
- .9 Complete roofing up to line of termination for each Day's work.

3.4 SUBSTRATE BOARD (SHEATHING/UNDERLAY)

- .1 Lay substrate board with tightly butted joints. Longitudinal joints must be at right angles to flute direction. Joints occurring along widths of board to be continuously supported on top flange of metal deck. Stagger end joints of adjacent board by 1/2 the board width.
- .2 Ensure substrate board is immediately protected with membrane.
- .3 Mechanical fasteners to penetrate top flutes only; by no less than 19 mm (3/4") and by no more than 25.4 mm (1"). Check underside of deck before installation to eliminate damaging existing conditions below deck.
- .4 Tape all seams in substrate board prior to the installation of the air / vapour barrier. Use 150 mm (6") wide strips of self adhering base sheet to prevent leakage into the building.

3.5 APPLICATION OF PRIMER

- .1 Roofing substrates surfaces shall receive a coat of primer at a rate required by roofing manufacturer's printed installation instructions.
- .2 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.
- .3 Cover primed surfaces with roofing membrane as soon as possible (same day coverage for self-adhesive membranes).

3.6 AIR AND VAPOUR BARRIER

- .1 Built-up two-ply asphalt and fibreglass felt: Install two glass-fibre felt plies lapping each felt 483 mm (19 inches) over preceding felt. Embed each felt in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt within plus or minus 14°C (25°F) of equiviscous temperature.
- .2 Completely seal air and vapour barrier at terminations, obstructions, and penetrations to prevent air movement into roofing.

3.7 ASPHALT APPLICATION

- .1 Asphalt Heating: Heat roofing asphalt and apply within plus or minus 14°C (25°F) of equiviscous temperature unless otherwise required by roofing system manufacturer. Do not raise roofing asphalt temperature above equiviscous temperature range more than one hour before time of application. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating. Do not heat roofing asphalt within 14°C (25°F) of flash point. Discard roofing asphalt maintained at a temperature exceeding finished blowing temperature for more than 4 hours.
- .2 Apply asphalt at EVT and do not spread more than 1830 mm (6 ft) of hot asphalt in front of each roll and reduce distance accordingly during cold weather. Ensure hot asphalt in kettle is in constant use and circulation to avoid distillation.
- .3 Apply asphalt at minimum rate of 1.2 kg/m² (25 lb/100 ft²) and as specified herein for aggregate surfacing flood coat.

3.8 INSULATION APPLICATION – CONVENTIONAL ROOFING

- .1 Comply with up roofing manufacturer's written instructions for installing roof insulation.
- .2 Adhesively applied insulation: Install insulation adhesive in accordance with roofing manufacturer's installation instructions.
- .3 Mechanically fastened insulation: Fasteners must be attached to steel deck's upper flutes and at spacing to meet performance requirements, in accordance with roofing manufacturer's installation instructions
- .4 Nailer strips: Mechanically fasten 90 mm (3-1/2") width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:
 - .1 4877 mm (16 ft) apart for roof slopes greater than 1:12 (1 inch per 12 inches) but less than 3:12 (3 inches per 12 inches).

- .2 1220 mm (48") apart for roof slopes greater 3:12 (3 inches per 12 inches).
- .5 Stagger and offset vertical joints from preceding insulation boards, 305 mm (12").
- .6 Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- .7 Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- .8 Install only as much insulation as can be covered with membrane roofing in the same day.
- .9 Install insulation boards with edges in moderate contact without forcing and fill gaps greater than 6 mm (1/4") with insulation.
- .10 Cut insulation to fit to blocking, upstands, and penetrations through roof; fill gaps greater than 6 mm (1/4") with insulation.
- .11 Reduce thickness of insulation at roof drains by 13 mm (1/2") for a distance of 610 mm (24") from centre drain.
- .12 Install tapered insulation under area of roofing to conform to slopes indicated.
 - .1 Apply insulation adhesive to underside and immediately bond tapered insulation to substrate.
 - .2 Apply hot roofing asphalt to underside and immediately bond tapered insulation to substrate.
- .13 Protect and keep insulation dry (in new condition). Do not install insulation which is not in dry condition.

3.9 COVER BOARD

- .1 Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 300 mm (12") in each direction. Loosely butt cover boards together. Tape joints if required by roofing manufacturer.
 - .1 Apply insulation adhesive to underside and immediately bond cover board to substrate.
 - .2 Apply hot roofing asphalt to underside and immediately bond cover board to substrate.

3.10 INSTALLATION OF REINFORCED GUSSETS

- .1 Install reinforcing gussets on inside and outside corners of base sheet flashing membrane.
 - .1 Provide self-adhesive base sheet flashing membrane gussets, adhered over base sheet membrane flashing into intersecting corner, with edges of gusset sealed with a bead of compatible mastic.

3.11 ROOFING DETAILS

- .1 Install as indicated on Drawings and with various roofing details illustrated in roofing manufacturer's printed installation instructions.

3.12 INSTALLATION OF TORCH-APPLIED CAP SHEET MEMBRANE

- .1 Once base sheet, base sheet flashing, and stripping are applied and do not show defects, and installation has been reviewed by the roofing system manufacturer and the inspection and testing company, cap sheet can then be laid.
- .2 Cap sheet shall be unrolled starting from lowest point of roof. Cap sheet shall be rerolled from both ends prior to torching. Care must be taken to ensure alignment of first roll (parallel with edge of roof).
- .3 Cap sheet shall be torch welded on to base sheet membrane. During this application, both surfaces shall be simultaneously melted, forming an asphalt bead that shall be pushed out in front of cap sheet. Maintain a consistent 3 mm (1/8") wide asphalt bead at seams.
- .4 Avoid overheating.
- .5 Base sheet and cap sheet seams shall be staggered a minimum of 305 mm (12").
- .6 Overlap side laps by 75 mm (3") and end laps by 150 mm (6").
- .7 Make sure 2 membranes are properly welded without unwelded areas. Torch welding speed varies depending on weather. In cold conditions, it slows down, in warm and dry conditions, it speeds up.
- .8 After installation of cap sheet, check lap seams on cap sheet.

3.13 INSTALLATION OF TORCH-APPLIED CAP SHEET FLASHING MEMBRANE

- .1 Cap sheet flashing shall be laid in strips one metre wide. Side laps shall be 75 mm (3") and shall be staggered a minimum of 100 mm (4") from cap sheet laps and base sheet laps, in order to avoid excessive thickness.
- .2 Draw parallel chalkline at termination line of cap sheet flashing at horizontal roof deck surface. Sink surface granules into bed of hot bitumen with torch and round-nosed trowel in area between chalk line and base of upstand or parapet, as well as over any granulated vertical surfaces to be overlapped.
- .3 Cap sheet flashing shall be torch welded directly on its base sheet, proceeding from bottom to top. Torching shall soften the two membranes and ensure a uniform weld, as described under "Cap Sheet Installation". When allowed by support, cap sheet top edge shall be nailed on 305 mm (12") centres.

3.14 WATERPROOF EXPANSION JOINT INSTALLATION

- .1 Install all components of the system in accordance with the manufacturer's printed instructions.
- .2 The system is to be wholly encapsulated between the plies of the modified bitumen membrane in a roofing system.

3.15 ROOF DRAINS

- .1 Ensure that roof drains are set to permit drainage, located at lowest possible location, and properly secured. Cut and slope insulation at each drain to form a sump and to accommodate

flashing immediately surrounding drain. Review final locations with Consultant prior to installation of drains.

- .2 Drain sumps to be Provided by the tapered insulation manufacturer.
- .3 Temporarily block drain pipes during application of membrane. Remove blocking when work is not in progress and after work of this section is completed.
- .4 Carry membrane and insulation to edge of drain base and trim around drain opening. Top ply to be granulated cap sheet flashing to minimum 200 mm (8") from edge of drains.
- .5 Ensure that installation of drain and membrane is performed in accordance with recommendations of drain manufacturer.
- .6 Prime drain flange and allow to dry.
- .7 Embed first felt ply in a coat of waterproofing mastic and extend plies of felt into the drain opening of drains, and trim as required.
- .8 Fill void between drain body and roof insulation board/base structure support with two-component polyurethane foam insulation.

3.16 ROOF PENETRATIONS

- .1 Install curb flashings around ducts, pipes, structural steel, and other projections through membrane systems in conformance with manufacturer's written instruction and as detailed.
- .2 Install penetration flashing supplied under work of mechanical and under the work of this section, in accordance with roofing manufacturer's installation instructions.
- .3 Prime metal flanges with primer and allow solvents to flash off prior to installation.
- .4 Remove poly film on areas to receive metal flashing. Set metal flange in full layer of waterproofing mastic to provide positive bond and seal.
- .5 Install base ply to the base of the metal flashing staying short of curved metal section.
- .6 Install cap ply to the base ply flashing ensuring a full bond to the base ply and apply bead of waterproofing sealer at the termination point.

3.17 METAL FLASHINGS

- .1 Install metal flashings in accordance with Section 07 62 00.

3.18 PAVER INSTALLATION

- .1 Public area pavers:
 - .1 Install paver pedestals in accordance with manufacturer's recommended installation instructions.
- .2 Paver installation:
 - .1 Install pavers in accordance with paver manufacturer's written instructions. Align the top cap joint spacers with paver edges. Level pavers in succeeding rows.

- .2 Install pavers tightly butted into pedestals. Form minimum joint widths.
- .3 Shim or adjust to level and as necessary to prevent rocking of pavers.
- .4 Installation tolerances:
 - .1 Step in face alignment between paver faces: Plus or minus 1.5 mm (1/16").
 - .2 Jog in joint alignment between paver sections: Maximum 1.5 mm (1/16").
 - .5 Do not use pavers with chips, cracks, voids, stains, or other defects which might be exposed to view in the finished work.
 - .6 Machine cut pavers as necessary to fit the conditions indicated. Joints shall be no wider than the typical paver to paver joint.

3.19 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00 and as follows:
 - .1 Inspection and testing:
 - .1 Prior to installation of cap sheet membrane, base sheet membrane installation shall be reviewed by manufacturer and inspection and testing company, who shall each submit field review reports to the Consultant.
 - .2 Independent inspection and testing company shall perform:
 - .3 Inspections and provide inspection reports.
 - .4 Tests and provide test reports:
 - .1 Core cuts (if requested).
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.20 ADJUSTING AND CLEANING

- .1 Remove applicator's equipment and debris as work progresses, and at completion of the work of this Section in accordance with Sections 01 77 00.
- .2 Remove bituminous markings from finished surfaces.
- .3 Repair or replace defaced or disfigured finishes caused as a result of the work of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Supply and installation of prefinished metal (aluminum) flashings.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings:
 - .1 Submit shop drawings including the following:
 - .1 Plans, elevations, sections, and attachment details.
 - .2 Detail fabrication and installation layouts, expansion-joint locations, and key details. Distinguish between shop and field assembled work.
 - .3 Include identification of material, thickness, weight, and finish for each item and location in the work.
 - .4 Include details for forming, including profiles, shapes, seams, and dimensions.
 - .5 Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - .6 Include details of termination points and assemblies.
 - .7 Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contracting from fixed points.
 - .8 Include details of roof penetrations flashing.
 - .9 Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings as applicable.
 - .10 Include details of special conditions.
 - .11 Include details of connections to adjoining work.
- .3 Samples:
 - .1 Submit full-size samples of each specified flashing material formed to detailed profile including corner, curb, cap, and parapet flashing, and coping including lock-joints and hold-down clips.
 - .2 Submit 2 - 50 mm x 50 mm (2" x 2") samples of each type of sheet metal material, colour and finish.

1.3 QUALITY ASSURANCE

- .1 Qualifications:

- .1 Installers / applicators / erectors: Provide work of this section, executed by competent installers with a minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval of Product manufacturers.
 - .1 Work of this section shall be installed by a Subcontractor that is a member in good standing of the Canadian Roofing Contractors Association (CRCA).
 - .2 Work of this section shall be installed by a Subcontractor that is a member in good standing of the Canadian Roofing Contractors Association (CRCA) and Ontario Industrial Roofing Contractors Association (OIRCA), who has been a member for at least 5 years.
 - .3 Sealant shall be applied by a Subcontractor of recognized standing, having preferably not less than 5 years of proven experience in this type of work, and who has the necessary equipment and skilled mechanics to carry out the work of this section satisfactorily and can substantiate this to satisfaction of Consultant.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Keep materials and equipment free from debris, ice, snow and contaminants. Allow air to circulate around metal components, sheets and break shapes.
- .2 Protect holes, and reglets from water and ice during freezing weather.

PART 2- PRODUCTS

2.1 PREFINISHED ALUMINUM FLASHING

- .1 Aluminum flat sheet: Flat aluminum sheet to ASTM B209-14, to the following minimum thickness and alloy:
 - .1 Painting quality: 3003H14 or 3105H14 to ANSI H35.1/H35.1M-2013.
 - .2 Minimum thickness:
 - .1 0.81 mm (0.032").

2.2 PREFINISHED METAL FINISHES

- .1 Provide the following finish to exposed prefinished metal (steel/aluminum as applicable):
 - .1 Type 1; Finish: factory prefinished CSSBI 10000 Series.
 - .1 10000 Series (Polyvinylidene Fluoride - PVDF) will not visibly (within 10 metres to the unaided naked eye) crack, chip, or peel (lose adhesion) for thirty-five (35) years from date of application. This does not include minute fracturing that may occur during the normal fabrication process. 10000 Series (Polyvinylidene Fluoride - PVDF) will not chalk in excess of a number eight (8) rating, in accordance with ASTM D4214-07(2015) method D659 at any time for thirty-five (35) years from date of installation (35.5 yrs from application); will not change colour more than five (5.0) Hunter ΔE units as determined by ASTM D2244-15.
 - .2 Colour to later selection by Consultant from manufacturer's full range.

2.3 ACCESSORIES

- .1 Isolation coating: to CAN/CGSB-1.108, bituminous type.
- .2 Sealants: in accordance with Section 07 92 00, colour as selected by Consultant from manufacturer's full range.
- .3 Cleats: of matching metal to flashing material, continuous, and of greater thickness than flashing material. Joints in cleats shall not coincide with joints in perimeter edge metal. Allow a 12.7 mm (1/2") gap between pieces.
- .4 Fasteners:
 - .1 Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - .2 General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head:
 - .1 Exposed screws: 38 mm (1-1/2") long minimum at 450 mm (18") on centre maximum. Heads matching colour of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM washer under heads of exposed fasteners.
 - .2 Blind fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - .3 Cleat fasteners: Corrosion-resistant barbed angular ring or screw shank nail; length to achieve approximately 32 mm (1-1/4") penetration into nailer; fasten at 150 mm (6") on centre.
 - .3 Fasteners for prefinished aluminum sheet: Aluminum or Series 300 stainless steel.
 - .4 Fasteners and plates to meet the requirements of Factory Mutual 4470 Standard for wind uplift and corrosion resistance.
- .5 Flexible flashing membrane; standard temperature grade for use at locations where membrane is protected by material with insulating properties:
 - .1 Description:
 - .1 Thickness: 1 mm (40 mils) minimum.
 - .2 Self-adhesive grade rubberized membrane backed by high density polyethylene.
 - .3 Primer for substrate.
 - .2 Acceptable Products:
 - .1 Bakor 'Blueskin Roof RF200'.
 - .2 Grace 'Ice & Water Shield'.
 - .3 Soprema 'LASTOBOND SHIELD'.
 - .4 Or equivalent.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable SMACNA "Architectural Sheet Metal Manual (Seventh Edition) details and as indicated.
- .2 Form pieces in 3048 mm (10 ft) maximum lengths. Make allowance for expansion at joints.
- .3 Sealed joints: Form non-expansion but movable joints in metal to accommodate sealant.
- .4 Expansion provisions: Form expansion joints of intermeshing hooked flanges, not less than 25.4 mm (1") deep, filled with sealant concealed within joints.
 - .1 Joints that provide expansion and contraction capabilities should be located near the corners within approximately 610 mm (24") from each direction of the corner measured from the interior side.
- .5 Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, and of greater thickness of metal being secured.
- .6 Hem exposed edges on underside 12.7 mm (1/2"). Mitre and seal corners with sealant.
- .7 At parapets, provide 25.4 mm (1") minimum overlap between bottom of wood blocking or flashing anchorage support and edge of drip or termination of flashing.
- .8 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .9 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .10 Provide 25.4 mm (1") minimum overlap between bottom of wood blocking or flashing anchorage support and edge of drip or termination of flashing.

PART 3 - EXECUTION

3.1 FLEXIBLE FLASHING UNDERLAYMENT INSTALLATION

- .1 Apply primer to concrete masonry and precast concrete substrates.
- .2 Install in a consecutive weatherboard method starting at bottom or base of wall and working up.
- .3 Provide minimum of 50 mm (2") side laps and 75 mm (3") end laps.
- .4 Cut to manageable lengths, position membrane for alignment, remove protective poly- film and firmly apply pressure to assure adhesion.
- .5 Eliminate wrinkles or gaps, roll entire membrane surface (including seams) with a counter top or "J-roller" to ensure full contact and adhesion.
- .6 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the air barrier membrane and around the perimeter edge of membrane terminations.
- .7 Flashing membrane shall be applied in weatherboard fashion starting at bottom of base of wall and working up, in and around the full perimeter of openings, to provide water tight protection and according to the following procedures:

- .1 Apply the first strip horizontally immediately below the sill, cut it sufficiently long to extend past each side of the window, so that it projects even with the vertical jamb flashing to be applied later. Turn sill flashing up 50 mm (2") at ends of sill.
- .2 Sill flashing shall overlap wall membrane. Overlap jamb at head flashing membrane in the same manner.

3.2 ROOF FLASHING INSTALLATION

- .1 Install sheet metal work in accordance with SMACNA's "Architectural Sheet Metal Manual (Seventh Edition)".
- .2 Provide watertight flashing installing capable of resisting specified uplift pressures in accordance with roofing specifications, thermally induced movement and exposure to weather.
- .3 Provide minimum 10% slope for drainage towards roof at parapet locations, with minimum 2% sloped to drain at remaining flashing locations.
- .4 Provide continuous cleats for attachment of flashings at exterior face of wall and cleats for interior face of wall.
- .5 Provide radius (3-piece) copings for curved wall condition unless otherwise indicated.
- .6 Prefabricate corner copings in 610 mm (24") x 610 mm (24") sections.
- .7 Concealed fastenings and cleats, from view except where exposed flashings are accepted by Consultant prior to installation.
- .8 Flash joints using S-lock forming tight fit over hook strips/cleats; unless otherwise indicated.
- .9 Install surface mounted flared joint true and level, and caulk top of reglet with sealant at reglets.
- .10 Insert metal flashings to other materials and flashings to form weather-tight junction.
- .11 Provide prefinished metal flashing over equipment curbs which are covered with roofing membrane.
- .12 Turn top edge of flashing into recessed reglet or mortar joint where indicated, to minimum depth of 25 mm (1"). Wedge flashing securely into joint. Seal flashing at reglet and cap flashing with sealant.
- .13 Expansion provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3048 mm (10 ft) and provide uniform joint spacing with no joints allowed within 610 mm (24") of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25.4 mm (1") deep, filled with sealant concealed within joints.
- .14 Provide vapour permeable synthetic building paper separation between galvanized steel and treated wood where applicable.
- .15 Install flexible flashing membrane in accordance with the manufacturer's printed installation instructions.

3.3 INSTALLATION OF ROOF ACCESSORIES

- .1 Incorporate devices to which roofing and flashing may be secured.

- .2 Install work to ensure that roofing and flashings will be properly applied to maintain building envelope weather-tight.

3.4 INSTALLATION TOLERANCES

- .1 Installation tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 6 mm in 6 m (1/4 inch in 20 feet) on slope and location lines as indicated and within 3.2 mm (1/8") offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 The work of this Section will be inspected and tested in conjunction with inspection and testing of roofing work.

3.6 ADJUSTING AND CLEANING

- .1 Remove deposits, stains or protections and wash metals left unpainted and exposed to view as recommended by manufacturer of metal or paint finish.

3.7 PROTECTION

- .1 The Consultant will advise the Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Sprayed fire-resistive materials.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 ULC or cUL design number, brand names and descriptive catalogue data of Products to be used in the work of this section.
 - .2 Include complete test report in cases where references are not published by testing laboratories, and where authority having jurisdiction has approved significant changes from tested assembly on basis of an engineering study; study calculations shall accompany report.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Provide work of this section, executed by competent installers with minimum 5 years experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Materials and applied systems shall have full acceptance by Authority Having Jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Store fireproofing materials in weathertight enclosure raised clear of the ground so they are protected from moisture.
- .2 Store materials in original undamaged sealed container with manufacturer's labels and seals intact to show the approval of Underwriters' Laboratories of Canada.
- .3 Discard any material which has come into contact with moisture prior to actual use.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 Materials shall be listed in accordance with CAN/ULC S101-07 achieve required fire protection rating.
- .2 Products shall be asbestos free.
- .3 Water, bonding agents, binders, accessories, cleaning solvents, aggregates and sealers shall be in accordance with base material manufacturer's recommendation.

- .4 Metal lath or non-metallic fibre mesh: as recommended by applied fireproofing manufacturer for application to painted surfaces.

2.2 CEMENTITIOUS FIREPROOFING (WET-MIX)

- .1 Description: Wet-mix spray-applied fire resistive materials (SFRM) consisting factory mixed dry formulation of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates mixed with water to form slurry for conveyance and application.
- .2 Acrylic fireproofing adhesive and sealer: Vinyl acrylic copolymer emulsion of fine particle size, films retain high degree of flexibility and elongation.
- .3 Acceptable Products; standard density:
 - .1 AD Fire Protection Systems 'Southwest Fireproofing Type 5GP'.
 - .2 Grace Construction Products 'Monokote MK-6'.
 - .3 Isolatek International 'Cafco 300'.
 - .4 Or approved equivalent.
- .4 Acceptable Products; medium density:
 - .1 A/D Fire Protection Systems Inc. 'Southwest Fireproofing Type 5MD'.
 - .2 Grace Construction Products 'Z-106 G'.
 - .3 Isolatek International 'Cafco 400'.
 - .4 Or approved equivalent.

PART 3- EXECUTION

3.1 PREPARATION

- .1 Review locations of exposed/non-exposed fireproofed surfaces with Consultant prior to application.
- .2 Prepare substrate in accordance with the printed instructions of the manufacturer of the sprayed fireproofing material to achieve required fire protection.
- .3 Mechanically fasten metal lath or non-metallic fibre mesh to painted surfaces to receive applied fireproofing in accordance with manufacturer's recommendations.
- .4 Apply medium coat of sealer to fireproofing in surfaces of indicated SFRM to prevent dust particles from becoming airborne.

3.2 APPLICATION

- .1 Apply sprayed-applied fireproofing in accordance with the printed instructions of the manufacturer of the sprayed fireproofing material, and as specified herein and in accordance with ULC or cUL design number.
- .2 Apply by the contour method in one or more coats of sufficient thickness to achieve the fire ratings as required.

- .3 Repair sprayed-applied fireproofing damaged by others after completion of the work of this Section. Costs for damage shall be borne by the responsible party. Coordinate work with other Sections.
- .4 Install the sprayed-applied fireproofing so that any movement of building structure acting alone or together does not tear, rupture, delaminate, puncture or perforate spray-applied fireproofing.

3.3 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.4 PROTECTION

- .1 Protect during installation any adjacent finished surfaces from contamination and damage due to the work under this section.
- .2 Protect completed work, vulnerable corners, edges and surfaces liable to be damaged due to construction activities. Provide wood cover strips and sheet material as required to prevent damage.
- .3 Method and materials to effect protection are subject to review by the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Materials installed in cavities, joints, around penetrations, and openings in floors, walls, partitions, and other building components to restrict the spread of fire and smoke.
- .2 Section excludes:
 - .1 Firestopping and smoke seals, for mechanical, electrical and communications penetrations of fire resistant assemblies, and firestopping and smoke seals within their respective assemblies.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Read and be governed by conditions of the Contract and sections of Division 1.
- .2 Coordination:
 - .1 Coordinate with other Sections to assure that pipes, conduit, cable, and other items that penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
 - .2 Schedule the Work to assure that penetrations and other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data: Submit data and installation instructions for Products and prefabricated devices, providing descriptions sufficient for identification at the Place of the Work.
- .3 Materials list of Products proposed for use in the work of this Section;
- .4 Listing agency's detailed drawing showing opening, penetrating items, and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.
- .5 Manufacturer's specifications, detail sheets, and other data needed to prove compliance with the specified requirements;
- .6 Certificates: Submit manufacturer's certification that installed firestopping and smoke seal Products are suitable for the use indicated and comply with specified requirements.
- .7 Submit fire resistance rating test listings for firestopping and smoke seal systems.
- .8 Manufacturer's engineering judgment identification number and shop drawing details when no ULC, c-UL or other Canadian listed assembly is available for an application. Engineered judgment must include both Project name and Subcontractor's name who will install firestop system as described in shop drawing.

.3 Shop drawings:

- .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.
- .2 Designate on shop drawings static through penetrations and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, firestopping details at receptacles and similar poke-through devices and surrounding permanent materials. Identify re-entry locations.

.4 Manufacturers' instructions:

- .1 Manufacturer of the Products proposed for use in the work of this Section shall prepare a firestopping manual scheduling the products to be used for each assembly and installation required in the Work.
- .2 Manual shall include manufacturer's Product data sheets as specified under paragraph 1.3.2.
- .3 Firestopping manual shall be submitted within 4 weeks of Contract award.

1.4 QUALITY ASSURANCE

.1 Qualifications:

- .1 Provide work of this Section, executed by competent installers with minimum 5 years experience in application of Products, systems and assemblies specified and with approval, training and certification of Product manufacturers.
 - .1 Submit proof of manufacturer's installer certification for each installer of firestopping and smoke sealant systems.
 - .2 Manufacturer's willingness to sell its firestopping Products to the Contractor or to a Subcontractor or installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .2 Applicator shall designate a single individual as Project foreperson who shall be present at the Place of the Work at all times when the work of this Section is being performed.

.2 Regulatory requirements:

- .1 Firestop systems shall be listed in accordance with CAN/ULC-S115-05 and tested assemblies shall achieve a fire resistance rating in accordance with Ontario Building Code.
- .2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.

1.5 DELIVERY STORAGE, AND HANDLING

- .1 Deliver the materials to the Place of the Work in the manufacturer's unopened containers, containing the classification label, with labels intact and legible at time of use.

- .2 Store materials in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
- .3 Do not use damaged or adulterated materials and materials exceeding their expiry date.

1.6 FIELD CONDITIONS

- .1 Comply with manufacturer's instructions relative to temperature and humidity conditions, before, during and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 General: Manufacturers of firestopping and smoke seal system Products and installation specialists for the work of this section are limited to applicable assemblies as required for the Work and having listing mark on packaging.
- .2 Acceptable manufacturers for work of this section:
 - .1 3M Canada Inc.
 - .2 A/D Fire Protection Systems Inc.
 - .3 Dow Corning.
 - .4 Hilti Canada Corp.
 - .5 Nuco – Self-Seal Firestopping Products.
 - .6 Tremco Canada Ltd.
 - .7 Or equivalent.

2.2 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Provide firestop and smoke seal systems consisting of a material, or combination of materials installed to retain the integrity of fire-rated construction by effectively impeding the spread of flame, smoke, and/or hot gasses through penetrations, blank openings or gaps, membrane penetrations, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.
- .2 Provide also smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.
- .3 Provide fire-resistance rating equivalent to the rating of the adjacent floor, wall or other fire separation assembly.
- .4 Provide firestopping and smoke sealant system assemblies as practical and as required to coordinate with the schedule and sequencing of the Work.
- .5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with Consultant prior to application.

- .6 Provide movement capability at movement joints in accordance with design requirements for movement joint.

2.3 MATERIALS

- .1 Single source responsibility for firestopping and smoke seal materials:
 - .1 Obtain firestopping and smoke seal materials from single manufacturer for each different Product required.
 - .2 Manufacturer shall instruct applicator in procedures for each material.
- .2 Firestopping and smoke seal systems shall conform to the following:
 - .1 VOC content not to exceed 250 grams per litre minus water.
 - .2 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN/ULC- S115-05 and not to exceed opening sizes for which they are intended.
 - .3 Provide firestopping materials and systems with fire-resistance rating not less than the fire-resistance rating of applicable adjacent assembly.
 - .4 Listed in accordance with CAN/ULC-S115-05.
 - .5 For services that penetrate a fire separation or a membrane forming part of an assembly required to have a fire-resistance rating, provide firestop system with "F" rating as required by Ontario Building Code.
 - .6 For combustible pipe penetrations through a fire separation required to have a fire-resistance rating, provide firestop system with "F" rating as required by Ontario Building Code.
 - .7 For services that penetrate a fire wall or a horizontal fire separation that is required to have a fire-resistance rating, provide firestop system with "FT" rating as required by Ontario Building Code.
 - .8 For joints in fire-separations, provide firestop system as required by Ontario Building Code.
 - .9 Products shall be compatible with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with requirements of Contract Documents and manufacturer of selected materials being installed.
- .3 Smoke sealants for overhead and vertical joints shall be non-sagging; sealants for floors shall be self-levelling.
- .4 Smoke sealants at vertical through penetrations in areas with floor drains shall be waterproof type.
- .5 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems).
- .6 Metal deck/wall penetration conditions with sprayed fireproofing: spray-on fire-rated firestop mastic.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written Product data including Product technical bulletins, Product installation instructions and Product packaging instructions.

3.2 PREPARATION

- .1 Examine sizes, anticipated movement and conditions to establish correct thickness and installation of back-up materials.
- .2 Clean bonding surfaces to remove deleterious substances including dust, paint, rust, oil, grease, moisture, frost and other foreign matter which may otherwise impair effective bonding.
- .3 Prime and mask adjacent surfaces. Mask areas adjacent to sprayed firestopping to limit firestopping overspray to area not greater than 25 mm (1") of minimum required.
- .4 Remove insulation from insulated pipe and duct where such pipes or ducts penetrate a fire separation unless listed assembly permits such insulation to remain within assembly, or where mechanical trades have installed special fire rated insulated sleeves.
- .5 Secure pipe, conduit, cable, and other items that penetrate firestopping and smoke seal systems.

3.3 INSTALLATION

- .1 Mix and apply firestopping, gas and smoke seals in accordance with manufacturer's written instructions and tested designs to achieve required flame rated seal, to prevent the passage of gas and smoke and, where specifically designated, the passage of fluids.
- .2 Provide temporary forming and packing as required and other accessories in accordance with manufacturers' written instructions. Apply materials with sufficient pressure to properly fill and consolidate the mass to seal openings.
- .3 Provide fill materials for through-penetration firestop systems by techniques to achieve the following results:
 - .1 Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - .2 Install materials so that they contact and adhere to substrates formed by openings and penetrating items.
- .4 Provide joint fillers to provide support of firestop materials during application and at the position required to produce the cross-sectional shapes and depths of installed firestop material relative to joint widths that allow optimum sealant movement capability and develop fire-resistance required.
- .5 For materials that will remain exposed after completing the Work, finish to Provide smooth, uniform surfaces. Tool or trowel exposed surfaces.
- .6 Seal joints to ensure an air and water resistant seal, capable of withstanding compressions and extensions due to thermal, wind or seismic joint movement.
- .7 Notify Consultant when random completed installations are ready for review, as directed by Consultant, prior to concealing or enclosing firestopping and as applicable, smoke seals.

- .8 Remove temporary forming and dams only after materials have gained sufficient strength.

3.4 IDENTIFICATION

- .1 Identify through-penetration firestopping and smoke seal systems with pressure- sensitive, self-adhesive, printed vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestopping system installation where labels will be visible to anyone seeking to remove penetrating items or firestopping and smoke seal systems. Include the following information on labels:
 - .1 The words: "Warning: Through-Penetration Firestopping system – Do Not Disturb";
 - .2 Applicator's name, address and phone number;
 - .3 Designation of applicable testing and inspection agency;
 - .4 Date of installation;
 - .5 Manufacturer's name for firestopping and smoke seal system materials.

3.5 FIELD QUALITY CONTROL

- .1 Quality control to be in accordance with Section 01 45 00.
- .2 Field tests and inspections:
 - .1 Inspection consultant to review installation of the work of this section and to perform random tests to verify its completion in accordance with the requirements of the Contract Documents.
 - .2 Give at least 48 hours notice before operations commence, and arrange for a pre-job conference with the Contractor, Subcontractor, inspection and testing company, manufacturer, and Consultant present.
 - .3 Inspection and testing company shall examine penetration firestopping in accordance with ASTM E2174-09 and ASTM E2393-10a as applicable. Inspection and testing company shall examine firestopping and shall determine, in general, that firestopping has been installed in accordance with the requirements of the Contract Documents and the tested and listed firestop system.
 - .4 Representatives of the manufacturer(s) shall have access to the Work. Contractor shall provide assistance and facilities for such access in order that the manufacturer(s) representative(s) may properly perform its function.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Exterior building sealants.
 - .2 Interior building sealants.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Submit manufacturer's and Product name for each sealant which will be used in the Work prior to commencing the Work.
- .3 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.
- .4 Test sealant in contact with samples of materials to be sealed to verify adhesion will be achieved and no staining of the material will result. Prepare sample joints at the Place of the Work of each type of sealant for each joint condition.
 - .1 Submit test results to Consultant prior to application of sealants.
- .5 Test sealant in contact with samples of porous materials to be sealed to ensure that no staining of the material will result in accordance with ASTM C1248-08 (2012).
 - .1 Submit test results to Consultant prior to application of sealants.
- .6 Submit 2440 mm (96") long sealant joint mock-up.
- .7 Submit "wet sample" sealant colour samples for each sealant Product and colour.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Provide work of this Section, executed by competent installers with minimum 5 years experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers. Installer to comply with quality assurance articles referenced in ASTM C1193-13 for installation of joint sealants.
- .2 Conduct quality control in accordance with Section 01 45 00.

1.4 FIELD CONDITIONS

- .1 Verify substrates and ambient air temperature at the Place of the Work before, during and after application to ensure compliance with manufacturer's recommendations. Surfaces shall be frost-free, dust-free, clean and completely dry at time of installation.
- .2 Weather Conditions: In accordance with manufacturer's instructions, do not apply silicone joint sealants in snow, rain, fog or mist, or when such conditions are expected. Allow joint surfaces to attain dry conditions as recommended by manufacturer before sealant application.

- .3 Sealant and substrate materials: Conform to sealant manufacturer's specifications and recommendations. Keep organic sealant materials heated to at least 16°C when working at temperatures below 10°C.

1.5 EXTENDED WARRANTY

- .1 Warrant work of this section for a period of 2 years, in accordance with Section 01 78 36.
- .2 Repair or replace joint sealants which fail to perform as air tight and water-tight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, or general durability; or appear to deteriorate or become unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship or in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.
 - .1 Defects shall include, but are not limited to:
 - .1 Staining from abutting materials or filler.
 - .2 Migrating, bleeding into, or staining abutting materials.
 - .3 Unightly surface deformation by causes other than movement.
 - .4 Excessive colour change, chalking, or dust pick-up.
 - .5 Failing adhesively or cohesively where maximum elongation is less than 25% of designed width of exposed joints.
 - .6 Hardening to more than 25% over specified hardness.

PART 2 - PRODUCTS

2.1 SEALANTS

- .1 General:
 - .1 Colours: Sealant colours shall match colours of adjacent materials, as selected and approved by Consultant:
 - .1 Colours shall be selected from manufacture's full range of colours, generally to match adjacent finished colours
 - .2 Comply with ASTM C920-11 and other requirements indicated for each liquid- applied chemically curing sealant, including those referencing ASTM C920-11 classifications for type, grade, class, and uses.
 - .3 Provide joint sealants, primer(s) and backings that are compatible with one another and with joint substrates under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience.
 - .4 For sealants to be applied to porous substrates: Provide products that have undergone testing according to ASTM D1248-12 and have not stained porous joint substrates indicated for Work.

- .5 Sealant supplied shall not exude any material(s) which travels into adjacent materials, or travels onto surfaces of adjacent materials; causing damage, or attracting soiling, which becomes apparent during the service life of the building.
- .2 Interior sealants shall have VOC limit of less than 250 g/L.
- .3 Sealant designations:
 - .1 Type 1 – Urethanes Two Part.
 - .1 Non-sag, multi-component, epoxidized polyurethane sealant to CAN/CGSB 19.24-M90, Type 2, Class B.
 - .2 Location: use at all locations except where noted otherwise.
 - .3 Acceptable Product: Dymeric, as manufactured by Tremco Ltd. or equivalent.
 - .2 Type 2 – Silicones One Part.
 - .1 One-part, acetoxysilicone sealant, mildew resistant, to CAN/CGSB 19.22-M89.
 - .2 Location: for washroom fixtures and vanity tops.
 - .3 Acceptable Product: Tremsil 200, as manufactured by Tremco Ltd. or equivalent.
 - .3 Type 3 – Acrylics One Part.
 - .1 Acrylic terpolymer sealant, solvent release, to CGSB 19-GP-5M-1984.
 - .2 Location: at interior joints between windows, door frames, and screen frames.
 - .3 Acceptable Product: Mono 555, as manufactured by Tremco Ltd. or equivalent.
 - .4 Type 4 – Acoustical Sealant.
 - .1 Siliconized acrylic latex sealant, to CGSB 19.21-M87.
 - .2 Location: at all perimeter joints and openings in gypsum board systems.
 - .3 Acceptable Product: Tremflex 834, as manufactured by Tremco Ltd. or equivalent.
 - .5 Type 5 – Urethanes Two Part.
 - .1 Non-sag, multi-component, chemically cured, polyurethane sealant to CAN/CGSB 19.24-M90, Type 2, Class B.
 - .2 Location: at control joints in masonry assemblies.
 - .3 Acceptable Product: Dymeric511, as manufactured by Tremco Ltd. or equivalent.
 - .6 Type 6 – Urethanes Two Part.
 - .1 Non-sag, multi-component, chemically cured, polyurethane sealant to CAN/CGSB 19.24.
 - .2 Location: at all locations calling for EPDM membrane.
 - .3 Acceptable Product: Lexcan pourable sealer or equivalent.
 - .7 Type 7 – Urethanes One Part.
 - .1 Non-sag, single component, polyurethane sealant to CAN/CGSB 19.13-M87.
 - .2 Location: at metal flashing and trim.

- .3 Acceptable Product: RC-1 Sealant as manufactured by Lexsuco or equivalent.
- .8 Type 8 – Polyurethane One Part
 - .1 Non-sag, single component, moisture curing, modified polyurethane sealant to CGSB 19.12, class MC-2-25-B-N.
 - .2 Location: as toe bead filling void beneath glazing strip in Window Wall in accordance with Section 08500 Aluminum Windows.
 - .3 Acceptable Product: DyMonic, as manufactured by Tremco Ltd. or equivalent.
- .9 Type 9 – Structural Silicone.
 - .1 Non-sag, single component, elastomeric, chemical curing, neutral core, medium modulus silicone sealant to CAN/CGSB 19.13-M87, MCG-2-25-A-L.
 - .2 Location: as structural silicone sealant in Window Wall in accordance with Section 08500 Aluminum Windows.
 - .3 Acceptable Product: Spectrum 2, as manufactured by Tremco Ltd. or equivalent.
- .10 Type 10 – Acrylics One Part.
 - .1 Single component, elastomeric, water based, acrylic firestop sealant to CAN/ULC-S115-11.
 - .2 Location: fire rated joints and penetrations in fire rated systems.
 - .3 Acceptable Product: TREMstop Acrylic, as manufactured by Tremco Ltd. or equivalent.
- .11 Interior sealant, mildew resistant one part silicone sealant in accordance with the following:
 - .1 Comply with:
 - .1 ASTM C920-11, Type S, Grade NT, Class 25
 - .2 CAN/CGSB 19.22-M89.
 - .2 Acceptable Products:
 - .1 GE Silicones "Sanitary SCS1700 Sealant"
 - .2 BASF Building Systems "OmniPlus";
 - .3 Dow Corning "786"
 - .4 Tremco, Inc. "Tremsil 200";
 - .5 Or equivalent.

2.2 ACCESSORIES

- .1 General: Provide component joint sealant primers, backings and fillers that are compatible with joint substrates and other sealants or joint fillers specified and approved for applications indicated under joint sealant schedule.
- .2 Cylindrical sealant backings: Provide joint backings that meet ASTM C1330-02, Type O (open-cell polyurethane), or Type B (non-absorbent bi-cellular backing materials with surface skin), sized 25 percent or greater than joint opening with proper density to control sealant depth and

profile. Follow joint sealant manufacturer's recommendations with backing selections for optimum joint sealant performance, in accordance with the following schedule:

- .1 Use open cell foam with non-absorbing closed cell skin (Sof-Rod) for vertical joints; round shape for open joints and triangular shape for angular joints.
- .2 Use closed cell foam for horizontal joints.
- .3 Bond-breaker tape: Polyethylene tape or other approved plastic tape as recommended by joint sealant manufacturer to prevent 3-sided joint adhesion to rigid, inflexible joint fillers or joint surfaces at back of joint where such adhesion would restrict proper sealant movement or result in sealant failure.
- .4 Masking Tape: Non-staining, non-absorbent and compatible with joint sealants and adjacent surfaces.
- .5 Sealant primers: Use primers only as recommended by sealant manufacturer where required to enhance adhesion of sealant to specific joint substrates indicated and as determined for use from pre-construction mock-up testing. Select primers in consultation with sealant manufacturer and manufacturer of substrate material which do not have a detrimental effect on sealant adhesion or in-service performance.
- .6 Cleaners for nonporous surfaces: Provide non-staining, chemical cleaners of type which are acceptable to manufacturer of sealant and sealant backing material, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
 - .1 Provide cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Unless specified otherwise herein, comply with the recommendations and directions of the manufacturer whose materials are being used in the work of this Section.

3.2 PREPARATION

- .1 Prior to installation, clean substrates of substances that could impair the bond of joint sealants. Clean and prepare joint surfaces immediately before installing joint sealants. Protect adjacent work areas and finished surfaces from damage during joint sealant installation.
- .2 Clean porous joint surfaces by using heavy-duty brushing, light abrasive, mechanical abrading or combination of these methods to produce a clean, sound surface for optimum bond with joint sealants per manufacturer's recommendations. Provide a dry, dust-free and cleaned substrate for optimum results.
- .3 Non-porous surfaces should be cleaned using the two-cloth solvent wipe method as referenced in ASTM C1193-13 and outlined by joint sealant manufacturer's instruction. IPA (isopropyl alcohol) is not a degreasing solvent yet may be used in new construction for non-porous joint cleaning and preparation. Use xylene, toluene or MEK for degreasing solvent and general cleaning of non-porous surfaces.

- .4 Rusting or scaling surfaces must be prepared using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Efflorescence, mould, mildew and algae must be removed and neutralized prior to joint sealant installation.
- .5 Coordinate cleaning, priming and installation to avoid contamination of wet, freshly coated or adjacent finished surfaces. Prepare finish-coated surfaces per joint sealant manufacturer's specific recommendations.
- .6 Test materials for indications of staining or poor adhesion before any sealing is commenced. Submit reports in writing to Consultant of results.

3.3 MASKING

- .1 Where necessary to prevent contamination or marring surfaces of adjacent materials, mask areas adjacent to joints with masking tape prior to priming or sealing application. Remove tape immediately after joint has been completed and an initial set achieved.

3.4 INSTALLATION

- .1 Review the complete Contract Documents for extent of sealant work required.
- .2 Comply with joint sealant manufacturer's installation instructions for products, primers and applications indicated unless more stringent project-specific instructions or requirements apply.
- .3 Apply joint sealants for continuous waterproof sealant joint protection. Vertical joints should be lapped over horizontal joints as recommended by sealant manufacturer. Comply with installation recommendations in ASTM C1193-13 for use of joint sealants as applicable to each specific sealant installation.
- .4 Install sealant primers only when recommended by sealant manufacturer and demonstrated at pre-construction tests after joint surface preparation has been completed and when surfaces are verified as clean and dry. Allow any primer installation to completely dry or cure prior to installation of backing or joint sealants.
- .5 Install joint sealants in accordance with joint sealant manufacturer's instructions using proven techniques that comply with the following and in proper sequence with installation of primers and backings.
 - .1 Using proper joint sealant dispensing equipment, place sealants by pushing sealant beads into opening to fully wet-out joint sealant substrates. Fill sealant joint opening to full and proper configuration.
 - .2 Install, providing uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's instructions.
- .6 Joint sealant tooling is required for non-sag joint sealant installations. Immediately after placing fresh sealants and before skinning or curing begins, tool sealants using metal spatulas designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth, uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.
 - .1 Provide concave joint configuration as indicated per figure 5-A in ASTM C1193- 13 unless otherwise indicated. Dry tooling is required for joint sealants, and wet tooling agents are not allowed.

- .2 Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.
- .7 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer.
- .8 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the Contract Documents.
- .9 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.
- .10 Check to make sure shop paint is compatible with primer and sealant. When incompatible, inform Consultant and change primer and sealant to compatible type acceptable to Consultant.
- .11 Check form release agent used on concrete for compatibility with primer and sealant. If they are incompatible inform Consultant and change primer and sealant to compatible type, or clean concrete to sealant manufacturer's acceptance.
- .12 Install joint backing material, filler strips, gaskets, bond breakers and similar type material of comparable performance characteristics. Install bond breaker tape or packing over asphalt impregnated fibre board as recommended by sealant manufacturer.
- .13 Where joints are 12.7 mm (1/2") or deeper, insert backing material in continuous uniform compression with setback from finished face of adjoining materials equal to required depth of sealant (width/depth ratio) as specified herein.
- .14 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.
- .15 Pack joints tightly with sealant backing set at depth specified for sealant. Fill other voids with filler.
- .16 Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.
- .17 Maintain correct sealant depth. Sealant depth shall be 1/2 the width of the joint, maximum depth shall be 12.7 mm (1/2"), minimum depth shall be 6 mm (1/4"). Comply with manufacturer's written recommendations.
- .18 Fillet bead sealant joints to be sized to provide proper contact area with substrates, in accordance with manufacturer's written recommendations.
- .19 Apply sealants using pressure-operated guns fitted with suitable nozzles in accordance with manufacturer's directions. Apply sealants in such manner as to ensure good adhesion to sides of joints and to completely fill voids in joints.
- .20 Apply sealants so that surfaces of joints are smooth, full bead, free from ridges, wrinkles, sags, air pockets and embedded impurities. Tool sealant surfaces to produce a smooth surface.
- .21 Remove droppings and excess sealant as work progresses, before material achieves initial set. Do not use soap and water in tooling.
- .22 Install sealant materials and primers when surfaces are prepared, and ambient temperature and weather conditions are prevalent, consistent with manufacturer's recommendations. Primer is mandatory for gun applied sealants.
- .23 Install sealant with exterior face of sealant set back 10 mm (3/8") from face of adjacent materials at building movement joints, unless otherwise indicated.

- .24 Do not apply sealants to areas where installation of paints, coatings or flooring is in progress.
Apply sealants after such work is complete and fully cured.

3.5 ADJUSTING AND CLEANING

- .1 Clean off excess sealant or sealant residue adjacent to sealant joint installations as the work progresses by methods approved by joint sealant manufacturer. Do not damage adjacent surfaces with harmful removal techniques and protect finished surfaces beyond those that have been masked. Protect installed sealants during and after final curing from damage resulting during construction. Remove and replace damaged joint sealants.
- .2 Remove temporary coverings and masking protection from adjacent work areas upon completion. Remove construction debris from the project site on a planned and regular basis.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Hollow metal doors and panels (steel doors).
 - .2 Insulated metal doors (insulated steel doors).
 - .3 Metal frames (steel frames, transom frames).
 - .4 Thermally broken metal door frames (thermally broken steel frames).

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Cooperate fully with finish hardware distributor's representative during preparation of shop drawings and execution of shop fabrication.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Submit copy of NAAMM-HMMA 840-07 standard.
- .3 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .4 Shop drawings:
 - .1 Include details of each door and frame type, finish hardware types and locations, frame profiles, door and frame elevations, mitre details, fire protection rating, glazing preparation details and anchor details and locations.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
 - .3 Electrified hardware requirements and preparations shall be clearly indicated on shop drawings.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Provide doors and frames manufactured by a firm specializing in the design and production of hollow metal steel doors and frames.
 - .2 Manufacturer shall be a member in good standing of the Canadian Steel Door Manufacturers Association (CSDMA).

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Inspect materials thoroughly upon receipt and report immediately discrepancies, deficiencies and damages, in writing, to supplier.
- .2 Note damages incurred during shipment on carriers' bill of lading and report immediately, in writing, to supplier.
- .3 Store materials properly on planks, out of water and covered to protect from damage from adverse weather conditions. Remove wet packaging immediately.
- .4 Remove wrappings or coverings from doors upon receipt at the Place of the Work, and store in a vertical position, spaced with blocking to permit air circulation between them.

PART 2- PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Exterior insulated metal doors shall be tested to meet an operable U-value of 0.400.
- .2 Fire rating requirements:
 - .1 Fire rated labelled doors and frames: tested to CAN/ULC-S104-10 and listed by a nationally recognized agency having a factory inspection service and shall be constructed as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
 - .2 Install fire labelled steel door and frame products in accordance with NFPA 80, except where indicated otherwise in the Contract Documents.

2.2 MATERIALS

- .1 Steel:
 - .1 Fabricated from tensioned levelled steel to ASTM A924/A924M-14, galvanized to ASTM A653/A653M-11, Commercial Steel CS, Type B.
 - .2 Steel shall be free of scale, pitting, coil breaks, surface blemishes, buckles, waves, and other defects.
 - .3 Equivalent minimum base steel thicknesses for gauges shall be in accordance with Appendix 1 of CSDMA "Recommended Specifications for Commercial Steel Door and Frame Products".
 - .4 Finish: Galvanneal coating designation ZF120 (A40).
- .2 Door core materials:
 - .1 Honeycomb: Structural small cell 25 mm (1") maximum kraft paper 'honeycomb'. Weight: 36.3 kg (80 lb) per ream (minimum). Density: 16.5 kg/m³ (1.03 pcf) minimum, sanded to required thickness.
 - .2 Polystyrene: EPS polystyrene, Type 1, density: 16 to 32 kg/m³ (1 to 2 pcf), thermal values: RSI 1.06 (R 6.0) minimum, conforming to ASTM C578-14a.
 - .3 Polyisocyanurate: Closed cell, faced board, thermal value: RSI 2.17 (R12.3) minimum, conforming to ASTM C1289-14a.

.3 Adhesives:

- .1 Heat resistant, single component, polyurethane reactive (water) hot melt, thermoset adhesive.
- .2 Rigid insulation cores: Heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Lock seam doors: fire resistant, resin reinforced polychloroprene, high viscosity sealant-adhesive.
- .4 Primer: rust inhibitive for touch-up.
- .5 Finishing hardware: in accordance with Section 08 71 00.
- .6 Miscellaneous:
 - .1 Door silencers: single stud rubber or neoprene type.
 - .2 Exterior top caps: Rigid polyvinylchloride extrusion.
 - .3 Frame thermal breaks: Rigid polyvinylchloride extrusion.
 - .4 Glazing stops: formed channel of minimum 1 mm (0.039") (20 gauge) steel, 15.9 mm (5/8") high.

2.3 FABRICATION - GENERAL

- .1 Fabricate steel doors, frames, transoms, sidelights and borrowed lights as applicable, to the design and dimensions indicated. Take field measurements where coordination with adjoining work is necessary.
- .2 Fabricate steel doors and frames to be rigid, neat in appearance and free from defects, warp, wave or buckle with all corners square unless otherwise indicated.
- .3 Operating clearances:
 - .1 Provide clearance at floor with allowance made for indicated finish flooring materials.
 - .2 Clearances for Fire-Rated Doors: As required by NFPA 80.
 - .3 Clearances for Non-Fire-Rated Doors: Not more than 3 mm (1/8") at jambs and heads, except not more than 6 mm (1/4") between pairs of doors. Not more than 19 mm (3/4") at bottom.
- .4 Drill and tap or reinforce for mortised or surface mounted hardware in accordance with accepted hardware schedule, ANSI A115, NFPA 80, or manufacturers recommendations.
- .5 Countersink exposed fasteners unless otherwise shown. Use flat or oval head screws.
- .6 Reinforce components to resist stresses imposed by hardware in use.
- .7 Allow for anticipated expansion and contraction of frames and supports.
- .8 Fit elements at intersections and joints accurately together, in true planes, and plumb and level.
- .9 Weld continuously at joints exposed to view or at joints through which air or water could penetrate from the exterior of building to the interior.
- .10 Perform welding to CSA W59-15.

- .11 Mortise, reinforce, drill and tap to receive hardware and security devices using templates provided by respective Supplier.
- .12 Touch up finish damaged during fabrication.
- .13 Prepare doors or frames to receive seals where seals are indicated.
- .14 Attach labels to suit required fire-protection and temperature rise ratings.

2.4 FABRICATION – STEEL DOORS AND PANELS

- .1 Fabricate steel doors and panels to a thickness of 45 mm (1-3/4"), unless indicated otherwise.
- .2 Exterior and insulated doors and panels:
 - .1 Face sheets fabricated from 1.60 mm (0.063") 16 gauge steel.
 - .2 Insulation core:
 - .1 Polystyrene.
 - .2 Polyisocyanurate.
 - .3 Longitudinal edges mechanically interlocked.
 - .1 Adhesive assisted with edge seams visible.
- .3 Interior doors and panels:
 - .1 Face sheets fabricated from 1.087 mm (18 gauge) steel.
 - .2 Honeycomb core.
 - .3 Longitudinal edges mechanically interlocked.
 - .1 Adhesive assisted with edge seams visible.
- .4 Fabricate of composite metal face construction with each face formed from flush sheet steel without visible seams, free of scale, pitting, coil brakes, buckles and waves.
- .5 Formed edges shall be true and straight with minimum radius for the thickness of steel used.
- .6 Lock and hinge edges shall be bevelled 3 mm in 50 mm (1/8" in 2") unless hardware or door swing dictates otherwise.
- .7 Top and bottom of doors shall be provided with inverted, recessed, 1.60 mm (0.063") 16 gauge steel end channels, welded to each face sheet at 50 mm (2") on centre maximum.
- .8 Prior to shipment, mark each door with an identification number as shown on the approved submittal drawings.
- .9 Exterior doors shall be provided with factory installed flush PVC top caps. Fire labelled exterior doors shall be provided with factory installed flush steel top caps.
- .10 Blank, reinforce, drill and tap doors for mortised, templated hardware. Locate hardware to manufacturer's standard unless indicated otherwise.
- .11 Holes 12.7 mm (1/2") and larger shall be factory prepared.
- .12 Glazing:

- .1 For glazing materials up to and including 8 mm (5/16") thick, doors shall be provided with 1.00 mm (0.039") 20 gauge steel glazing trim and snap-in glazing stops.
- .2 For glazing materials greater than 8 mm (5/16") thick, doors shall receive 1.00 mm (0.039") 20 gauge steel trim and screw fixed glazing stops. Screws shall be #6 x 32 mm (1¼") oval head Tek™ (self-drilling) type at 305 mm (12") on centre maximum.
- .3 Glazing trim and stops shall be accurately fitted (within 0.39 mm (0.015") tolerance), butted at corners, with removable glazing stops located on the 'push' side of the door.
- .13 Fabricate closing stiles of paired doors as indicated or scheduled.
- .14 Where indicated in the Contract Documents, prepare doors and panels for installation of fire-rated door grilles. If required to meet door grille manufacturer's rated design, provide reinforcement around door grill opening.

2.5 FABRICATION – STEEL FRAMES

- .1 General: Applicable to frames, transom panel frames, sidelights, and window assemblies.
- .2 Interior and non-thermally broken frames; welded:
 - .1 Fabricated from:
 - .1 1.60 mm (0.063") 16 gauge steel.
 - .2 1.98 mm (0.078") 14 gauge steel for frames noted as heavy duty.
 - .2 Supplied set-up and welded (SUW).
- .3 Factory assembled frame product shall be square, free of defects, warps or buckles.
- .4 Set-up and welded corner joints (SUW):
 - .1 Profile welded–punch mitred, continuously welded on inside of the profile faces, rabbets, returns and soffit intersections, with exposed faces filled and ground to a smooth, uniform seamless surface, as defined in the CSDMA - "Recommended Specifications for Commercial Steel Door and Frame Products".
- .5 Set-up and welded joints at mullions, sills and center rails:
 - .1 Coped accurately, butted and tightly fitted.
 - .2 At intersecting flush profile faces, securely weld, fill and grind to flush, smooth, uniform, seamless surface.
 - .3 At intersecting recessed profile faces, securely weld to concealed reinforcements, with exposed hairline face seams.
 - .4 At other intersecting profile elements make exposed face seams to hairline tolerance.
- .6 Glazing stops shall be formed 1.00 mm (0.039") 20 gauge steel, 16 mm (0.625") height channel, accurately fitted, butted at corners and fastened to frame sections with #6 x 32 mm (1¼") oval head Tek (self-drilling) type screws at 305 mm (12") on centre maximum.
- .7 Where required due to site access, when required for co-ordination or installation, or shipping limitations, frame product shall be fabricated in sections for splicing in the field.

- .1 Field spliced jambs, heads and sills shall be provided with 1.60 mm (0.063") 16 gauge steel splice plates securely welded into one section, extending 100 mm (4") minimum each side of splice joint.
- .2 Field splices at closed sections (mullions or center rails) shall be 1.60 mm (0.063") 16 gauge steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100 mm (4") minimum into closed sections when assembled.
- .3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the installation company responsible for installation after assembly.
- .8 On factory assembled frame product, provide 2 temporary steel shipping bars welded to the base of the jambs or mullions to maintain alignment during shipping and handling. Remove shipping bars prior to anchoring of frames to floor.
- .9 Each door opening shall be prepared for single stud door silencers. Silencers shall be shipped loose for installation by installer, after finish painting.
 - .1 Single interior doors: 3 at strike jamb.
 - .2 Pair of interior doors: 2 at header.
 - .3 Dutch doors: 4 at strike jamb.
 - .4 Weather-stripped doors: None required.
 - .5 Sound, light, or smoke sealed doors: None required.
 - .6 Transom panels: 2 at each jamb.
- .10 Prior to shipment, mark each frame with an identification number as shown on the approved submittal drawings.
- .11 Provide mullions and transom bars of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.
- .12 Conceal fastenings unless otherwise indicated.
- .13 Fasten removable stops by counter-sunk Phillips head screws at approximately 225 mm (9") on centre symmetrically spaced on stop length.
- .14 Anchor frames to floor by 1.60 mm (0.063") 16 gauge thick angle clips, welded to frame and Provide with 2 holes for floor anchorage.
- .15 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .16 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction.
- .17 Reinforce head of frames wider than 1220 mm (48").
- .18 Brace frame units to prevent distortion in shipment and protect finish.
- .19 Where removable mullions provided under this section are indicated, head or transom mullion shall be reinforced. Provide loose mounting bracket/shoe mechanical fasteners and installation instructions.

2.6 HARDWARE REINFORCEMENTS AND PREPARATIONS

- .1 Door and frame product shall be blanked, reinforced, drilled and tapped at the factory for fully templated mortise hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier.
- .2 Door and frame products shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
- .3 Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware are required frame product shall be reinforced only, with drilling and tapping done by field installation.
- .4 Templated holes 12.7 mm (1/2") diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by installation on site. Templated holes less than 12.7 mm (1/2") diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
- .5 Hinge reinforcements shall be 3.51 mm (0.138") 10 gauge steel minimum, high frequency type shall be provided.
- .6 Frames shall be prepared for 114 mm (4.5") standard weight hinges minimum unless otherwise indicated.
- .7 Doors and frames in excess of 2450 mm (96") rabbet height shall be prepared for 114 mm (4.5") heavy weight 4.6 mm (0.180") hinges minimum.
- .8 Lock, strike and flush bolt reinforcements shall be 1.60 mm (0.063") 16 gauge steel minimum, with extruded tapped holes that provide equivalent number of threads as 2.74 mm (0.108") 12 gauge.
- .9 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 1.30 mm (0.051") 18 gauge steel minimum.
- .10 Reinforcements are not required for surface applied hardware supplied with thru-bolts and spacers or sex-bolts.
- .11 Provide hardware mortises on perimeter frame members to be grouted in masonry or concrete partitions with 0.84 mm (0.033") 22 gauge steel grout guards.
- .12 Electrified hardware:
 - .1 Where electrically or electronically operated hardware is specified on the schedules or details or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on the templates, shall be provided and inter-connected with CSA approved 12.7 mm (1/2") diameter conduit and connectors.
 - .2 Refer to electrical documents for general electrical rough-in details. At door locations indicated in electrical documents as requiring rough-in only of electrical (ie. where no electrically or electronically operated hardware is specified in the hardware schedule), provide enclosures, boxes, and conduit to permit future installation of devices without removal of grout, demounting of frames, or installation of exposed conduits.
 - .3 Frames:
 - .1 Frames with electrified devices shall include electrical connection boxes sized to accommodate devices specified in Section 08 71 00. At time of frame manufacture,

electrical connection boxes shall be supplied by Divisions 26, 27, and 28 for installation into frame by work of this section.

- .2 Frame electrical connection boxes shall be positioned flush to edge of frame face return. Clearance shall be maintained to allow wall material to be consistently applied for length of frame member. Frame connection boxes shall be welded in place and positioned to allow necessary clearance for electrical trade to install conduit and connection components, with conduit layout in a manner that takes conduit up to ceiling in an uninterrupted configuration and to accommodate wire installation.

.4 Doors:

- .1 Doors with electrified devices shall be manufactured to include wire raceway in door panel to accommodate electrified devices, such as electric hinge, power transfer units, electrified locks, electrified door closures and electrified exit devices. Construction of raceways shall provide a continuous conduit or channel between entry and exit points to accommodate wire installation after door manufacture.
- .2 Doors with electrified locks may require extended space to accommodate plug-type connection components or wire collection space. Coordinate with work of Section 08 71 00 and obtain hardware templates for electrified hardware clearly indicated on reviewed shop drawings and prior to door manufacture.

2.7 FRAME ANCHORAGE

- .1 Frame products shall be provided with anchorage appropriate to floor, wall and frame construction.
- .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb.
- .3 Frame products for installation in new masonry walls shall be provided with steel adjustable wall anchors of the T-strap, stirrup or wire, 1.60 mm (0.063") 16 gauge minimum or 3.96 mm (0.156") diameter wire. Straps shall be not less than 50 mm (2") x 254 mm (10") in size, corrugated and/or perforated.
- .4 Frame products installed in steel stud and drywall partitions shall be provided with 1.00 mm (0.039") 20 gauge steel snap-in or "Z" stud type anchors.
- .5 Jambs of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4 mm (1/4") diameter, located not more than 150 mm (6") from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcing and directly opposite on the strike jamb. Each preparation shall be provided with 1.60 mm (0.063") 16 gauge anchor bolt guides.
- .6 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the installation company.
- .7 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 1.60 mm (0.063") 16 gauge steel floor anchors. Each anchor shall be provided with 2 holes for mounting to the floor and shall be securely welded to the inside of the jamb profile.
- .8 On sidelights or windows exceeding 3 m (9'-10") in width, installed in stud partitions, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 2.74 mm (0.108") 12 gauge steel formed channels,

mounting angles and adjusting brackets, with mounting angles welded to the inside of frame head. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.

2.8 SIZES AND TOLERANCES

- .1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of $\pm 1.6 \text{ mm}$ ($\pm 0.063"$).
- .2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of $\pm 1.2 \text{ mm}$ ($\pm 0.047"$).
- .3 Unless finishing hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3 mm ($1/8"$) clearance at jambs and head. A clearance of 19 mm ($3/4"$) between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be $\pm 1.2 \text{ mm}$ ($\pm 0.047"$).
- .4 Manufacturing tolerances on formed frame profiles shall be $\pm 0.8 \text{ mm}$ ($\pm 0.031"$) for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbets shall be $\pm 1.6 \text{ mm}$ ($\pm 0.063"$) and $\pm 0.4 \text{ mm}$ ($\pm 0.016"$) respectively. Hardware cut-out dimensions shall be as per template dimensions, $\pm 0.4 \text{ mm}$ ($\pm 0.015"$).

2.9 HARDWARE LOCATIONS

- .1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in paragraph 2.8 of this section.
- .2 Top of upper hinge preparation for 114.3 mm ($4.5"$) hinges shall be located 180 mm ($7.5"$) down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3 mm ($4.5"$) hinges shall be located 310 mm ($12.625"$) from finished floor as defined in paragraph 2.8 of this section. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts.
- .3 Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033 mm ($40-5/16"$) from finished floor. Strikes for deadlocks shall be centered at 1220 mm ($48"$) from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
- .4 Push and/or pulls on doors shall be centered 1070 mm ($42"$) from finished floor.
- .5 Preparations not noted above shall be as per hardware manufacturer's templates.
- .6 Hardware preparation tolerances shall comply with the ANSI A115 standards.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Provide necessary grounds, bracing and strapping for fitting and adequate for securing of the work.

- .2 Cooperate with work of other sections to ensure fastenings set by others are provided and located, their work is installed to their specifications and that those responsible for back priming are notified in sufficient time for them to schedule work.

3.2 INSTALLATION – STEEL DOORS AND FRAMES

- .1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-07.
- .2 Frame product installation tolerances:
 - .1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be ± 1.6 mm ($\pm 1/16"$).
 - .2 Squareness tolerance, measured through a line 90 from one jamb at the upper corner of the product, to the opposite jamb, shall be ± 1.6 mm ($\pm 1/16"$).
 - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16"$).
 - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16"$).
- .3 Fire labelled product shall be installed in accordance with NFPA 80.
- .4 Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install temporary wood spreaders at mid-point of frame rabbet height to maintain frame widths. Remove wood spreaders after product has been built-in.
- .5 Provide vertical support at center of head for openings exceeding 1250 mm (48") in width.
- .6 Secure anchorages and connections to adjacent construction.
- .7 Execute installation and assembly using skilled forces under supervision of a competent joinery foreperson.
- .8 Install doors in accordance with NAAMM-HMMA 840-07, maintaining clearances outlined in paragraph 2.8 of this section.
- .9 Install finishing hardware in accordance with ANSI A115.1G-1994, manufacturers' templates and instructions, and Section 08 71 00.
- .10 Adjust operable parts for correct clearances and function.
- .11 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
- .12 Remove grout or other bonding material from products immediately following installation.
- .13 Provide appropriate anchorage for floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike jamb. On each jamb, install 2 anchors for openings up to and including 1525 mm (60") high and install 1 anchor for each additional height of 760 mm (30") of height or fraction thereof, except as indicated below. Frames placed in previously placed concrete, masonry or structural steel shall be provided with anchors located not more than 150 mm (6") from top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum.

- .14 Secure frames set in previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee wall anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.
- .15 Fill and grind smooth "punch and dimpled" frame installations.
- .16 Prior to site touch-up, exposed surfaces of galvalume steel to be finished shall be cleaned to remove foreign matter. Refer to paint manufacturers recommendations for additional information and requirements of Section 09 91 00.
- .17 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.
- .18 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.
- .19 Finish paint in accordance with Section 09 91 00.
- .20 Install door silencers.
- .21 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.
- .22 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.
- .23 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .24 Adjust operable parts for correct clearances and function.

3.3 INSTALLATION - FINISHING HARDWARE

- .1 Install finishing hardware in accordance with Section 08 71 00.

3.4 ADJUSTING AND CLEANING

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by Supplier's instructions.
- .3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.
- .4 Clean hardware after installation in accordance with Supplier's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - a. Four-fold metal doors; motorized.
- .2 All costs associated with the work of this Section shall be included in the Contract Price.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.
- .3 Shop drawings:
 - .1 Include details of each door and frame type, hardware types and locations, frame profiles, door and frame elevations, anchor details and locations.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
 - .3 Indicate materials, operating mechanisms, required clearances and electrical connections

1.3 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's maintenance instructions for incorporation into the operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers: Doors shall be manufactured by a firm with a minimum of 5 years' experience in the fabrication and installation of specified doors.
 - .1 Manufacturers proposed for use, which are not named in these specifications, shall submit evidence of ability to meet performance and fabrication requirements specified, and include a list of 5 projects of similar design and complexity completed within the past 5 years.
 - .2 Installers / applicators / erectors: Installation of doors shall be performed by the authorized representative of the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Package or crate, and brace Products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

PART 2- PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Exterior door construction shall be designed to withstand windload in accordance with building code requirements.

2.2 MATERIALS

- .1 General:
 - .1 Single-source responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- .2 Steel:
 - .1 Structural steel: ASTM A36/A36M.
 - .1 Hot dip galvanizing: for irregular sections, conforming to CAN/CSA G164- M92, minimum zinc coating of 600 g/m² (21 oz. /ft²).
 - .2 Steel sheets: Steel sheets of commercial quality, complying with ASTM A36/A36M cold-rolled steel sheet, or ASTM A1011/A1011M-10 hot-rolled steel sheet.
 - .1 Zinc coated sheet steel: sheet steel to ASTM A653/A653M-11 with coating designation Z275 (G90) to ASTM A924/A924M-14.
- .3 Hardware: Door manufacturer's standard heavy-duty hardware components, galvanized.
- .4 Fasteners:
 - .1 Zinc-coated steel.

2.3 FOUR-FOLD METAL DOORS

- .1 Manufacturers/Acceptable Products:
 - .1 Door Engineering and Manufacturing Company, tel: 1-800-959-1352.
 - .2 Acceptable Product:
 - .1 Door; with glazing panels: 'FF300 Series' as supplied by Northern Dock Systems Inc.
- .2 Construction:
 - .1 Door assembly shall be fully welded minimum 2.5 mm (0.1") 11 gauge structural steel tube framing with sheet steel facing on the exterior and interior faces, hot- dipped galvanized after door fabrication.

- .2 Steel sheeting shall be formed on vertical edges with no visible welds on interior or exterior panel faces.
 - .1 Face sheets fabricated from:
 - .1 1.5 mm (0.06") 16 gauge steel.
- .3 Frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 3 mm in 6000 mm (1/8" in 20').
- .4 Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.
- .5 Door panels thickness: 50 mm (2") thick minimum.
- .6 Insulation:
 - .1 Fibreglass
- .7 Door finish:
 - .1 All steel shall be painted with standard factory applied gray oxide primer. Finish paint shall be factory applied: Ral Color 7024 (Charcoal Gray).
- .3 Operating hardware:
 - .1 Hardware shall include guide tracks and brackets, trolleys, guides, not less than 3 pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.
 - .2 Jamb hinges shall be dual shear and have 2 thrust bearings and 2 needle bearing.
 - .3 Fold hinges shall be dual shear with 2 thrust bearings.
 - .4 Bearings shall be completely concealed within hinge barrels.
 - .5 Hinge pins shall be non-removable, minimum 19 mm (3/4") diameter hardened steel.
 - .6 Trolleys to be equipped with nylon, bronze or ball bearing rollers.
- .4 Weatherstripping:
 - .1 Material shall be adjustable and readily replaceable and provide a substantially weathertight installation.
 - .2 Weatherstripping at and bottom shall be 1.6 mm (1/16") cloth inserted neoprene.
 - .3 Weatherstripping shall be retained continuously.
 - .4 Perimeter weatherstripping: Jamb and head weatherstripping, 1.6 mm (1/16") cloth-inserted neoprene bulb or closed cell neoprene.
- .5 Glazing panels:
 - .1 Vision panels: Provide vision panels of type, size, shape and location as noted on the drawings.
 - .1 Glazing type: 25mm, Sealed, insulated, tempered, grey tinted units, with Low E coating on 2nd surface – Pilkington Energy Advantage.
 - .2 Provide Bird-Friendly dots in accordance with Contract Documents.

2.4 MOTORIZED OPERATION

- .1 Motorized operation:
 - .1 Door opening speed: 0.6096 mm/s (2 fps).
 - .2 Each four-fold door shall be operated by an overhead mounted electro- mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.
 - .3 Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to free wheeling mode for manual operation.
 - .4 Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity.
 - .5 Power supply: 3 phase 230 VAC, 60 Hertz, unless otherwise indicated.
 - .6 Electric controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards. Control circuits shall not exceed a nominal 110 volts.
 - .1 Controls shall include a self diagnostic programmable logic controller with digital message display and input LED. Controller shall include programmable close time delays and maximum open and close run-time timers.
 - .2 Motor starters shall be magnetic reversing, factory wired with overload and under voltage protection, and equipped with mechanical interlocks. All control components shall be enclosed in one enclosure with a wiring diagram placed on the inside of the cover.
 - .3 Enclosures shall be NEMA 4 with programmable door logic controller, VFD for Speed Control, O/C/S Pushbuttons, Auto/Hand selector switch and power disconnect.
 - .4 Pushbuttons for each door shall have one momentary pressure three-button push-button station marked "OPEN", "CLOSE" and "STOP". Push button enclosure shall be NEMA 4.
 - .5 Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
 - .7 Safety edges: Electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
 - .8 Photo eyes: One interior and one exterior mounted photo eye (sender/receiver type) with mounting brackets. Photo eyes shall be NEMA 4.
 - .9 Remote control units:
 - .1 Provide radio receiver and single button remote control units.
 - .1 Quantity; remote control units: as directed by the Consultant.

- .10 Wiring: Door manufacturer shall supply controls only. Electrical Subcontractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.

2.5 FABRICATION

- .1 Fabricate work of this section with materials, and with component dimensions and gauges, reinforcing, attached anchors and fastenings of adequate strength to prevent warping, buckling, opening of joints and seams, loosening of hardware, distortion, and displacement within limits of intended and specified use.
- .2 Conceal and weld connections wherever possible.
- .3 Fit joints and junctions between components tightly and in true planes.
- .4 Isolate from each other dissimilar metals, and metal from concrete or masonry to prevent electrolysis. On aluminum, use bituminous paint in concealed locations and lacquer where exposed to view.
- .5 Finishing:
 - .1 File and grind exposed welds smooth.
 - .2 Zinc coating: clean and smooth ground surfaces at welds, fill if necessary, and prime all areas from which zinc coating has been removed with zinc rich paint applied in a minimum thickness of 0.102 mm (0.004").

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine building structure, finishes and conditions at the Place of the Work.
- .2 Notify the Consultant of any adverse conditions which could jeopardize system installation or system operation. Do not proceed until such conditions have been documented, assessed, rectified and approved for installation. Starting work indicates acceptance of conditions unless the Consultant is notified otherwise in writing.

3.2 ELECTRICAL WIRING

- .1 Power shall be brought up to circuit breaker/disconnect switch adjacent to controller under Electrical and in conformance with requirements specified therein.
- .2 Wiring from motor to switches, controls, starters, safety devices and other items requiring power shall be carried out under work of this section.
- .3 Use EMT conduit for fixed wiring. Use purpose-made and approved type flexible cables or cords at applicable locations; adequately support so as not to impede access or foul moving parts of equipment.

3.3 INSTALLATION – GENERAL

- .1 Install doors and operators in accordance with door manufacturer's printed instructions.
- .2 Work shall be performed by qualified personnel approved by door manufacturer.
- .3 Fit doors snugly to edges of jambs and heads of frames. Doors shall operate smoothly and freely under all conditions of operation. Door shall sit in any position in door opening and shall not drift upward or downward.
- .4 Furnish necessary appurtenances relating to door installation, including those required on door frames.
- .5 Upon completion of installation of doors and operating equipment, lubricate moving parts prior to putting into operation. Supply oil to gear reduction units and grease sprockets, bearings, cables, link chains and door guides. Check and re-adjust as required, items of operating hardware, including weatherstripping.
- .6 Install doors to operate freely and to close tight.
- .7 Full commissioning and training shall be completed after installation.

3.4 ADJUSTING AND CLEANING

- .1 Adjust work of this section to ensure free-running, tightly closing and properly counterbalanced operation. Ensure that installation is free from warp, twist or other distortion. Lubricate operating hardware.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at site only if approved.
- .3 Clean work on completion of installation.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Sectional overhead metal doors. All costs associated with the work of this Section shall be included in the Contract Price.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Include details of each door and frame type, hardware types and locations, frame profiles, door and frame elevations, anchor details and locations.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
 - .3 Indicate materials, operating mechanisms, required clearances and electrical connections

1.3 CLOSEOUT SUBMITTALS

- .1 Operation and maintenance data:
 - .1 Submit manufacturer's maintenance instructions for incorporation into the operation and maintenance manuals in accordance with Section 01 77 00.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers: Sectional doors shall be manufactured by a firm with a minimum of 5 years' experience in the fabrication and installation of sectional doors. Manufacturers proposed for use, which are not named in these specifications, shall submit evidence of ability to meet performance and fabrication requirements specified, and include a list of five projects of similar design and complexity completed within the past 5 years.
 - .2 Installers / applicators / erectors: Installation of sectional doors shall be performed by the authorized representative of the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Package or crate, and brace Products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- .1 Acceptable Product:
 - .1 Aluminum A175A-NDS as supplied by Northern Dock Systems Inc.

2.2 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Design exterior door assembly to withstand windload of 1 kPa (0.1 PSI) with a maximum horizontal deflection of 1/240 of opening width.
- .2 Design door panel assemblies with thermal insulation factor R14.
- .3 Design door panel assemblies to withstand minimum 100,000 cycles per annum.

2.3 MATERIALS

- .1 General:
 - .1 Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- .2 Galvanized steel sheet: 0.5 mm (0.02") roll formed commercial quality to ASTM A653/A653M-08 with Z275 zinc coating to both faces.
- .3 Steel structural shapes, plates, bars, angles, dowels, and the like: to CSA G40.21-04, grade 300W.
- .4 Aluminum extrusions: 6063-T6 alloy and temper, clear anodized.
- .5 Touch-up primer: to CAN/CGSB 1.181-M99 for galvanized steel surfaces.
- .6 Insulation: polyurethane, to achieve R14.
- .7 Glazing: clear, sealed, insulated, tempered, grey tinted units fitted into PVC snap-on mouldings for easy replacement. Provide Feather Friendly dots in accordance with Contract Documents.
- .8 Cable: multi-strand galvanized steel aircraft cable to ASTM A1023M.
- .9 Solid kick proof bottom section (plywood core)

2.4 ACCESSORIES

- .1 Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.
- .2 Track guards: 5 mm (1/4") thick formed sheet 1500 mm (59") high.
- .3 Pusher springs.
- .4 Weather stripping: aluminum vinyl C 'Arctic' standard.

2.5 HARDWARE

- .1 All hardware to be galvanized steel.
- .2 Track: standard hardware with 75 mm (3") size minimum 2.28 mm (0.09") core thickness galvanized steel track.
- .3 Track supports: 2.3 mm (0.1") core thickness continuous galvanized steel angle track supports constructed of 32 mm (1-1/4") x 4.76 mm (0.2") steel angle neatly cut and connected. Punched steel angle is not acceptable.
- .4 Spring counter balance: heavy duty oil tempered torsion spring with manufacturer's standard brackets and as follows:
 - .1 Minimum rating: 100,000 cycles per annum.
 - .2 Drum: 133 mm (5.2") diameter.
 - .3 Shaft: 25 mm (1") diameter solid steel.
 - .4 Install cycle counter device.
- .5 Top roller carrier: galvanized steel minimum 2.28 mm (0.09") thick adjustable.
- .6 Rollers: full floating, grease packed hardened steel, ball bearing minimum 75 mm (3") diameter, stamped tire.
- .7 Roller brackets: adjustable, galvanized steel, 2.5 mm (0.1") thick.
- .8 Hinges: standard duty industrial 2.28 mm (0.09") thick galvanized steel.
- .9 Cable: minimum 4 mm (0.2") diameter galvanized aircraft cable.

2.6 FINISHES

- .1 Exposed aluminum surfaces; anodized to AAMA 611:
 - .1 Clear anodized to AA Designation AA-M12C22A41

2.7 MOTORIZED OPERATION

- .1 Motorized Operation: Jackshaft type:
 - .1 Heavy duty: SDI Model S19.85, voltage to suit supply voltage.
 - .2 Auxiliary operation: include hand chain to operate door manually and independently of motor operator. Incorporate interlock to disconnect motor mechanically and electrically when auxiliary operator is engaged.
 - .3 Provide momentary relay contact for off-delay timers, and rated for 25 cycles per hour or 100 cycles per day.
- .2 Electrical supply is 230V, 1HP, 60Hz.
- .3 Operator to open doors at a rate of 610 mm (24") per second.
- .4 Entrapment Protection:
 - .1 Photoelectric sensors.

- .5 Operator Controls:
 - .1 Type: Push-button.
 - .2 Function: operated control stations with open, close, and stop buttons for surface mounting, for interior location.
- .6 Special Operation:
 - .1 Provide radio controlled operators, including remote operators for exterior operation of doors, as follows:
 - .1 Receiver to be Chamberlain Model 412 HMC.
 - .2 Remote to be Chamberlain Model 972 LMC.

2.8 FABRICATION

- .1 Fabricate work of this section with materials, and with component dimensions and gauges, reinforcing, attached anchors and fastenings of adequate strength to prevent warping, buckling, opening of joints and seams, loosening of hardware, distortion, and displacement within limits of intended and specified use.
- .2 Conceal and weld connections wherever possible.
- .3 Fit joints and junctions between components tightly and in true planes.
- .4 Isolate from each other dissimilar metals, and metal from concrete or masonry to prevent electrolysis. On aluminum, use bituminous paint in concealed locations and lacquer where exposed to view.
- .5 Finishing:
 - .1 File and grind exposed welds smooth.
 - .2 Zinc coating: clean and smooth ground surfaces at welds, fill if necessary, and prime all areas from which zinc coating has been removed with zinc rich paint applied in a minimum thickness of 0.102 mm (0.004").

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine building structure, finishes and conditions at the Place of the Work.
- .2 Notify the Consultant of any adverse conditions which could jeopardize system installation or system operation. Do not proceed until such conditions have been documented, assessed, rectified and approved for installation. Starting work indicates acceptance of conditions unless the Consultant is notified otherwise in writing.

3.2 ELECTRICAL WIRING

- .1 Power shall be brought up to circuit breaker/disconnect switch adjacent to controller under the work of Divisions 26, 27, and 28 and in conformance with requirements specified therein.

- .2 Wiring from motor to switches, controls, starters, safety devices and other items requiring power shall be carried out under this Section.
- .3 Use EMT conduit for fixed wiring. Use purpose-made and approved type flexible cables or cords at applicable locations; adequately support so as not to impede access or foul moving parts of equipment.

3.3 INSTALLATION – GENERAL

- .1 Install sectional overhead doors and operators in accordance with door manufacturer's printed instructions.
- .2 Work shall be performed by qualified personnel approved by door manufacturer.
- .3 Secure guides to steel framing members, header box to side guides and the motor to header box.
- .4 Drill and tap door frames to receive hardware. Fasten door tracks and stops to door frame by means of machine bolts; welding will not be permitted.
- .5 Fit doors snugly to edges of jambs and heads of frames. Doors shall operate smoothly and freely under all conditions of operation. Door shall sit in any position in door opening and shall not drift upward or downward.
- .6 Furnish necessary appurtenances relating to door installation, including those required on door frames.
- .7 Upon completion of installation of doors and operating equipment, lubricate moving parts prior to putting into operation. Supply oil to gear reduction units and grease sprockets, bearings, cables, link chains and door guides. Check and re-adjust as required, items of operating hardware, including weather stripping.
- .8 Install doors to operate freely and to close tight.

3.4 ADJUSTING AND CLEANING

- .1 Adjust work of this section to ensure free-running, tightly closing and properly counterbalanced operation. Ensure that installation is free from warp, twist or other distortion. Lubricate operating hardware.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at site only if approved.
- .3 Clean work on completion of installation.
- .4 Adjust weather-stripping to form a weathertight seal.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Aluminum entrances.
 - .2 Aluminum windows.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Further to requirements of Section 01 33 00, indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anticipated deflection under load, affected related work, weep drainage network, expansion and contraction joint location and details, field welding, coordination with hardware and electrical requirements.
 - .2 Identify and describe material types being supplied, wall thicknesses of extrusions, and shapes including connections and grades, dimensions and tolerances (minimum and maximum), attachments, reinforcing, anchorage and locations of fastenings, and provisions for thermal and structural movement between components of this section and adjacent materials.
 - .3 Include description of materials, metal finishing specifications, and other pertinent information.
 - .4 Design loads, typical reactions and support movement allowances, both vertical and horizontal, shall be placed on the shop drawings.
 - .5 Shop drawings shall clearly indicate the specification of materials and, where applicable, indicate installation methods and coordination with other sections.
 - .6 Submit framing member structural and physical characteristics, calculations, dimensional limitations, special installation requirements.
- .4 Samples:
 - .1 Submit samples of frame, sill and mullion sections, sill flashing and accessories, fasteners for connection of frame to opening, glazing tape, glass retainers, glazing gaskets, screening and frame, spandrel panels and each finish material and any other material, as requested.
 - .2 Samples of colour and finish prepared as specified on respective metal components for both extrusion and sheet.
 - .3 Identify samples as to treatment, thickness, alloy, framing composition, colour, manufacture, performance standard and portion of the work to which they apply.
 - .4 Fabrication shall not proceed without written acceptance of samples from the Consultant.

.5 Test reports:

- .1 Submit valid laboratory test reports, prepared by an independent laboratory, verifying that proposed system has been tested by an independent laboratory and achieved performance values that meet the specified performance criteria.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and maintenance data:

- .1 Submit manufacturer's operation and maintenance instructions for incorporation into the operation and maintenance manuals in accordance with Section 01 77 00.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installers / applicators / erectors:

- .1 Execute work of this section only by company who has adequate plant, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.
- .2 Provide at least one trade specialist who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of this work, and personally direct installation performed under this section.
 - .1 Foreperson experience: Minimum 10 years experience as glazing mechanic.
 - .2 Typical glazing mechanic experience: Minimum 3 years experience as glazers.
- .3 Welding: Perform welding of structural components only by fabricators certified by Canadian Welding Bureau to CSA Welding qualification codes; CSA W47.1-09(2014) for welding of steel, and CSA W47.2-12 for welding of aluminum.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Store parts in a dry place and permit natural ventilation over their finished surfaces.
- .2 Store materials in locations protected from damage of other trades.
- .3 Under conditions of high humidity or cold temperatures, supply heating or forced air ventilation to prevent accumulation of surface moisture.
- .4 Mark components to show location on building and on drawings.
- .5 Protect finishes with strippable coating that will not mar, nor deface finish on removal, or a similar method designed to afford an equivalent amount of protection. Leave protected coating intact until damage risk is past or immediately prior to final cleaning.
- .6 Stacking should be done to prevent bending pressure or abrasion of finished surfaces.
- .7 Brace and protect frame units to prevent distortion and damage in shipment and handling.

- .8 Provide methods for lifting or hoisting units into place without causing damage.

1.6 FIELD CONDITIONS

- .1 Comply with requirements of Product manufacturers.

1.7 WARRANTY

- .1 This section shall assume responsibility for warranties of glass and glazing included in the work of this section, in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- .1 Work of this section shall be provided by one of the following:
 - .1 Alumatic Limited.
 - .2 Kawneer Company Ltd. or
 - .3 Or equivalent.

Substitutions: Refer to Section 01 25 00.

2.2 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Air Leakage; except entrance doors: Air leakage through the work shall not exceed 0.3 L/s/m² (0.06 cfm/ft²) of glazing area when tested in accordance with ASTM E283- 04(2012) at test pressure of 300 Pa (6.24 psf).
- .2 Water Penetration (other than entrance doors): No water penetration shall occur when the work is tested in accordance with ASTM E331-00(2009), amended to prohibit water from passing through interior glazing seals or frame joints, at a test pressure of 300 Pa (6.24 psf).
- .3 Fabricate mullions to ensure under specified loads a maximum deflection of 1/175 of mullion span or 19 mm (3/4"), whichever is less.
- .4 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system as calculated in accordance with code.
- .5 Design and size components to withstand seismic loads and sway displacement as calculated in accordance with code.
- .6 Provide system to accommodate, without damage to components or deterioration of seals:
 - .1 Movement within system,
 - .2 Movement between system and perimeter framing components,
 - .3 Dynamic loading and release of loads,
 - .4 Deflection of structural support framing,

- .7 Maintain continuous air barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound, in accordance with the Contract Documents.
- .8 Position thermal insulation to exterior of air barrier, in accordance with the Contract Documents.
- .9 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.
- .10 Provide anchors sufficiently rigid to resist wind and snow loads caused by aluminum shades and brackets, without damage to wall system.

2.3 MATERIALS

- .1 Aluminum extrusions: Aluminum Association alloy AA6063-T5 or T6 temper for framing.
- .2 Sheet aluminum: aluminum sheet, 0.92 mm (0.04") minimum thickness.
 - .1 Aluminum alloy:
 - .1 AA3003-H14 Painting Quality.
 - .2 AA5005H14 Anodizing Quality.
 - .3 Concealed sheet metal air barriers: 1 mm (0.04") (22 gauge) Z275 galvanized steel sheet.
 - .4 Fasteners: aluminum or Type 304 stainless steel, finished to match adjacent material.
 - .5 Isolation coating: alkali resistant bituminous paint or epoxy solution.
 - .6 Glazing gaskets: fully resilient, shim type butyl glazing tape or EPDM glazing gasket.
 - .7 Glass and other glazing materials: Refer to Section 08 80 00.
 - .8 Silicone Sealant: One component, chemical curing; capable of water immersion without loss of properties: cured Shore A Durometer hardness of 15 to 25 to ASTM D2240- 05 (2010), colour as selected by the Consultant, where exposed, to ASTM C920-11.
 - .9 Sheet metal work air barrier sealant: One component elastomeric chemical curing, to ASTM C920-11.
 - .10 Air barrier membrane:
 - .1 Self-Adhesive membrane: Composite preformed modified membrane system consisting of SBS modified asphalt for low temperature flexibility and polyethylene scrim reinforcing.
Acceptable Products:
 - .1 Bakor 'Blueskin SA' Self-Adhesive Grade Air Barrier Membrane.
 - .2 Soprema 'Sopraseal Stick 1100'.
 - .3 W.R. Meadows 'Air Shield'.or equivalent
 - .2 Primer: as recommended by manufacturer.
 - .3 Membrane Properties:
 - .1 Thickness: 1.0 mm (40 mils).
 - .2 Application temperature: minimum +5°C.

- .3 Service temperature: -40°C to +70°C.
- .4 Elongation: 200% minimum in accordance with ASTM D412-06a (2013)- modified.
- .5 Low temperature flexibility: to -30°C to CGSB 37-GP-56M-1985.
- .6 Air leakage: 0.005 L/m².s under a pressure differential of 75 Pa (0.01 PSI) in accordance with ASTM E283-04(2012).

2.4 ENTRANCE FRAMING

- .1 Exterior aluminum framing: 50.8 mm x 152.4 mm (2" x 6") frames and 152.4 mm x 152.4 mm (6" x 6") jambs, thermally broken extruded aluminum assembly with flush sight lines.
 - .1 Acceptable Product: Kawneer Tri Fab 601UT.
- .2 Interior aluminum framing: 45 mm x 114 mm (1-3/4" x 4-1/2") frames and 114 mm x 114 mm (4-1/2" x 4-1/2") jambs, non-thermally broken extruded aluminum assembly with flush sight lines.
 - .1 Acceptable Product: Kawneer Tri Fab 450.
- .3 All section shall be designed for shear block joinery.

2.5 ALUMINUM ENTRANCE DOORS - EXTERIOR

- .1 Entrance glazing system shall be designed according to Section 08 41 00 requirements and the following:
 - .1 Doors:
 - .1 Acceptable Product: Kawneer '350 Medium Stile' or equivalent.
 - .2 Fasteners connecting and fixing the frame members shall be concealed.
 - .3 Reinforce mechanically-joined corners of doors by welding, spigotting, welding and spigotting or by one piece cast aluminum angle to produce sturdy door unit.
 - .4 Door stiles shall be weathered with metal backed polypropylene pile weather- stripping. Provide weather-stripping sweeps at door bottoms.
 - .5 Door hardware: Norton 1605 closer, 1 MS lock and 2 thumb latches (locations as scheduled or indicated), exterior threshold 115 mm (4.5"), 1 pair butt hinges, weather stripping and Classic Hardware CO-9 with stainless steel US32 polished finish, flash cap across the top of door.
 - .1 Provide a Unican locks where indicated or scheduled in the Contract Documents.
 - .2 Barrier free door operators: in accordance with Section 08 71 13.
 - .6 Weathering on offset pivot or butt hung doors (single or pairs) shall be Kawneer SEALAIR elastomeric weathering of tubular shape, with a semi-rigid polymeric backing, or equivalent.
 - .7 Door bottom rail weathering (where required) shall be an extruded elastomeric blade sweep strip applied with concealed fasteners.
 - .8 Glass: Refer to Section 08 80 00.

2.6 ALUMINUM ENTRANCE DOORS - INTERIOR

- .1 Interior entrance and interior glazing system shall be designed according to Section 08 41 00 requirements and the following:
 - .1 Doors:
 - .1 Acceptable Product: Kawneer '350 Medium Stile' or equivalent.
 - .2 Fasteners connecting and fixing the frame members shall be concealed.
 - .3 Reinforce mechanically-joined corners of doors by welding, spigotting, welding and spigotting or by one piece cast aluminum angle to produce sturdy door unit.
 - .4 Door stiles shall be weathered with metal backed polypropylene pile weather- stripping. Provide weather-stripping sweeps at door bottoms.
 - .5 Door hardware: Norton 1605 closer, 1 MS lock and 1 thumb latch (locations as scheduled or indicated), 1 pair butt hinges, and Classic Hardware CO-9 with stainless steel US32 polished finish, flash cap across the top of door.
 - .1 Barrier free door operators: in accordance with Section 08 71 13.
 - .6 Weathering on offset pivot or butt hung doors (single or pairs) shall be Kawneer SEALAIR elastomeric weathering of tubular shape, with a semi-rigid polymeric backing, or equivalent.
 - .7 Door bottom rail weathering (where required) shall be an extruded elastomeric blade sweep strip applied with concealed fasteners.
 - .8 Glass: Refer to Section 08 80 00.

2.7 ALUMINUM CURTAIN WALL

- .1 Glass Design:
 - .1 Glass shall be designed according to CAN/CGSB 12.20-M89 and Section 08 80 00.
 - .2 Glass subjected to guard loads shall be designed with an alternative resistance path in the event of failure of one lite or ply of glass.
 - .3 Insulating glass units in accordance with Section 08 80 00.
- .2 Curtain wall shall be designed according to Section 08 41 00 requirements and the following:
 - .1 Acceptable Products:
 - .1 Alumaticor 'VersaWall 2200 Series'.
 - .2 Kawneer '1620', with vertical SSG (50.8mm x 152.4mm)
or equivalent.
 - .2 Thermally broken sections.
 - .3 Mechanically fasten horizontal and vertical edges of infill materials and glass units with mechanically fastened continuous pressure plates complete with caps.
 - .4 Glazing cavity shall be compartmentalized at every floor level and every 6000 mm horizontally to prevent the movement of air in accordance with standard rain screen design.
 - .5 Fasteners: concealed.

- .6 Cap extensions shall be extruded to profiles indicated and scheduled. Break- formed cap extensions will not be accepted.

2.8 FINISHES

- .1 Exposed aluminum surfaces; anodized to AAMA 611-98:
 - .1 Clear anodized to AA Designation AA-M12C22A41 at exterior, AA-M12C22A31 at interior.

2.9 FABRICATION

- .1 Sills: extruded aluminum, finished to match window frames, 15 mm (5/8") minimum projection beyond wall surface. Provide preformed end caps wherever sill terminates. Butt joint sill and provide preformed splice connector and sealant to prevent water penetration. Locate splice connectors (joint covers) at center line of mullions when required. Trim and detail corners neatly.
- .2 Make allowances for deflection of structure. Ensure that structural loads are not transmitted to aluminum work.
- .3 Provide structural steel reinforcement for strength, stiffness and connections.
- .4 Fit intersecting members to flush hairline weathertight joints and mechanically fasten together, except where indicated otherwise.
- .5 Conceal fastenings from view. Exposed fastenings where indicated.
- .6 Form cut-outs, recesses, mortising or milling for finishing hardware to templates supplied. Reinforce with aluminum or galvanized steel plates.
- .7 Field apply isolation coating to aluminum in contact with dissimilar metals and/or cementitious materials.
- .8 Fabricated assemblies shall make required clearances other assemblies and for deflection of structure.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install work of this section plumb, square, level, free from warp, twist and superimposed loads.
- .2 Secure work in required position. Do not restrict thermal movement.
- .3 Install hardware in accordance with templates.
- .4 Adjust operable parts for correct function.
- .5 Isolate from cementitious materials.

3.2 AIR VAPOUR BARRIER CLOSURES

- .1 It is the responsibility of this section to give complete cooperation in providing and maintaining the continuity of air/vapour seal to adjacent materials to which the windows and frames abut. Fit flexible seals, tapes, sealants and gaskets at locations required to achieve air/vapour/water

resistant and weathertight junctions. Ensure continuity of seal at end joints between lengths of material by overlapping and cementing. Caulk junctions of system components to themselves and other work with sealant to maintain effective vapour, air and water barrier and fix in place with an aluminum flat to the air/vapour seal line at the adjacent material and to the glazing rebate.

- .2 Where deflection of structure will cause dynamic joint movement between aluminum work and dissimilar materials, install flexible seals of sufficient width to allow formation of bellows to take up any torsional and shear stresses.

3.3 GLAZING

- .1 Glaze aluminum framed windows and doors at exterior using insulating glazing units in accordance with Section 08 80 00.
- .2 Glaze interior windows and doors in accordance using glass types given in the glazing schedule and in accordance with section 08 80 00.

3.4 SEALANTS

- .1 Seal between frame members, sills and adjacent construction as a part of the work of this section and in accordance with Section 07 92 00.

3.5 HARDWARE

- .1 Install in accordance with manufacturer's installation instructions.
- .2 Accurately locate and adjust hardware to meet manufacturer's instructions. Use special tools and jigs as recommended.
- .3 Set, fit and adjust hardware according to manufacturer's directions, at heights as confirmed by the Consultant. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.
- .4 Powered hardware:
 - .1 Power wiring will be supplied and installed by electrical work installer including conduit, boxes and other electrical appurtenances, including connections and terminations. Be responsible for ensuring that all wiring work is done in accordance with the Suppliers wiring diagrams and directions.
 - .2 Arrange for testing and commissioning of system by the distributor of the system. Submit a copy of reports to the Consultant.

3.6 ADJUSTING AND CLEANING

- .1 Cleaning on completion of installation:
 - .1 Remove deposits which affect appearance or operation of units.
 - .2 Remove protective materials.
 - .3 Clean interior and exterior surfaces by washing with clear water; or with water, and soap or detergent; followed by a clear water rinse.

- .4 Clean and restore stained metal surfaces in accordance with manufacturer's recommendations. Replace if cleaning is impossible.
- .5 Final cleaning is specified in Section 01 77 00.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 RELATED DOCUMENTS

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

.2 SECTION INCLUDES

- .1 Furnishing of all items of finish hardware as hereinafter specified or obviously necessary for all swinging, sliding, folding and other doors as indicated. Except, items which are specifically excluded from this section of the specification or are of unique hardware specified in the same sections as the doors and frames on which they are installed.

.3 RELATED SECTIONS

- .1 06 40 00 – Architectural Woodwork
- .2 08 11 13 – Steel Doors and Frames
- .3 08 35 13 – Four-Fold Metal Doors
- .4 08 36 13 – Sectional Overhead Metal Doors
- .5 08 41 00 – Aluminum Framed Glazing
- .6 08 71 13 – Automatic Door Operators
- .7 28 00 00 – Security System

1.2 REFERENCES

.1 CODES AND STANDARDS

- .1 ANSI A117.1 – Accessible and Usable Buildings and Facilities
- .2 ANSI A156.1 – Butts and Hinges
- .3 ANSI A156.3 – Exit Devices
- .4 ANSI A156.4 – Door Controls – Closers
- .5 ANSI A156.5 – Cylinders and Input Devices for Locks
- .6 ANSI A156.6 – Architectural Door Trim
- .7 ANSI A156.7 – Template Hinge Dimensions
- .8 ANSI A156.8 – Door Controls – Overhead Stops and Holders
- .9 ANSI A156.9 – Cabinet Hardware
- .10 ANSI A156-10 – Power Operated Pedestrian Doors
- .11 ANSI A156.11 – Cabinet Locks
- .12 ANSI A156.12 – Interconnected Locks
- .13 ANSI A156.13 – Mortise Locks and Latches Series 1000
- .14 ANSI A156.16 – Auxiliary Hardware
- .15 ANSI A156.18 – Materials and Finishes
- .16 ANSI A156.19 – Power Assist and Low Energy Power Operated Doors
- .17 ANSI A156.21 – Thresholds
- .18 ANSI A156.22 – Door Gasketing and Edge Sealing Systems
- .19 ANSI A156.25 – Electrified Locking Devices
- .20 ANSI A156.26 – Continuous Hinges
- .21 ANSI A156.28 – Recommended Practices for Mechanical Keying Systems
- .22 ANSI A156.29 – Exit Locks, Exit Alarms, Alarms for Exit Devices
- .23 ANSI A156.30 – High Security Cylinders
- .24 ANSI A156.31 – Electric Strikes and Frame Mounted Actuators
- .25 ANSI A156.32 – Integrated Door Opening Assemblies
- .26 ANSI A156.36 – Auxiliary Locks
- .27 ANSI A250.4 – Steel Doors and Frames Physical Endurance
- .28 NFPA 80 – Standard for Fire Doors and Other Opening Protectives
- .29 NFPA 101 – Life Safety Code
- .30 OBC 2006 – Ontario Building Code
- .31 SDI 122-07 – Installation and Troubleshooting Guide for Standard Steel Doors and Frames

- .32 Door and Hardware Institute Publication – Sequence and Format for the Hardware Schedule (1996)
- .33 Door and Hardware Institute Publication – Keying Systems and Nomenclature (1989)

1.3 SUBMITTALS

.1 GENERAL REQUIREMENTS

- .1 Submit all documentation and samples in accordance with Division 1, General Requirements.

.2 SCHEDULES AND DATA

- .1 Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- .2 Door Hardware Schedule: Prepared and submitted within 2 weeks of receipt of purchase order by or under the supervision of supplier and coordinated with all drawings and related documents to ensure; size, thickness, hand, function, finish and application of hardware. All approved hardware changes shall be incorporated in the hardware schedule and kept current throughout the duration of the project.
 - .1 Format: Vertical format and sequence as detailed in the Door and Hardware Institute (DHI) publication "Sequence and Format for the Hardware Schedule".
 - .2 Content: Include the following information for each opening:
 - .1 Location of each hardware set cross-referenced to identifying mark(s) on Architectural floor plans and in door and frame schedule.
 - .2 Handing and degree of swing of each door.
 - .3 Keying information.
 - .4 Quantity, type, style, function, size and finish of each hardware item.
 - .5 Complete methods of operation for all openings containing electronic components with detailed operational descriptions of each items function(s) during all typical conditions and ingress/egress situations.
 - .6 Elevation drawings of all openings with electronic hardware systems identifying locations of components, conduit, back boxes, junction boxes and miscellaneous system requirements.
 - .7 Name and manufacturer of each hardware item.
 - .8 Fastenings and other pertinent installation information.
 - .9 Hardware mounting locations when different from standard.
- .3 Samples: Provide each type of hardware in finish indicated as requested. Items will be returned in original packaging and working order to the supplier to be incorporated into the project scope of work.
- .4 Templates: Furnish a complete, indexed list with templates and finish hardware schedule to the Contractor for each trade supplying materials requiring hardware preparations.

.5 Electronic Hardware Systems:

- .1 Wiring Diagrams: Prepared and submitted within 2 weeks of receipt of purchase order by or under the supervision of supplier and coordinated with all drawings and related documents to ensure accurate function and coordination.
 - .1 Elevations: Provide diagrams for each unique opening with electronic hardware components identifying individual item locations, conduits, back boxes, junction boxes and miscellaneous system requirements and devices.
 - .2 Risers: Provide diagrams detailing locations and infrastructure between door openings, power supplies, access control panels and system components.
 - .3 Point to Points: Provide diagrams detailing wiring terminations at all electrified devices as applicable to function of all openings. (inclusion depending on installation)
 - .4 Responsibility matrix: Provide documentation for approval detailing basic responsibilities inclusive of all related sections involved in the preparation for, installation and commissioning of electrified systems.
- .6 Keying Schedule: Prepare a separate schedule, in accordance with DHI publication "Keying Systems and Nomenclature", detailing final keying instructions for all locksets and cylinders. Include; keying system explanation, door numbers, keyset symbols, hardware set numbers, and special instructions. The Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- .7 Operations and Maintenance Manuals: Provide operating and maintenance manuals in accordance with Division 01, Section 01 77 00, Closeout Submittals. Manuals to include; complete manufacturer and distributor contact information, manufacturers documentation for care and maintenance of all products and finishes, manufacturers product parts lists, manufacturers installation and adjustment instructions, manufacturers/service representatives warranty documentation, and 'as built' copies of all submittal documentation.
- .8 Warranties and Maintenance Agreements; provide manufacturers/service representatives special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

.1 SUBSTITUTIONS

- .1 Refer to Section 01 25 00 – Product Substitution Procedures.

.2 SUPPLIER QUALIFICATIONS

- .1 A recognized Architectural door hardware supplier who has maintained an office and has minimum of five (5) years documented experience in providing consulting services and supplying mechanical and electromechanical hardware comparable in material, design and extent to that required for this project.
- .2 Have an office and warehouse facilities to accommodate this project.
- .3 Authorized factory distributor in good standing of all products herein specified.
- .4 Have in their employment a minimum of one (1) Architectural Hardware Consultant (AHC) as administered and certified by The Door and Hardware Institute, Chantilly VA. AHC shall be responsible for preparation of finish hardware/keying schedules.

.3 INSTALLER QUALIFICATIONS

- .1 Trained by the primary product manufacturers with a minimum of five (5) years documented experience in the installation of both mechanical and electromechanical hardware comparable in material, design and extent to that required for this project.

.4 SOURCE LIMITATIONS

- .1 Electrified modifications and enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- .2 Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

.5 FIRE-RATED OPENINGS

- .1 Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of the Authorities Having Jurisdiction (AHJ). Provide only items that are listed/labelled by Underwriter's Laboratories (UL) or Warnock Hersey (WH) for use on types and sizes of doors indicated.

.6 KEYING CONFERENCE

- .1 Conduct conference to comply with requirements in Division 01, Section 01 31 19, Project Meetings. Keying conference to incorporate the following criteria into the final keying schedule document:
 - .1 Function of building, purpose of each area and degree of security required.
 - .2 Plans for existing and future key system expansion.
 - .3 Requirements for key control storage and software.
 - .4 Installation of permanent keys, cylinder cores and software.
 - .5 Address and requirements for delivery of keys.

.7 PRE-SUBMITTAL CONFERENCE

- .1 Conduct conference to comply with requirements in Division 01, Section 01 31 19, Project Meetings, with attendance by representatives of Supplier(s), installer(s) and Subcontractor(s) to review proper methods and the procedures for receiving, handling and installing door hardware.

1.5 DELIVERY, STORAGE AND HANDLING

.1 MARKING AND PACKAGING

- .1 Mark items according to the approved hardware schedule indicating hardware set and door number.
- .2 Items to be sorted, verified and repackaged in manufacturer's original packaging complete with necessary screws, accessories, templates, installation instructions and any specialized tools required for installation.

.2 DELIVERY

- .1 The Contractor shall ensure that delivery times for receipt of door hardware are acceptable to the Consultant.. The Contractor shall check deliveries against accepted list and provide written acceptance assuming responsibility for storage and care. Immediately identify any shortages or damaged items in writing.
 - .2 The Contractor shall ensure that hardware items are jointly inventoried on site by representatives from hardware supplier, installer and relevant Subcontractor.
 - .3 Deliver permanent keys, cylinders, cores, access control credentials, software and related accessories directly to the Owner via registered mail or as established at the 'Keying Conference'.
 - .4 Do not store electronic access control hardware, software or accessories at project site without prior authorization.
 - .5 Construction master keys to be separately packaged from all other items and delivered to Contractor as previously coordinated.
- .3 STORAGE
- .1 The Contractor shall provide a clean, dry and secure hardware storage room with adequate shelving to layout each item by door number and hardware set number. Room size, location and layout to be jointly coordinated with hardware supplier, installer and Subcontractor.

1.6 COORDINATION

- .1 Obtain and distribute templates for doors, frames and other work specified to be factory prepared for installing standard and electrified hardware. Review shop drawings of related sections to ensure that adequate provisions and modifications are made for locating and installing hardware.
- .2 Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required power connections, conduit, fire alarm connections, junction boxes, back boxes, reinforcing and mounting locations for low voltage power supplies, detection/monitoring hardware, power transfer devices and all other listed components.
- .3 Coordination meetings:
 - .1 The Contractor shall ensure that hardware supplier meets with the Owner, the Consultant, electrical Subcontractor, security consultant and Access Control Subcontractor to review, coordinate and implement all details relating to the proper operation and location of all electronic hardware prior to start of construction. Review methods of operation for each unique opening with electrified components.
 - .2 Conduct a project specific training meeting to instruct the installation Subcontractor's personnel on the proper installation and adjustment of all products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates, physical product samples as required and review of method of operation for electrified openings.
 - .3 Inspect and review electrical rough-ins, power supply connections and all other applicable work by related trades.
 - .4 Review and finalize construction schedule and verify material availability.
 - .5 Review the required inspection, testing, commissioning and demonstration procedures.

- .4 Upon completion of installation, provide written documentation that components were applied as per manufacturer's instructions and recommendations according to the approved hardware schedule. Identify any defective or damaged materials.

1.7 WARRANTY

- .1 General Warranty in accordance with Division 01, General Requirements and Article A-15 of the Agreement Between Owner and Contractor. Special warranties specified in this article shall not deprive the Owner of other rights under other provisions of the Contract Documents and shall be in addition to, and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- .2 Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period of two (2) years as specified in Article A-15 of the Agreement Between Owner and Contractor. Failures include, but are not limited to:
 - .1 Structural failures including excessive deflection, cracking, or breakage.
 - .2 Faulty operation of hardware.
 - .3 Deterioration of metals, finishes and other materials beyond normal weathering.
 - .4 Electrical component defects and failures within system operation.
- .3 Special Warranty Periods:
 - .1 Hinges - Lifetime
 - .2 Mortise Locksets – Seven (7) years
 - .3 Exit Devices – Five (5) years
 - .4 Door Closers – Ten (10) years
 - .5 Electric Strikes – Five (5) years
 - .6 Electromechanical Locksets – Two (2) years
 - .7 Electromagnetic Locks – Lifetime
 - .8 Power Supplies - Lifetime

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Manufacturers as listed below have been determined as the acceptable standard. Obtain each type of finish hardware (hinges, latch and locksets, exit devices, door closers, etc.) from a single manufacturer.

2.2 MATERIALS

- .1 SCREWS AND FASTENERS

- .1 All required screws shall be supplied as necessary for securing finish hardware in the appropriate manner. Thru-bolts shall be supplied for exit devices and door closers where required by code and the appropriate blocking or reinforcing is not present in the door to preclude their use.

2.3 HANGING DEVICES

.1 HINGES

- .1 Hinges shall conform to ANSI A156.1 and have the number of knuckles as specified, oil-impregnated bearings as specified with NRP (non-removable pin) feature, at all exterior and interior locked reverse bevel doors. Unless otherwise scheduled, supply 2 hinges for doors up to 60" (1520mm) in height and supply one (1) additional hinge for every 30" (760mm) of door height or part thereof. Hinges shall be sized per the manufacturer's recommendations. Hinges shall be a minimum of 4 1/2" high and 4" wide; heavy weight hinges (.180) shall be supplied at all doors where specified in the Contract Documents.
- .2 Provide hinge size to comply with the following:

<u>DOOR WIDTH</u>	<u>HINGE HEIGHT</u>	<u>HINGE WIDTH</u>
UP TO 36"	4-1/2"	4"
OVER 36"	5"	4-1/2"
UP TO 48"	5"	5"
OVER 48"	6"	6"

- .1 Specified Manufacturer: McKinney TA/T4A Series

.2 ELECTRIC HINGES

- .1 Electric hinges shall be provided with Molex standardized plug connectors to accommodate up to twelve (12) wires. Plug connectors shall plug directly into Molex through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a mortar guard for each electric hinge specified.

- .1 Specified Manufacturer: Assa Abloy McKinney or Markar - QC Series

.3 CONTINUOUS GEARED HINGES

- .1 All hinges to be non-handed and completely reversible. Hinge line to be available in concealed flush mount with or without inset, full surface and half surface types as specified in the hardware sets. All hinges to be made of extruded 6060 T6 aluminum alloy with polyacetal thrust bearings, anodized after cutouts are made for bearings. All concealed hinges to be fire-rated for 20, 45 and 90 minutes when incorporated into proper door and frame labeled installations, without necessitating the use of fusible-link pins. All concealed hinges to be available in standard, heavy, and extra heavy duty weights; all full surface and half surface hinges in standard and heavy duty weights as specified in the hardware sets. All hinges to be factory cut for door size.

- .1 Specified Manufacturers: Assa Abloy McKinney

- .2 Equivalent. Refer to Section 01 25 00 – Product Substitution Procedures.

2.4 FLUSH BOLTS AND ACCESSORIES

- .1 All manual and automatic flush bolts to be furnished as specified.
 - .1 Specified Manufacturer: Assa Abloy Rockwood
 - .2 Or equivalent. Refer to Section 01 25 00 – Product Substitution Procedures

2.5 CYLINDERS AND KEYING

.1 CYLINDERS

- 1. All Permanent Cylinders are to be Schlage Large Format Interchangeable Core.
 - .1 Specified Manufacturer: Schlage IFIC C keyway
 - .2 Or equivalent. Refer to Section 01 25 00 – Product Substitution Procedures

.2 KEYING

- .1 Permanent Cores to be Master keyed & keyed Different at the factory.
- .1 Furnish the Cylinders directly to the Owner. The Owner will have their Locksmith Rekey the cylinders to their requirement.
- .2 The Contractor shall remove all construction cores and install all permanent cores. Unless otherwise directed by the Owner.
- .3 Pack all permanent cylinders and keys separately from locksets. Identify door number and keyset symbol on each envelope.
- .4 Ship the control keys directly to the owner unless directed otherwise.
- .5 Furnish the following:
 - a. Two (2) change keys per lock.
 - b. I/C Core – four (4) construction control keys and four (4) permanent control keys.
 - c. Fifteen (15) construction keys.
- .6 The construction keys are to be shipped separate from the locksets, directly to the Contractor.

.3 KEY CABINET

- .1 Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall expansion capacity of 150% of the number of locks required for the project. Hardware Supplier shall assist owner with the set up of the key cabinet.
 - .1 Specified Manufacturer: Telkee AWC Series or equivalent.

2.6 LOCKING DEVICES

.1 MORTISE LOCKSETS

- .1 All locksets shall be ANSI 156.13 Series 1000, Grade 1 Certified. All functions shall be manufactured in a single sized case formed from 12 gauge steel minimum. The lockset shall have a field-adjustable, beveled armored front, with a .125" minimum thickness and shall be reversible without opening the lock body. The lockset shall be 2 3/4" backset with a two-piece 3/4" anti-friction stainless steel latchbolt. The deadbolt shall be a full 1" throw made of stainless steel and have 2 hardened steel roller inserts. All strikes shall be non-handed with a straight lip. To insure proper alignment, all trim, shall be thru-bolted and fully interchangeable between rose and escutcheon designs and shall be the product of one manufacturer.

- .1 Specified Manufacturer: Corbin Russwin Inc. ML2000 Series or equivalent.

.2 ELECTRIFIED LOCKSETS

- .1 Mechanical features of locksets shall conform to standards as specified above. Locksets shall be fail-secure unless otherwise specified. Where specified electrified locksets shall be provided with a switch to monitor inside or outside lever handle or signal remote location. Provide an in-line power controller with all electrified locksets.

- .1 Specified Manufacturer: Corbin Russwin Inc. or equivalent.

.3 LOCKSET STRIKES

- .1 Strikes shall be non-handed and straight lip. Provide strikes with lip-length required to accommodate jamb and/or trim detail and projection.

2.7 ELECTRIC STRIKES

.1 STANDARD STRIKES

- .1 All standard electric strikes shall meet BHMA standard 501, grade 1 and be UL Listed for Burglary Resistance, category 1034. Strikes shall be all stainless steel construction for corrosion resistance, strength and durability. Strikes shall have been tested to withstand a forcing strength of a minimum 2400 lbs. before releasing and perform with a minimum of one million cycles of operation. Strikes shall be 24VDC fail-secure unless otherwise specified in the Contract documents. Provide an in-line power controller with all electric strikes.

- .1 Specified Manufacturers: Assa Abloy HES 1006 Series or equivalent.

.2 SURFACE MOUNTED STRIKES

- .1 All surface mounted electric strikes shall meet BHMA standard 501, grade 1 and be UL Listed for Burglary Resistance, category 1034. Strikes shall have two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Optional latchbolt and latchbolt strike monitoring that indicates position of the latchbolt and locked condition of the strike shall be available. Strikes shall have been tested for a minimum of 500,000 operating cycles. Provide an in-line power controller with all electric strikes.

- .1 Specified Manufacturers: Assa Abloy HES 9500(Fire Rated) HES 9600(non-Rated) or equivalent.

2.8 EXIT DEVICES

.1 CONVENTIONAL DEVICES – PUSH RAIL

- .1 All exit devices shall be ANSI A156.3, Grade 1 Certified and shall be listed by Underwriters Laboratories and bear the UL label for life safety in full compliance with NFPA 80 and NFPA 101. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze no less than 0.072" thick. Push rails shall be constructed of 0.062" thick material. Painted or anodized aluminum shall not be considered heavy duty and is not acceptable. Lever trim shall be available in finishes and designs to match that of the specified locksets.

.1 Specified Manufacturer: Von Duprin 99/33 Series or equivalent.

.2 ELECTRIFIED DEVICES

- .1 Electrified exit devices shall conform to all traditional exit device standards as specified above. All power requirements for exit devices used must utilize a continuous circuit electric hinge for clean design and no visible means of interrupting power to device.
- .2 All exit devices, both fire labeled and non-labeled devices, requiring electric dogging shall be held in the "dogged" or retracted position. All exit devices with electric latch retraction shall provide for a remote means of unlocking for momentary or maintained periods of time.
- .3 Where specified exit devices shall be provided with a switch to monitor push rail or signal remote location and latchbolt monitoring.
- .4 Provide a 782 Series Controller from Corbin Russwin Inc. with all Electric Latch Retraction devices.

.1 Specified Manufacturers: Corbin Russwin Inc. or equivalent.

2.9 AUTOMATIC DOOR OPERATORS

- .1 All operators shall be ANSI 156.19, Grade 1 Certified. Units shall have adjustments for door closing force and backcheck, motor assist from 0 to 30 seconds, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay up to 30 seconds. Operator units shall provide conventional door closer opening and closing forces unless the power operator motor is activated by an initiating device with door closer assembly having adjustable spring size, backcheck valve, sweep valve, latch valve, speed control valve, and pressure adjustment valve to control door closing. Operators shall have push and go function to activate power operator or power assist functions. Units shall have a presence detector input to prevent a closed door from opening or a door that is fully opened from closing and shall have a hold open toggle input to allow remote activation for indefinite hold open; door shall close the second time the input is activated. Operators shall have a SPDT relay for interfacing with latching or locking devices. All controlling operator switches shall be of radio- frequency design and not hard-wired.

- .1 Specified Manufacturer: Assa Abloy BESAM SW200i(exterior) BESAM SW100(interior) or equivalent.

2.10 DOOR CLOSERS

.1 SURFACE MOUNTED CLOSERS – HEAVY DUTY

- .1 All door closers shall be ANSI 156.4, Grade 1 Certified. All closers shall have aluminum alloy bodies, forged steel arms, and separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arms mounting on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 - .1 Specified Manufacturer: Yale Security Inc. Norton 7500 Series or equivalent.
- .2 SURFACE MOUNTED CLOSERS – STANDARD DUTY
 - .1 All door closers shall be ANSI 156.4, Grade 1 Certified. All closers shall have aluminum alloy bodies, forged steel arms, and separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arms mounting on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 - .1 Specified Manufacturer: Yale Security Inc. Norton 8500 Series or equivalent.

2.11 DOOR TRIM AND PROTECTIVE PLATES

- .1 Door Pulls/Push/Kick/Armour Plates: to be 0.050 inches thick and 1.5 inches less full width of door, or as specified. Furnish all push/kick and armour plates with 'B4E' beveled edges. Where door pulls and push plates are specified countersink door pull throughbolts in door for flush fit and apply push plates over top of throughbolts. Follow specific mounting instructions where push plate, door pull and deadlock applications occur. Fasteners for push plates, pull plates, door pulls and miscellaneous door trim shall be as shown in the hardware schedule. Where full height door pulls are specified supply units less 150mm from the top of door and 300mm from bottom of door. Submit shop drawing of pulls for review.
 - .1 Specified Manufacturer: Assa Abloy Rockwood or equivalent.

2.12 DOOR STOPS AND HOLDERS

- .1 WALL MOUNTED DOOR STOPS
 - .1 Where a door is indicated on the plans to strike flush against a wall, wall bumpers shall be provided. Provide convex or concave design as indicated.
 - .1 Specified Manufacturers: Assa Abloy Rockwood or equivalent.
- .2 OVERHEAD STOPS/HOLDERS
 - .1 Where specified, overhead stops/holders as shown in the hardware sets are to be provided. Track, slide, arm and jamb bracket shall be constructed of extruded bronze and shock absorber spring shall be of heavy tempered steel. Overhead stops shall be of non-handed design.
 - .1 Specified Manufacturers: Assa Abloy Rixson 1/2/9/10 Series or equivalent.

2.13 GASKETING AND THRESHOLDS

- .1 On exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide seals as required to meet UL10C. Provide only those units where silicon seal strip is easily replaceable and readily available from stocks maintained by manufacturer. Provide head seal as solid aluminum extrusion suitable for stop applied hardware ie P/A closers or surface overhead door stops.
- .2 Door Sweeps: House nylon brush seal in extruded aluminum case. Surface applied and adjusted to suit gap at bottom of door, complete with snap cover.
- .3 Auto Door Bottoms: Surface or semi mortise automatic door bottoms housed in aluminum case and equipped with nylon brush inserts. Each unit sized to suit the door width and meets the requirements of ANSI/BHMA 156.22-2003 for latching force and air infiltration.
- .4 Astragal Seal: House nylon brush seal in extruded aluminum case. Surface applied, meeting stile astragal, consisting of two pieces attached to pull side face of door. Adjust during installation for proper seal prior to attaching snap cover.
- .5 Provide threshold units not less than 4" wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames. All threshold units shall comply with the Accessibility for Ontarians with Disabilities Act (AODA).
 - .1 Specified Manufacturers: Assa Abloy Pemko or equivalent.

2.14 SILENCERS

- .1 Furnish rubber door silencers all hollow metal frames; two (2) per pair and three (3) per single door frame.

2.15 SLIDING DOOR TRACK

- .1 Supply sliding door track and hardware for doors weighing up to 200lbs for standard applications. Provide needle bearing rollers and aluminum track. Where noted provide sliding door hardware in kit form consisting of hangers, nylon guide, stops and adjustable wrench and mounting hardware. For applications of heavy sliding doors use individual components designed to carry required load capacities, as noted in the hardware schedule.
- .1 Specified Manufacturer: Assa Abloy Pemko or equivalent.

2.16 ELECTRONIC PRODUCTS AND ACCESSORIES

.1 KEYPADS

- .1 Keypads shall be 24VDC and operate a 5-amp Double Pole double Throw (DPDT) relay to switch any type of fail-safe or fail-secure electric lock or strike and be weather proof, vandal resistant and suitable for mounting on a narrow mullion. The keypad system circuit board shall be a remote unit to allow for increased security. Release time shall be programmable from 1 to 99 seconds. Keypads shall support 2 to 7 digit codes for a minimum of 59 users and shall be locked out for 30 seconds when 16 wrong digits are entered. System shall have user/installer programmable options such as anti-tailgate, anti-door prop, and duress code alarm.
- .1 Specified Manufacturer: Assa Abloy Securitron DK26 Series or equivalent.

.2 KEYSWITCHES

- .1 Keyswitches shall be furnished on a stainless steel single gang face plate with a 12/24VDC bi-color LED and an integral backing bracket that shall permit integration with any 1.25" or 1.125" mortise cylinder. Keyswitches shall be available for momentary or maintained action and in narrow stile designs.
- .1 Specified Manufacturers: Assa Abloy Securitron MK Series or equivalent.

.3 IN-LINE POWER CONTROLLER

- .1 Where specified, electrified products shall be supplied with an in-line power controller that enables the hardware to operate from 12 to 32 volts. On board safety features shall include an in-line fuse to protect the hardware and host system from any possible reverse current surges. The controller shall regulate current to provide continuous duty operation without the typical head build up.
- .1 Specified Manufacturers: Assa Abloy HES 2005 Smart-Pac III or equivalent.

.4 POWER SUPPLIES

- .1 Power supplies shall furnish regulated 24VDC and shall be UL class 2 listed. LED's shall monitor zone status (voltage/no voltage) and slide switches shall be provided to connect or disconnect the load from power; 1, 4 or 8 separate output circuit breakers shall be provided

to divide the load. Power supplies shall have the internal capability of charging optional 24VDC sealed lead acid batteries in addition to operating the DC load. Power supplies shall be supplied complete requiring only 120VAC to the fused input and shall be supplied in an enclosure. Power supplies shall be provided with emergency release terminals that allow the release of all devices upon activation of the fire alarm system.

- .1 Specified Manufacturer: Assa Abloy Securitron BPS or equivalent.

.5 ELYNX CABLES

- .1 All power transfer hinges, electrified locksets, electric exit device trim and electric exit devices are to be equipped with Molex plug connectors. Door and Frame Elynx cables have been specified at a provisional length at each of these locations. It is the responsibility of the finishing hardware supplier to supply these cables, prior to door/frame manufacture, in appropriate lengths required by the various manufacturers. The hardware supplier is responsible to contact the door manufacturers to determine the cabling route and supply the correct length. Where the door manufacturer requires flying ends on Elynx cables the hardware installer will be responsible to map and pin Molex connectors.

- .1 Specified Manufacturer: Assa Abloy McKinney or equivalent.

2.17 FINISHES

- .1 The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 or traditional U.S. finishes shown by certain manufacturers for their products.
- .2 Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine scheduled openings, with installer present, for compliance with requirements for; installation tolerances, labelled fire door assembly construction, wall and floor conditions, and other site conditions affecting performance. Notify the Consultant in writing of any discrepancies or conflicts between the door schedule, door types, drawings or scheduled hardware. Discrepancies and conflicts to be resolved in writing prior to installation of hardware.
- .2 Examine hardware to ensure it is free from defects prior to installation.
- .3 Ensure that building is secured and free from weather elements prior to installation of interior door hardware.

3.2 PREPARATION

- .1 Door and Frame Preparation: Field prepare doors and frames for all function holes and fasteners under 25.4mm (1") as per the manufacturer(s) templates and installation instructions provided. Drill and tap as required.

3.3 INSTALLATION

- .1 Install each item of mechanical and electromechanical hardware and access control equipment to comply with the manufacturer's written instructions and according to specifications. All items to be installed with fasteners identified by manufacturer's installation instructions unless otherwise noted.
- .2 Mounting Heights: Install door hardware at heights indicated in the following applicable publications unless; specifically indicated or required by local governing regulations, requirements to match existing conditions, special templates, necessary coordination with door elevations, and or to ensure consistency with pairs of doors.
 - .1 DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames"
 - .2 DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors"
 - .3 ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities"
 - .4 NWWDA
- .3 Power door operator products and accessories are required to be installed by an AAADM certified technician as approved by the manufacturer. Adjust for proper opening and closing operation after final balancing of HVAC system.
- .4 Wall stops: Locate wall stops to contact door pulls/levers at mounting post connecting to door. Ensure existence of necessary wall reinforcing where specified for installation on drywall, plaster or clad wall conditions prior to installation.
- .5 Closers: Size closers as per manufacturer's installation instructions. Adjust all closers after final balancing of HVAC system to ensure; proper latching of doors, proper closing/latch speed, adequate backcheck and opening force in accordance with referenced accessibility requirements.
- .6 Protection plates – Install on clean surface, and in temperature range of 5-25 degrees Celsius where tape applied. Pre-drill pilot holes doors when using mechanical fasteners.
- .7 Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 7, Section 07 92 00, Joint Sealants.
- .8 Architectural Seals – Install prior to other soffit mounted door hardware as indicated in hardware schedule. Ensure continuous seal of gasketing to door without impeding latching.
- .9 Door Bottoms – Ensure continuous seal to threshold or finished floor.
- .10 Electronic hardware systems: Install all electronic hardware as per electrical elevations and point-to-point drawings furnished under Submittals.

3.4 FIELD QUALITY CONTROL

- .1 The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures for coordinating all portions of work under the Contract, unless the Contract Documents give other specific instructions.
- .2 The Contractor will conduct periodic inspections to ensure that door frames are installed plumb, level and square with verification by installer prior to installation of doors and door hardware.

- .3 The Contractor shall ensure that the hardware supplier attends site meetings as required to ensure proper execution of the guidelines set forth herein.
- .4 The Contractor shall ensure that the hardware supplier will perform final field inspection of installed door hardware after final adjustment of all products and will document and report any deficiencies or omissions for correction and written acceptance by the Contractor.

3.5 ADJUSTING

- .1 Adjust and verify proper operation and function of each operating item of hardware (including electromechanical) on all doors prior to acceptance and occupancy. Replace units that cannot be adjusted to operate freely and as intended for the application made.

3.6 CLEANING AND PROTECTION

- .1 The Contractor shall protect all hardware, as it is stored on construction site in a covered, dry and secure place. Protect exposed hardware installed on doors and frames during the construction phase. Install any and all hardware at the latest possible time frame.
- .2 Remove manufacturer's protective coating from items after written acceptance of installation by Consultant.
- .3 Clean operating items as necessary to restore to proper function and finish of hardware and doors.
- .4 Clean adjacent surfaces soiled by door hardware installation.

3.7 DEMONSTRATION

- .1 Instruct the Owner's maintenance personnel in the proper adjustment, operation and maintenance of mechanical and electromechanical door hardware, electronic devices and maintenance of finishes.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Automatic door operators.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Check dimensions at the Place of the Work before fabrication commences, and report to Consultant in writing all discrepancies.
 - .2 Where dimensions are not available before fabrication commences, the dimension required shall be agreed upon between the various sections concerned.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Shop drawings to be prepared specifically for this Contract and to indicate location of components, anchorage details, adjacent construction interface, and dimensions as well as all necessary wiring and electrical requirements.
- .4 Samples:
 - .1 Submit samples of each finish material proposed for use in the Work.
- .5 Certificates:
 - .1 Submit certificate of conformance to specified standards following procedures for submittal of Product data.
- .6 Templates:
 - .1 Submit templates during construction for use by installers and fabricators as required for proper location and installation of hardware.

1.4 CLOSEOUT SUBMITTALS

- .1 Operation and maintenance data:
 - .1 Demonstrate, and provide instruction in, the proper operation and maintenance of the Products Provided as part of the work of this section to the Owner in accordance with Section 01 77 00.

- .2 Submit operation data and maintenance data for cleaning and maintenance of hardware for incorporation into the operation and maintenance manual specified in Section 01 77 00.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Execute the work of this section only by a certified Subcontractor who has adequate plant, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years, and with 10 years satisfactory experience.
 - .2 Installer shall be approved in writing by the manufacturer of the operators for installation of their Product.
 - .2 Barrier free door operators shall be certified by the manufacturer to performance design criteria in accordance with CAN/CSA C22.2 No. 247-92(R2014), and ANSI/BHMA A156.19-2013.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Store finishing hardware in locked, clean dry area.
- .2 Package each item of hardware, including fastenings, separately or in like groups of hardware, and label each package as to item definition and location.
- .3 Submit hardware with an easily removable covering to protect against scratches, abrasions, coating with dissimilar finish materials on adjacent surfaces, and tarnishing.

PART 2 - PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Use ULC or ULI listed and labelled hardware in fire separations and exit doors.
- .2 Be responsible for, and abide by, all requirements and regulations of the building code. Conduct tests and inspections required, and pay all charges incidental thereto.

2.2 AUTOMATIC DOOR OPERATORS - GENERAL

- .1 Operation:
 - .1 Activation type:
 - .1 Push-plate.
 - .2 Door to safely stop and reverse if an object is encountered in the opening or closing cycle.
 - .3 Manual opening force: 62 N.
 - .4 Closing force: 26.6 N.
 - .5 Factory-set door hold open voltage.

- .6 Fail safe: In the event of power failure, door shall operate manually, without damage to operator components.
- .2 Activators; wall-mounted:
 - .1 Push-plate:
 - .1 Formed stainless steel plate, satin finish, approximately 127 mm (5") square, with depressed wheelchair logo marking, 2 required per opening.
 - .2 Electrical supply: 120 Volt.

2.3 AUTOMATIC DOOR OPERATORS - DOOR FRAME/WALL MOUNTED

- .1 Provide adjustment by microprocessor for the following:
 - .1 Opening speed.
 - .2 Back-check.
 - .3 Hold-open, from 5 seconds to 30 seconds.
 - .4 Closing speed.
 - .5 Opening force.
 - .6 Acceleration during opening and recycling, for soft start.
- .2 Controller:
 - .1 Completely electromechanical capable of the following functions:
 - .1 Obstruction detection.
 - .2 Initialization and power on.
 - .3 Door motion learn cycle.
 - .4 Manual mode, without spring closer.
 - .5 Power open/power close logic.
 - .2 Control box and motor/gear box to be contained in aluminum housing finished to match aluminum entrances, precision-machined gears and bearing seats and all- weather lubricant, mounted on vibration isolators.
 - .1 Design for surface-mounted application on surface of door frame/wall, maximum 3 mm (1/8") above top of door.
 - .2 Design for interior application.
 - .3 Gears: manufactured by operator manufacturer specifically for operators being provided.
 - .4 Motor: DC permanent magnet motor with shielded ball bearings. Stop motor when door stops or is fully open and when breakaway is operated.
 - .5 Door operating arm: forged steel, attached at natural pivot point of door. Do not use side block in top of door. Exposed arms to be factory polished and finished to match operator enclosure.
 - .6 Control circuits for actuators and safeties: low-voltage, NEC Class II.

- .7 Service conditions: satisfactory operation between -34°C and 71°C.
- .3 Acceptable Products:
 - .1 Typical: Horton '7100 Series' or approved alternate by Hunter Automatics.

2.4 FINISHES

- .1 Finish components to match aluminum framed glazing systems in conjunction with which they are to be Provided, in accordance with Section 08 41 00.

2.5 FABRICATION

- .1 Fit intersecting members to flush hairline weathertight joints and mechanically fasten together, except where indicated otherwise.
- .2 Conceal fastenings from view, except where indicated otherwise.
- .3 Form cut-outs, recesses, mortising or milling for finishing hardware to templates supplied. Reinforce with aluminum or galvanized steel plates.
- .4 Field apply isolation coating to aluminum in contact with dissimilar metals or cementitious materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify that door openings are properly installed and ready to receive the work of this section.
- .2 Verify that electrical service is available, properly located, and of proper type.

3.2 PREPARATION

- .1 Before furnishing any hardware, carefully check Contract Documents, verify door swings, door and frame materials and operating conditions, and assure that hardware will fit work to be attached.
- .2 Check shop drawings and frame and door lists affecting hardware type and installation, and verify to correctness thereof, or advise of required revisions. Check that doors, frames and panels requiring additional support are reinforced.
- .3 Point out special requirements to installer. Make final adjustment of hardware, in particular closer arms, valves and locksets, to work properly.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions and in accordance with CAN/CSA C22.2 No. 247-92(R2014).

- .2 Provide operator system complete in all its parts and connected to electrical service Provided as part of the work of Divisions 26, 27, and 28. Secure all wiring such that it is concealed from view.

3.4 ADJUSTING AND CLEANING

- .1 Verify that installed hardware and operators function properly, and instruct installers accordingly of requirements and procedures for adjustments for operation without binding or scraping, and without excessive noise.
- .2 Clean hardware after installation in accordance with Supplier's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Glass and glazing.

1.2 REFERENCES

.1 Definitions:

- .1 Deterioration of coated glass: Defects developing from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking and other indications of deterioration in metallic coating.
- .2 Deterioration of insulating glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture or film on interior surfaces of glass.
- .3 Deterioration of laminated glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delaminating material obstructing vision through glass and blemishes exceeding those allowed by referenced laminated glass standards.
- .4 Interspace or airspace: The space between lites of any insulating glass unit that contains dehydrated air or a specified gas.
- .5 Manufacturer: A firm that produces primary glass or fabricated glass products as defined in referenced glazing publications.

1.3 SUBMITTALS

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Product data sheets:

- .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.

.3 Shop drawings:

- .1 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.
- .2 For glass scheduled or indicated as engineered and glass to serve as guards in accordance with building code, shop drawings to be engineered shop drawings.
- .3 Indicate analysis of glass including maximum deflection and allowable stresses (from imposed dead/live loads and thermal loads).

.4 Samples:

- .1 Submit 305 mm (12") square samples of each type of glass indicated except for clear monolithic glass products, and 305 mm (12") long samples of each color required, except black, for each type of sealant or gasket exposed to view.
 - .1 Submit 3 control samples for each glass type showing maximum range of visible difference between units for the Project.

.5 Test and evaluation reports:

- .1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.

.6 Manufacturer reports:

- .1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.

.7 Submit sample glazing warranty.

- .8 Submit letter from IGMAC or IGMA/IGCC, or a test report prepared by independent testing company confirming insulating glass units of the types required have been successfully tested in accordance with CAN/CGSB 12.8-97 or ASTM E2190-10 and will withstand design loads specified in the Contract Documents.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.

.2 Operation and maintenance data:

- .1 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.5 QUALITY ASSURANCE

.1 Qualifications:

- .1 Manufacturers: Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002 1994.
- .2 Installers / applicators / erectors: Provide the work of this section executed by specialist Subcontractor who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of the work of this section, and personally direct installation performed under this section.
 - .1 Foreperson experience: a minimum of 10 years' experience as glazing mechanic.
 - .2 Typical glazing mechanic experience: a minimum of 3 years' experience as glazers.

- .3 Mirror installations: Installation only by applicator trained and approved by adhesive manufacturer for application of its products.
- .3 Licensed professionals: Retain a Professional Engineer to design the work of this section; to prepare, seal and sign shop drawings; and to perform field review. Shop drawings shall show both design and installation requirements.
- .2 Mock-ups:
 - .1 Provide mock-up of mirror installation, including minimum of 4 full size mirrors.
 - .2 Locate mirror mock-up where approved by the Consultant.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Protect glass from edge damage, dust, and contaminants during handling and storage. For insulating units exposed to substantial altitude changes, comply with insulating glass manufacturers written recommendations for venting and sealing to avoid hermetic seal ruptures.
- .2 Storage and protection: Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.7 FIELD CONDITIONS

- .1 Ambient Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation or other causes.
- .2 Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4°C.

1.8 EXTENDED WARRANTY

- .1 The glazing systems shall perform properly to the extent that the design and Contract Documents permit such performance for the duration of the warranty period.
- .2 Special product warranty for insulating glass unit products:
 - .1 Provide a written warranty from date of manufacture for sealed insulating glass units. Warranty shall cover the following:
 - .1 Deterioration due to normal conditions of use and not to handling, installing, protecting and maintaining practices contrary to the glass manufacturer's published instructions.
 - .2 Replacement of sealed insulating glass units.
 - .3 No dollar limit.
 - .4 Non-prorated.
 - .5 10-year warranty duration.

.3 Special product warranty for mirror glass products:

- .1 Provide a written warranty from date of manufacture for mirror silvering. Warranty shall cover the following:
 - .1 Deterioration due to normal conditions of use and not to handling, installing, protecting and maintaining practices contrary to the glass manufacturer's published instructions.
 - .2 Replacement of mirror glass units.
 - .3 10 year warranty duration.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 General:
 - .1 Publications: Comply with recommendations in the publications below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section.
 - .1 GANA Glazing Manual.
 - .2 GANA Engineering Standards Manual.
 - .3 GANA Laminated Glazing Reference Manual.
 - .4 GANA Sealant Manual.
- .2 Regulatory requirements:
 - .1 Fire rated glass:
 - .1 Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.
- .3 Glass strength:
 - .1 Provide glass products in the thickness and strengths required to meet or exceed the following criteria based on project loads and in-service conditions.
 - .1 Analysis shall comply with CAN/CGSB 12.20-M89.
 - .2 Minimum thickness of annealed or heat-treated glass products to be selected so the worst case probability of failure does not exceed the following:
 - .1 8 breaks per 1000 for glass installed vertically less than 15 degrees from the vertical plane and under wind action.
 - .2 5 breaks per 1000 for heat soaked tempered glass as a result of verifiable NiS inclusion.
 - .3 1 break per 1000 for glass installed 15 degrees or more from the vertical plane and under action of wind and/or snow.

- .3 Maximum lateral deflection; insulating glass units:
 - .1 For insulating glass units supported on four edges, limit centre-of-glass deflection at design wind pressure to not more than 1/175 times the long-side length or 19 mm (3/4") maximum.
- .4 Glass at guards, balustrades, and where glass is likely to be subjected to human impact shall comply with safety glass requirements of CAN/CGSB 12.20-M89 and CAN/CGSB 12.1-M90, where applicable, and building code.
- .5 Provide annealed, heat strengthened, and tempered lights where required by the building code, and where required for the various solar exposures on the building.
- .6 Glass thicknesses and glass types specified, indicated, or scheduled in the Contract Documents are minimums required. Glass designer/engineer to modify as required to satisfy design and building code requirements, and requirements of authorities having jurisdiction, and any such modifications shall be clearly indicated on shop drawings.
- .4 Thermal and optical performance: Provide glass products with performance properties specified or published by glass manufacturer where not specified. Performance properties to be manufacturer's published data as determined according to the following procedures:
 - .1 Centre of glass U-Value: National Fenestration Rating Council (NFRC) 100 methodology using LBNL WINDOW 5.2 computer program.
 - .2 Centre of glass solar heat gain coefficient: NFRC 200 methodology using LBNL- 35298 WINDOW 5.2 computer program.
 - .3 Visible light transmittance: NFRC 200 methodology.
 - .4 Solar optical properties: NFRC 300 or LBNL Optics.
- .5 Glazing systems shall be capable of withstanding normal thermal movements, without failure, including loss due to defective manufacture, fabrication and installation; deterioration of glazing materials; and other defects in construction.
- .6 Protect laminated glass interlayer from damage or discolouration resulting from contact with deleterious and incompatible sealants, substances, and materials. Comply with manufacturer's recommended installation instructions.

2.2 GLASS MATERIALS

- .1 General:
 - .1 Single source responsibility: Provide materials from a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source and manufacturing plant for each type and class required.
- .2 Insulating glass units:
 - .1 Hermetically sealed, CAN/CGSB 12.8-97, minimum 12 mm (1/2") air space, air filled, double sealed edges (primary to be polyisobutylene, secondary to be polysulphide/polyurethane, desiccant filled aluminum spacer bar).
 - .1 The minimum thickness of the secondary seal shall be 1.59 mm (1/16").
 - .2 The target width of the primary seal shall be 3.97 mm (5/32").

- .3 There shall be no voids or skips in the primary seal.
- .4 Gaps or skips between primary and secondary sealant are permitted to a maximum width of 1.59 mm (1/16") by maximum length of 50 mm (2") with gaps separated by at least 450 mm (18"). Continuous contact between the primary seal and the secondary seal is desired.
- .5 Both primary and secondary sealant adhesion shall exhibit continuous, tenacious adhesion to both glass and spacer contact areas.
- .2 Warm edge, hermetically sealed, CAN/CGSB 12.8-97, minimum 12 mm (1/2") air space, air filled, double sealed edges (primary to be polyisobutylene, secondary to be polysulphide, desiccant filled warm edge spacer (splice connectors at corner of each glass unit).
 - .1 The minimum thickness of the secondary seal shall be 1.59 mm (1/16").
 - .2 The target width of the primary seal shall be 3.97 mm (5/32").
 - .3 There shall be no voids or skips in the primary seal.
 - .4 Gaps or skips between primary and secondary sealant are permitted to a maximum width of 1.59 mm (1/16") by maximum length of 50 mm (2") with gaps separated by at least 450 mm (18"). Continuous contact between the primary seal and the secondary seal is desired.
 - .5 Both primary and secondary sealant adhesion shall exhibit continuous, tenacious adhesion to both glass and spacer contact areas.
 - .6 Warm edge spacer:
 - .1 Vinyl faced, electrolytic tinplated steel: Fenzi 'Warmedge' or equivalent.
 - .1 Spacer bar colour:
 - .1 Black.
- .3 IGMAC or IGMA/IGCC certified.
- .4 Low 'E' coating (double silver):
 - .1 Acceptable Products:
 - .1 Vitro Architectural Glass 'Solarban 90'.
 - .2 Or equivalent
- .5 Glass thickness: 6 mm (1/4") minimum, and as required to suit design requirements.
- .6 Glass colour: clear, unless otherwise indicated in the Contract Documents
- .7 Performance Requirements:
 - a. Visible Light Transmittance: 41 percent minimum
 - b. Winter Nighttime U-Factor: 0.47 (Btu/hr*ft²*°F) maximum
 - c. Summer daytime U-Factor: 0.45 (Btu/hr*ft²*°F) maximum
 - d. Shading Coefficient: 0.26 maximum
 - e. Solar Heat Gain Coefficient: 0.23 maximum
 - f. Outdoor Visible Light Reflectance: 16 percent maximum

- .3 Annealed (float) glass:
 - .1 Clear, annealed glass, 6 mm (1/4") thick minimum, CAN/CGSB 12.3-M91, Glazing Quality.
- .4 Heat treated (tempered or heat strengthened) float glass:
 - .1 CAN/CGSB 12.1-M90.
 - .2 Provide thickness as indicated or greater thickness as needed to comply with requirements. Minimum thickness: 6 mm (1/4").
 - .3 Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - .4 For uncoated glass, comply with requirements for Condition A in accordance with ASTM C1048-12e1.
 - .5 For coated vision glass, comply with requirements for Condition C (other coated glass) in accordance with ASTM C1048-12e1.
 - .6 Heat strengthened glass shall have surface compression of 24-52 MPa (3,500- 7,500 psi).
- .5 Mirrors:
 - .1 Annealed glass, to ASTM C1503-08(2013) as follows:
 - .2 Grade: Mirror Cut Size.
 - .3 Quality: Mirror Select Quality, except allowable distortion shall be $\geq 80^\circ$ vision interference angle to ASTM C1036-11e1 Table 5.
 - .4 Colour: Clear.
 - .5 Thickness: 6 mm (1/4")
 - .6 Exposed edges shall be chamfered, ground, and polished.
- .6 Ceramic-coated spandrel glass:
 - .1 Glass treatment:
 - .1 Tempered float glass.
 - .2 Thickness: 6 mm (1/4") minimum thickness.
 - .3 Coating Location: Second surface.
 - .4 Fallout Resistance: Passes fallout-resistance test in ASTM C1048-12e1 for an assembly of glass and adhered reinforcing material.
 - .5 Ceramic enamel coating, baked on.
 - .1 Colour: Custom colour to later selection by the Consultant
 - .6 Acceptable ceramic coating manufacturers:
 - .1 Viracon Inc.
 - .2 Prelco Inc.
 - .3 or equivalent.

2.3 FIRE PROTECTION RATED GLASS

- .1 Fire rated, impact safety resistant glass, non-wired:
 - .1 Film-faced ceramic glazing:
 - .1 Fire-rated and impact safety-rated, clear ceramic glazing material with surface applied impact safety film, and listed for use in doors, sidelites, transoms, and borrowed lites in both interior and exterior applications, not functioning as a barrier to heat.
 - .2 Fire-ratings: as indicated or scheduled, from 20 minutes to 90 minutes, 3 hours in doors where applicable, with hose stream test.
 - .3 Impact Safety Resistance: ANSI Z97.1-2010 and CPSC 16 CFR 1201 (Cat. I and II).
 - .4 Surface finish:
 - .1 Premium Grade: clear glass, polished for superior optical clarity.
 - .5 Acceptable Product:
 - .1 Schott Gemtron (Canada) Corporation 'Pyran Platinum F'.
 - .2 Technical Glass Products Ltd. 'FireLite NT'.
 - .3 or equivalent.

2.4 GLAZING MATERIALS (NON-FIRE RATED)

- .1 Glazing materials; general: Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
- .2 Glazing gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
 - .1 Preformed, EPDM to ASTM C864-05(2011).
- .3 Setting blocks: Moulded or extruded material with Shore, Type A Durometer hardness of 85, plus or minus 5, made from the following:
 - .1 Preformed, EPDM to ASTM C864-05(2011).
- .4 Spacers: Moulded or extruded blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated made from the following:
 - .1 Preformed, EPDM to ASTM C864-05(2011).
- .5 Edge blocks: Moulded or extruded material of hardness needed to limit glass lateral movement (side walking) made from the following:
 - .1 Preformed, EPDM to ASTM C864-05(2011).
- .6 Cleaners, primers and sealers: Type recommended by sealant or gasket manufacturer.
- .7 Polyurethane foam glazing tape:

- .1 High density, closed-cell, flexible, non-extruding tape, adhesive backed one side only; recommended by manufacturer for exterior applications with nominal pressure in glazing channel.
- .2 Acceptable manufacturer: Norton Company.
- .3 Acceptable products: As recommended by manufacturer suitable for conditions of application and use.
- .8 Silicone glazing (Weatherseal) sealant:
 - .1 Medium-modulus, neutral-curing silicone sealant; complying with ASTM C920- 11, Type M or S, Grade NS, Class 25.
 - .2 Acceptable products:
 - .1 Dow Corning '790' or '795'.
 - .2 Pecora Corporation '864' or '890'.
 - .3 Sika Canada Inc. 'Sikasil WS-290' or 'WS-295'.
 - .4 Tremco Inc. 'Spectrum 2'.
 - .5 Momentive Performance Materials Inc. 'SilGlaze II'.
 - .6 or equivalent.
- .9 Mirror clips:
 - .1 Nickel plated, CR Laurence 'Vancouver' clips or equivalent.
- .10 Mirror adhesive: Palmer Mirro-Mastic, complete with sealer as required.

2.5 GLAZING ACCESSORIES (FIRE RATED)

- .1 Glazing tape; fire-rated glass (non-wired):
 - .1 Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air and vapour seal.
- .2 Silicone sealant: One-part neutral curing silicone, medium modulus sealant, to ASTM C920-11, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
 - .1 Acceptable Products:
 - .1 Dow Corning '795'.
 - .2 Momentive Performance Materials Inc. 'Silglaze-II 2800'.
 - .3 Tremco Inc. 'Spectrem 2'.
 - .4 or equivalent
- .3 Setting blocks: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.
- .4 Cleaners, primers, and sealers: Type recommended by manufacturer of glass and gaskets.

2.6 FABRICATION

- .1 Factory sealed insulating glass units:
 - .1 Fabricate units to requirements of CAN/CGSB 12.8-97.
 - .2 Spacer core shall be straight and evenly set into glass units.
 - .3 Insulating glass units shall be manufactured to conform to IGMAC recommendations (Insulated Glass Manufacturers Association of Canada) and the manufacturer shall be a member of IGMAC. Sealed units shall bear IGMAC certification markings.
- .2 Grind, chamfer, and polish exposed glass edges, unless otherwise indicated in the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine framing, glazing channels, and stops, with glazing installer present, for compliance with the following:
 - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - .2 Inspect butt and mitre joints in framing. Seal joints found to be open with a compatible sealant prior to glazing.
 - .3 Glazing pockets and surfaces are free of dust, construction debris, and contaminants.
 - .4 Presence and functioning of weep systems.
 - .5 Minimum required face and edge clearances as per IGMA and GANA standards.
 - .6 Effective sealing between joints of glass-framing members.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- .2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.
- .3 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's instructions. Ensure surfaces are free of moisture and frost.

3.3 GLAZING - GENERAL

- .1 Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- .2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- .3 Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- .4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.
- .5 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- .6 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- .7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- .8 Provide spacers for glass lites where length plus width is greater than 1270 mm (50").
 - .1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - .2 Provide 3.2 mm (1/8") minimum bite of spacers on glass and use thickness equal to sealant width.
- .9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.
- .10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- .11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- .12 Glaze hollow metal doors and frames specified under work of Section 08 11 13 using tape glazing installation.
- .13 Install fire rated glazing in accordance with fire rated glazing material manufacturer's specifications. Field cutting or tampering is not permissible.

3.4 TAPE GLAZING

- .1 Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- .2 Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- .3 Cover vertical framing joints by applying tapes to heads and sills first and then to jambs.

- .4 Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- .5 Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- .6 Do not remove release paper from tape until right before each glazing unit is installed.
- .7 Centre glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings.

3.5 GASKET GLAZING (DRY)

- .1 Allow gaskets to relax and cut compression gaskets to lengths recommended by gasket manufacturer to fit openings to suit frame dimensions.
- .2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- .3 Installation with drive-in wedge gaskets: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .4 Installation with Pressure-Glazing Stops: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .5 Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- .1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- .2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- .3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 INSTALLATION – MIRRORS

- .1 Provide frameless mirrors only. Grind and polish exposed mirror edges.
- .2 Mount mirrors in true planes, free of distortions. Surfaces of butted mirrors shall be flush to ≤ 1 mm (0.04"). Mirror installation shall be flat to within 1.5 mm in 1220 mm (1/16" in 4 ft).

- .3 Locate joints in mirrors at maximum available mirror sizes to Consultant's direction, unless otherwise indicated. Provide butt joints with flat ground and polished edges to provide inconspicuous joint complete with black tape behind joint to hide wall substrate.
- .4 Mastic adhesive and top and bottom support clip installation:
 - .1 Secure mirrors in place over mastic adhesive with metal clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.
 - .2 Make sure mirror and substrate are free of dust, clean, and dry. On nonporous substrates, such as glass, tile, or metal, sealing is not necessary. On porous substrates, such as drywall or wood, use Mirro-Mastic Bond (or a primer or sealer, not paint) on the substrates and allow it to dry. Painted surfaces should be sanded through to the original surface and the substrate cleaned and sealed where the mastic is to be applied.
 - .3 Support mirror at the bottom using concealed bottom angles.
 - .4 Apply mirror adhesive to the mirror or substrate in a minimum of 1 ping-pong ball size mound for every 0.0929 m² (1 ft²) of mirror. Do not apply mastic too close to the edge to prevent "squeeze out". Place the mounds so space will be left between them when the mirror is installed. Mastic adhesive shall be at room temperature (22°C).
 - .5 Press mirror firmly in place making good contact between the mirror, mastic, and substrate. Mastic should spread to a pat approximately 114 mm (4-1/2") in diameter. The mastic needs air circulation to cure properly. Curing time will depend on temperature, humidity, type of substrate, and amount of air that can reach the mastic.

3.8 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

3.9 PROTECTION

- .1 Provide safety markings to installed glass by attaching streamers or tape to face of sash. Do not apply tape directly to the glass. Do not mark the glass with paint or any other substance that is hard to remove or could leave permanent stains.
- .2 Take all precautions necessary to protect stored glass and installed glass from lime mortar, water run-off from concrete or copper, weld spatter, acids, roofing tar, solvents, abrasive cleaners, careless handling of construction machinery and equipment, and any other activities that could permanently damage the glass.
- .3 Install protective cover to glass where there is a high risk of damage. Use plywood, heavy kraft paper, or non-staining transparent plastic sheet. Do not let protective materials contact surface of glass.
- .4 Do not rely on use of adhesive plastic films to protect installed glass. When plastic sheeting is used, it must be transparent, suspended away from the surface of the glass, and be provided with adequate ventilation holes to prevent heat build-up.

FINISHING

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.
- .2 Final cleaning of glass in accordance with Section 01 77 00.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:

- .1 Louvres.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section, including the following information:
 - .1 Air flow and water entrainment performance test results.
 - .2 Material types and thickness.
- .3 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Include elevations, sections and specific details for each louvre.
 - .3 Show anchorage details and connections for component parts.
- .4 Samples:
 - .1 Submit colour chips for approval. Submit duplicate samples of each type of louvre showing colour and finish.
- .5 Test and evaluation reports:
 - .1 Air and water performance data: Submit AMCA test data as required to confirm that the louvres have the specified air and water performance characteristics when tested in accordance with AMCA Standard 500-L-99.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors: Provide work of this section, executed by competent installers with minimum a 5 years' experience in application of Products, systems and assemblies specified, and with approval of Product manufacturer.

1.4 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years as specified in Article A-15 of the Agreement Between Owner and Contractor. .

PART 2 - PRODUCTS

2.1 MANUFACTURER

- .1 Specifications are based on Products of the McGill Architectural Products. The following listed manufacturers are acceptable only when in compliance with requirements of this section.
 - .1 E.H. Price Ltd.
 - .2 McGill Architectural Products
 - .3 TenPlus Architectural Products Ltd.
 - .4 Or equivalent.

2.2 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Structural requirements: Design louvres to withstand wind and snow loads as required by the building code. Maximum allowable deflection for the louvre structural members to be L/180 or 19 mm (3/4"), whichever is less. Maximum allowable deflection for the louvre blades to be L/120 or 13 mm (1/2") across the weak axis, whichever is less.
- .2 Aluminum framing members shall be designed in accordance with CAN/CSA-S157- 05/S157.1-05.
- .3 Design structural steel structural components and fasteners in accordance with CSA- S16-09.
- .4 Delegated design: Design louvres, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- .5 Structural performance: Louvres shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louvre blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
- .6 Thermal movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

2.3 LOUVRES

- .1 Except as noted under Paragraph 2.3.2 (below), Provide HP245, frame depth 50 mm, flanged frame, complete with bird screen, to sizes indicated.
- .2 At Generator Room, Provide HP445, frame depth 100 mm, channel frame, complete with bird screen, to sizes indicated.

2.4 ACCESSORIES

- .1 Bird screen and frames:

- .1 Bird screen mesh: 15.9 mm (5/8") mesh, 1.27 mm (0.050") thick expanded and flattened aluminum screen secured within 1.40 mm (0.055") thick extruded aluminum frames with mitred corners and corner locks.
- .2 Finish: Mill finish.
- .2 Aluminum extrusions: ASTM B211-12, Alloy 6063-T5, 6063-T6 or 6061-T6.
- .3 Aluminum sheet: ASTM B209-14, Alloy 1100, 3003 or 5005. For anodized finish if required use Alloy 5005.
- .4 Fasteners and anchors: Stainless steel Type 304.
- .5 Arrange blades and frame extrusions as indicated.
- .6 Attach bird screen to non-exposed face of louvres.
- .7 Isolate from other dissimilar metals and materials to prevent electrolysis.
- .8 Sealant: in accordance with Section 07 92 00.

2.5 FINISHES

- .1 Exposed aluminum surfaces:
 - .1 Elsewhere: Finish to be Interpon D2000, AAMA 2604, Powder Coating,
 - .1 Colour: to later selection by Consultant.
- .2 Finish exposed metal fasteners, if applicable, to related aluminum surfaces.
- .3 Finish steel clips and reinforcing steel with 380 g/m² (13 oz/ft²) zinc coating to CAN/CSA G164-M92.

2.6 FABRICATION

- .1 Fabricate finish work free from distortion and effects detrimental to appearance and performance.
- .2 Fasten aluminum louvre framing, blade with stainless steel screws or heliarc welding.
- .3 Louvres indicated to wrap continuously around corners shall be mitred at corner intersection.
- .4 Blank off panels to be full extent of louvres except where penetrated by mechanical services, unless indicated otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure. Fasten louvres with angle, lag bolts and anchors where required for support with rust proof screws and anchor bolts.
- .2 Apply sealant to joints and penetrations to maintain weather tight installation, while allowing drainage to exterior at sill flashing.
- .3 Anchor louvres to the building substructure.

- .4 Allow for thermal expansion and contraction.
- .5 Repair or replace damaged finishes or materials.
- .6 Erection tolerances:
 - .1 Maximum variation from plane or location shown on the reviewed shop drawings: 3 mm per 3660 mm (1/8" per 12 feet) of length, but not exceeding 13 mm (1/2") in any total building length or portion thereof (non-cumulative).
 - .2 Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 75 mm (3"): 1.5 mm (1/16") (shop or field joints). This limiting condition shall prevail under both load and no load conditions.
- .7 Cut and trim component parts during erection only with the approval of the manufacturer, and in accordance with its recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- .8 Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- .9 Set units level, plumb and true to line, with uniform joints.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Metal support systems for interior gypsum and cement board partitions, interior ceilings, and interior assemblies as indicated.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section, including additional data as may be required to demonstrate compliance with the Contract Documents.
- .3 Test and evaluation reports:
 - .1 Submit certified test results for each required fire resistance rated assembly for work of this section.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Provide work of this section, executed by a Subcontractor with a minimum 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.

PART 2 - PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS - FIRE RESISTANCE RATED ASSEMBLIES

- .1 Fire resistance rating: Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.
- .2 Materials for fire resistance rated construction shall conform to requirements of indicated fire resistance rated assembly.

2.2 MATERIALS - GENERAL

- .1 For sheet metal Products: Sheet metal thickness indicated herein pertains to the "minimum base steel thickness exclusive of coating".

2.3 PARTITION SUPPORT MATERIALS

- .1 Interior non-loadbearing channel stud framing: to ASTM C645-14; roll formed from 0.455 mm (0.0179") minimum thickness unless otherwise indicated or as recommended by gypsum board manufacturer, electro-galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.
 - .1 Steel studs; at backer plate locations: 0.836 mm (0.0329") minimum thickness.
 - .2 Steel studs at cement board locations: 0.836 mm (0.0329") minimum thickness.
 - .3 Steel studs at tile backer board locations: 0.836 mm (0.0329") minimum locations.
- .2 Interior floor and ceiling tracks (runners): to ASTM C645-14; in widths to suit stud sizes.
 - .1 Metal thickness: to match studs.
 - .2 For openings wider than 914 mm (36"), provide 0.836 mm (0.0329") minimum thickness for header.
 - .3 At carpet locations: 124 mm (4-7/8") high floor tracks, Bailey 'Carpet Base Track'.
- .3 Runner fasteners:
 - .1 To concrete and masonry: Use stub nails or power-driven fasteners.
 - .2 To suspended ceilings: Use prefinished clips to match ceiling grid, as manufactured by CGC or equivalent.
- .4 Bracing channels: Minimum 19 mm x 10 mm x 1.087 mm (3/4" x 3/8" x 0.0428") cold rolled galvanized steel.

2.4 CEILING SUPPORT MATERIALS AND SYSTEMS

- .1 General: Size ceiling support components to comply with ASTM C754-15 unless otherwise indicated in the Contract Documents.
- .2 Main runners: Steel channels, hot or cold rolled; Z180 (G60) galvanized where used in shower rooms, other wet areas, and outdoors.
- .3 Hanger wire: ASTM A641/A641M-09A (2014), soft, Class 1 galvanized, minimum 4.064 mm (0.160", 8 AWG).
- .4 Hanger rods and flats: Mild steel with zinc coating, galvanized for exterior applications.
 - .1 General: Size devices for 5 times load imposed by completed system as determined in accordance with ASTM E488/E488M-15.
 - .1 Power actuated fastening systems are not permitted.
 - .2 Screws, clips, bolts, concrete inserts or other devices for ceiling hangers whose suitability for use intended has been proven through standard construction practices or by certified test data.
 - .3 Hangers: Comply with ASTM C754-15 for maximum ceiling area and loads to be supported.
 - .4 Interior concrete ceiling anchors; acceptable products:
 - .1 Dynabolt Sleeve Anchor 'TW-1614' or 'Redi-Drive Tie Drive' or 'Redi-Drive' by ITW Ramset/Red Head.

- .2 Redi-Drive by ITW Construction Products Canada, complete with galvanized angle clip.
- .3 ITW Ramset Trubolt, or Dynabolt anchors by ITW Construction Products Canada, complete with galvanized angle clip.
- .4 Hilti Corporation Kwik-Bolt 3 - HHDCA 1/4 Ceiling Hangers by Hilti.
- .5 or equivalent.
- .5 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .5 Tie wire: 1.19 mm (0.047", 18 AWG) minimum zinc coated, soft-annealed wire, to ASTM A641/A641M-09A (2014).
- .6 Furring anchorages: 1.62 mm (0.0637", 16 AWG) galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C754-15.
- .7 Runner (carry) channels: 1.367 mm (0.0538") thick cold rolled steel, primer painted or zinc coated for interior locations, Z275 galvanized for exterior locations, to ASTM C754- 15, with minimum 228 MPa yield strength:
 - .1 38 mm x 12.7 mm (1-1/2" x 1/2") where supported at centres of 914 mm (36") maximum.
 - .2 38 mm x 19 mm (1-1/2" x 3/4") where supported at centres of 1220 mm (48") maximum.

2.5 FURRING

- .1 Furring channels: 0.455 mm (0.0179") minimum typical thickness, minimum 0.836 mm (0.0329") at exterior soffits, cold rolled steel, wiped coated, nominal size of 22 mm (7/8") depth x 35 mm (1-3/8") face, hat type with knurled face.
- .2 Resilient furring channels: 'Resilient Channel' as manufactured by Nicholson Rollforming or Bailey Metal or equivalent..
- .3 Z-furring members: Galvanized steel z-shaped furring members; ASTM A653/A653M-11, G60, 0.836 mm (0.0329") minimum thickness of base metal, of depth indicated, designed for mechanical attachment of insulation boards or blankets.
- .4 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated, corrosion resistant finish for exterior building envelope applications, load rating and spacing to support materials carried by assembly with factor of safety of 3x per fastener manufacturer data sheets.

2.6 ACCESSORIES

- .1 Backer plates:
 - .1 Metal backer plates: Steel, galvanized; minimum 150 mm (6") wide x 0.836 mm (0.0329") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.

- .2 Plywood backer plates: Softwood plywood; 19 mm (3/4") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
- .3 Elimination of backer plates or direct attachment of accessories or equipment to studs will not be permitted.

PART 3- EXECUTION

3.1 INSTALLATION GENERAL

- .1 Comply with ASTM C754-15 and manufacturer's instructions, except as modified herein. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane.
 - .2 Do not exceed 10 mm (3/8") from drawings locations.
 - .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .4 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.
 - .5 In double stud walls, do not bridge across studs on opposite sides of wall with gypsum board or metal cross bracing.
- .3 Give complete cooperation and direction to trades erecting framing and furring over which this work is applied. Coordinate finished joint location with framing.
- .4 Coordinate installation and cooperate with mechanical and electrical work to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with the partitions, ceiling and soffit systems.
 - .1 Where the presence of suspended ductwork or other mechanical or electrical services or devices above ceiling framing conflicts with ceiling framing suspension points from structure above, provide bridging framing below conflicting work as required to support ceiling framing on specified intervals.
 - .2 Do not suspend ceiling framing from mechanical or electrical suspension systems unless agreement is obtained in writing from engineer for Subcontractor installing such framing that additional imposed loads are acceptable; obtain the Consultant's acceptance before proceeding.
- .5 Provide clearances between work of this section and structural elements to prevent transference of structural loads.
- .6 Do not bridge building expansion joints with steel framing or furring members. Independently frame both sides of joints with framing of furring members or as indicated.
- .7 Size framing systems according to manufacturer's engineered load tables, to meet allowable deflection without permanent deformation.
 - .1 Maximum allowable deflection: L/240.

- .2 Maximum allowable deflection for tiled partitions: L/360.

3.2 BLOCKING

- .1 Attach to framing adequate backer plates to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this section. Such items include, but are not restricted to:
 - .1 Coat hooks.
 - .2 Washroom accessories.
 - .3 Mop brackets/shelving.
 - .4 Handrail anchors.
 - .5 Guards.
 - .6 Fitments.
 - .7 Cabinetry.
 - .8 Shelving.
 - .9 Window shades.
 - .10 Finish hardware.
 - .11 Toilet partition wall attachment points.
 - .12 Urinal screen wall attachment points.
 - .13 Miscellaneous specialties.
 - .14 Glazing accessories.
 - .15 Benches.
 - .16 Items as indicated.

3.3 FURRING - GENERAL

- .1 Furring indicated in the Contract Documents is schematic. Do not regard as exact or complete. Provide all necessary framing and furring to support gypsum board in accordance with manufacturers' specifications.
- .2 Shim furring as required to achieve required installation tolerances.
- .3 Leave finished work rigid, secure, square, level, plumb, curved to detailed radius and erected to maintain finish gypsum board line dimensions and contours. Make allowance for thermal movement.
- .4 Thermally separate metal studs from exterior concrete or masonry.

3.4 SUSPENDED AND FURRED CEILINGS

- .1 Arrange hangers for suspended gypsum board ceilings to provide support independent of walls, columns, pipes, ducts; erect plumb, and securely anchored to structural frame, or embed in concrete slabs.
- .2 Keep lateral braces at hangers back 450 mm (18") minimum unless otherwise noted in the Contract Documents.
- .3 Space hangers at 914 mm (36") on centre maximum along runner channels, and not more than 150 mm (6") from ends.
- .4 Space runner channels at 1220 mm (48") on centre, maximum, and not more than 150 mm (6") from boundary walls, interruptions of continuity, and changes in direction. Run channels transversely to structural framing members.
- .5 Where splices are necessary, lap members at least 200 mm (8") and wire each end with 2 loops. Avoid clustering or lining up of splices.
- .6 Attach to rod hangers by bending hanger sharply under bottom flange of runner, and securely wiring in place with saddle tie.
- .7 Erect cross furring channels transversely across runner channels at 400 mm (16") on centre maximum, 305 mm (12") on centre at fire rated assemblies, at not more than 150 mm (6") from boundary wall openings, interruptions in ceiling continuity, and changes in direction.
- .8 Secure furring channels to each support with purpose-made slips or wire tie. Splice joints by lapping channels and tying together.
- .9 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).

3.5 WALL FURRING

- .1 Install steel furring for braced walls, free standing walls, walls that are furred out as indicated.
- .2 Frame openings and around built-in equipment, cabinets, access panels, on 4 sides, with channels. Extend furring into reveals. Check clearances with equipment suppliers.
- .3 Provide bulkheads and boxed-in duct shafts, for beams, columns, pipes and around exposed services where indicated. Install 19 mm (3/4") channels at corners and at 305 mm (12") on centre.

3.6 RESILIENT FURRING

- .1 Erect gypsum board resilient furring maximum 610 mm (24") on centre and not more than 150 mm (6") from ceiling/wall juncture. Secure to each support with 25 mm (1") gypsum wallboard screw.
- .2 Install 150 mm (6") continuous strip of 12.7 mm (1/2") gypsum board along base of partitions where resilient furring installed.
- .3 Provide resilient furring channel transverse to framing members, or as indicated.
- .4 On partitions, install resilient furring with outer leg oriented upward.

3.7 METAL STUD PARTITION FRAMING

- .1 Provide partition tracks (runners) at floor and underside of structural assembly and as follows:
 - .1 Align accurately and lay out according to partition layout.
 - .2 Secure runners to concrete access flooring and to concrete slabs, as applicable, with screwed or shot fasteners located 50 mm (2") from each end and spaced at maximum 610 mm (24") on centre.
 - .3 At partition corners, extend one runner to end of corner and butt other runner to it, allowing necessary clearance for gypsum board thickness. Runners should not be mitred.
- .2 Unless otherwise indicated, place interior studs vertically at centres as follows:
 - .1 Provide studs at 400 mm (16") on centre, and as specially spaced in accordance with details indicated.
 - .2 Provide studs not more than 50 mm (2") from abutting walls, openings and each side of corners.
 - .3 Provide freedom for 19 mm (3/4") deflection under beams, structural slabs and the like to avoid transmission of structural loads to studs, or install 50 mm (2") leg ceiling tracks.
- .3 Install studs in tracks at floor and ceiling.
- .4 Where horizontal runs of service lines are scheduled to be installed, arrange with applicable trades and install studs simultaneously with services.
- .5 At openings in stud walls, erect track at head and sills to accommodate intermediate studs. At each end of track, cut out flanges, turn up web, and fasten to studs. Install intermediate studs above and below openings in same manner and spacing as wall studs. Install double studs at each jamb, and double tracks at head of door openings.
- .6 At partitions requiring fire rating, erect in accordance with requirements of listing.
- .7 Size studs, connections, and runners to carry loads according to stud manufacturer's load tables, at 24 kg/m² (5 lb/ft²) live load to meet maximum allowable deflection limits. Where depth of stud is indicated, size metal thickness to meet allowable deflection limits.
- .8 Provide three studs at corner and intermediate intersections of partitions.
- .9 Coordinate work with others installing horizontal runs of service lines so that work is done simultaneously. Where standard holes are too small for installed services, notch studs, and splice notched flanges with splice pieces 305 mm (12") longer than notches, each fastened with 2 screws.
- .10 Provide metal studding to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).
- .11 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .12 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other sections.
- .13 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structure above.
- .14 Maintain clearance to avoid transference of structural loads to studs.
- .15 Chase walls:

- .1 Provide chase walls where indicated, consisting of two parallel steel stud partitions.
- .2 Provide cross bracing consisting of metal furring, located at quarter points on each pair of studs. Attach cross bracing to studs with metal screws. Coordinate construction of partitions to suit installation of services.
- .16 Lateral support bracing channels:
 - .1 Stiffen partitions over 3 m (10') in vertical span, at mid-height to maximum vertical spacing of 2440 mm (8') on centre, with at least one 19 mm (3/4") horizontal bracing channel, extending full length of partition, overlapping at least two stud spaces at ends of bracing channels.
 - .2 Stiffen partitions at not more than 150 mm (6") from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.

3.8 CONTROL JOINTS

- .1 Control joints: in accordance with Section 09 29 00.

3.9 CONCRETE ANCHORS

- .1 Provide anchorage points in reinforced concrete floor slab underside in accordance with gypsum board manufacturer's suspension requirements. Drill holes with carbide-tipped drill bits conforming to ANSI B212.15-1994 (R2000).
- .2 Provide anchors; minimum installation depth, and method of expansion as recommended by the anchor manufacturer.

3.10 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Gypsum board; plain.
 - .2 Gypsum board; fire-rated.
 - .3 Water resistant backing board; paper faced gypsum.
 - .4 Tile backer board; cement board.
 - .5 Exterior sheathing board; glass scrim gypsum sheathing board.
 - .6 Gypsum board accessories and miscellaneous related materials.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Fire-rated assembly listings:
 - .1 Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.

1.3 QUALITY ASSURANCE

- .1 Subcontractor executing the work of this section shall have a minimum of 10 years continuous experience in successful installation of work of type and quality indicated and specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Store materials in protected dry areas. Store gypsum board flat in piles with edges protected.
- .2 Ensure that finish metal members are not bent, dented, or otherwise deformed.
- .3 Deliver Products supplied under the work of this section only to those who are responsible for installation, to the place they direct, and to meet installation schedules.
- .4 Package fire rated materials with labels attached.

1.5 FIELD CONDITIONS

- .1 Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum boards.

- .2 When ambient outdoor temperatures are below 12°C maintain continuous, uniform comfortable building working temperatures of not less than 12°C for a minimum period of 48 hours before, during and following application of gypsum board and joint treatment materials or bonding of adhesives.
- .3 Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.
- .4 Protection:
 - .1 Provide adequate protection of materials and work of this section from damage by weather and other causes. Protect work of other trades from damage resulting from work of this section. Make good such damage at no additional cost to the Owner.
 - .2 Exterior sheathing board's exposure to weather: Comply with manufacturer's printed instructions. Provide protection prior to exposure for periods greater than manufacturer's recommendations and warranty.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Fire resistance rating:
 - .1 Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

2.2 GENERAL

- .1 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

2.3 GYPSUM BOARD PANELS

- .1 Plain gypsum board:
 - .1 Paper faced gypsum core panel solid set core enclosed in paper, 12.7 mm (1/2") or 16 mm (5/8") thick unless otherwise indicated, 1220 mm (48") wide x maximum practical length, ends square cut, tapered edges, to ASTM C1396/C1396M-11.
- .2 Acceptable Products:
 - .1 CertainTeed 'Regular Gypsum Board'.
 - .2 CGC Inc. 'SHEETROCK Gypsum Panel, Regular'.
 - .3 Georgia-Pacific 'ToughRock Gypsum Board'.
 - .4 Lafarge 'Gypboard'.
 - .5 National Gypsum 'Gold Bond Gypsum Board'.
 - .6 or equivalent.

.2 Fire-rated gypsum board:

- .1 Paper faced gypsum core panel with a specially formulated core for use in fire- resistive Type X or Type C designs, to ASTM C1396/C1396M-11.

.2 Acceptable Products:

- .1 CertainTeed 'Type X and Type C'.
- .2 CGC Inc. 'SHEETROCK Firecode and Firecode C'.
- .3 Georgia-Pacific 'ToughRock Fireguard and Fireguard Gypsum Board'.
- .4 Lafarge 'Firecheck C and X'.
- .5 National Gypsum 'Gold Bond Fire-Shield and Fire Shield C Gypsum Board'.
- .6 or equivalent.

.3 Water resistant gypsum backing board (greenboard), wall applications:

- .1 Paper faced gypsum core panel with enhanced water and water resistant paper facers to ASTM C1396/C1396M-11, fire rated where indicated.

.2 Acceptable Products:

- .1 CertainTeed 'ProRoc Moisture Resistant'.
- .2 CGC Inc. 'SHEETROCK Mold Tough Panel'.
- .3 Georgia-Pacific 'ToughRock Moisture-Guard'.
- .4 Lafarge 'Mold Defense'.
- .5 Or equivalent.

.4 Exterior sheathing board:

- .1 Service grade: Exterior grade.
- .2 Fibreglass mat faced on front and back sides and long edges, silicone-treated water-resistant core, to ASTM C1177/C1177M-08, fire rated where indicated.

.1 Acceptable Products:

- .1 CertainTeed 'GlasRoc Sheathing'.
- .2 CGC Inc. 'Securock Glass-Mat Sheathing'.
- .3 Georgia-Pacific 'Dens-Glass Gold'.
- .4 Lafarge; Weather Defense Platinum Sheathing'.
- .5 Or equivalent

2.4 CEMENT BOARD PANELS

.1 Cement board; interior and exterior grade, tile backer board and sheathing applications:

.1 Composition:

- .1 Portland cement, sand, and expanded polystyrene beads, with a fully embedded alkali resistant glass fibre mesh facing.

- .2 Free of asbestos, gypsum, organic fibres or cellulose.
- .2 Thickness: 12.7 mm (1/2") minimum.
- .3 Acceptable Products:
 - .1 CGC 'Durock'.
 - .2 National Gypsum 'PermaBase Plus Cement Board'.
 - .3 Or equivalent.

2.5 ATTACHMENT MATERIALS

- .1 Screws; for gypsum board: bugle head, fine thread, self-tapping, Type W or S or S-12 point to suit framing type and metal gauge, with corrosion resistant finish to ASTM C1002-07/ASTM C954-11. Screw sizing:
 - .1 #6 x 25 mm (1") for single thickness board fastening.
 - .2 #6 x 32 mm (1-1/4") for single thickness 15.9 mm (5/8") board fastening.
 - .3 #7 x 41 mm (1 5/8") for double thickness board fastening.
- .2 Screws; for cement board: Wafer head, Type S-12 point or 'Hi-Lo', self-tapping, with corrosion resistant polymer finish.
- .3 Tie wire: 1.6 mm (0.063") diameter galvanized soft annealed steel wire.

2.6 ACCESSORIES

- .1 Accessories: to ASTM C1047-14a unless otherwise indicated, maximum length pieces per location. Flanges shall be free from dirt, grease, or other material that adversely affects the bond of joint treatment or decoration.
- .2 Trim reveal:
 - .1 Standard metal trim reveal for suspended gypsum board walls or ceilings abutting concrete block walls, suitable for paint finish in all locations except where indicated otherwise in the Contract Documents.
- .3 Control joints: No. 093 Zinc Control Joint by CGC Inc. or equivalent, certified by manufacturer for use at fire resistance rated assemblies.
- .4 Casing beads, corner beads: 0.5 mm (0.02") base thickness commercial grade sheet steel with Z275 zinc finish to ASTM A525, perforated flanges, one piece length per location.

2.7 RELATED SUPPORT ASSEMBLIES AND BACKER PLATES

- .1 Dimensional wood blocking at interior assemblies: in accordance with Section 06 10 53.
- .2 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.8 JOINT TREATMENT MATERIALS

- .1 General: Comply with ASTM C475/C475M-12e1.
- .2 Joint tape:
 - .1 Interior gypsum board: Paper.
 - .2 Glass-mat gypsum sheathing board: 10-by-10 glass mesh.
 - .3 Tile backing panels: As recommended by panel manufacturer.
- .3 Joint compound for interior gypsum board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - .1 Prefilling: Use setting-type compound as recommended by panel manufacturer.
 - .2 Embedding and first coat: Use setting-type or taping compound as recommended by panel and trim manufacturers.
 - .3 Fill and finish coats: Use sanding type setting-type or taping compound as recommended by panel manufacturer.
- .4 Joint compound for exterior applications:
 - .1 Glass-mat gypsum sheathing board: As recommended by sheathing board manufacturer.
- .5 Joint compound for tile backing panels:
 - .1 Cementitious backer units: As recommended by backer unit manufacturer.
 - .2 Water-resistant gypsum backing board: Use setting-type taping compound and setting-type, sandable topping compound.

2.9 ACOUSTIC WALL ASSEMBLY MATERIALS

- .1 Acoustic sealant; concealed locations: non-skinning butyl sealant, non-hardening, remains soft and tacky, to CGSB 19.21-M87:
 - .1 Sealant shall not deteriorate (stain or bleed into) painted surfaces.
 - .2 Acceptable Products:
 - .1 DAP 'Mono Acoustic Sealant'.
 - .2 Pecora 'BA98'.
 - .3 Quiet Solution 'QuietSeal'.
 - .4 Tremco 'Acoustical Sealant'.
 - .5 Substitutions: in accordance with Section 01 25 00.
- .2 Acoustic sealant; exposed locations: Interior paintable sealant in accordance with Section 07 92 00.
- .3 Acoustic compound: premixed perlite plaster.
- .4 Acoustic (sound attenuation) insulation:

- .1 Mineral-fibre sound attenuation batts: to CAN/ULC S702-09, Type 1, fire resistant and non-combustible to CAN/ULC-S114-05, high density for sag-free, tight fitting installation.
 - .1 Density: minimum 40 kg/m3 (2.5 lbs/ft3).
 - .2 Acceptable Products:
 - .1 Roxul 'AFB'.
- .2 Fasteners: use mechanical fasteners where required to secure insulation into position in accordance with insulation manufacturer.

2.10 ACCESS DOORS

- .1 Access doors: in accordance with Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 General: Comply with ASTM C840-11, GA-216, GA-600, and manufacturer's instructions, except as otherwise indicated. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.6 mm (1/16") open space between boards. Do not force into place.
- .3 Cover both faces of stud partition framing with gypsum board in concealed spaces (above ceiling, and the like) unless otherwise indicated, except in chase walls which are properly braced internally.
- .4 Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cut-outs.
- .5 Securely attach trim, casings, framing, and accessories.
- .6 Apply components of fire-rated assemblies in conformance with indicated designs.
- .7 Erect materials to dimensions indicated, plumb, level, straight, and square to adjoining elements.
- .8 Do not apply gypsum board in close proximity to hot pipes or heating ducts.
- .9 Install materials with the minimum number of joints. Tightly butt joints, without force, and neatly align them.
- .10 Frame openings on every side. Provide clearances with services.
- .11 Work shall include bulkheads over doors, frames, screens, and changes in ceiling levels, pipe space and as indicated.
- .12 Provide clearances between work of this section and structural elements to prevent transference of structural loads in accordance with Section 09 22 00.
- .13 Tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.

- .2 Do not exceed 10 mm (3/8") from indicated location.
- .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
- .4 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

3.2 ACCESSORIES

- .1 At external corners install corner trim secured to framing at 230 mm (9-1/16") on centre on both flanges with screw fasteners or clinch tool.
- .2 Secure casing trim at board edges where exposed to view, where board butts against other materials with no trim to conceal junction, at perimeter of ceiling surfaces at tops of partitions where they stop against continuous ceiling surfaces, and where indicated.
- .3 Erect accessories straight, plumb or level, rigid and at proper plane.
- .4 Use full length pieces.
- .5 Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners, free from rough edges. Secure in accordance with manufacturer's specifications unless otherwise required.
- .6 Installation tolerances:
 - .1 Alignment with board panels shall not exceed tolerances specified above.
 - .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.3 BOARD APPLICATION - GENERAL

- .1 Before application of gypsum board commences, ensure that internal services have been installed, tested, and approved; that conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports installed by others are in place.
- .2 Extend board into door, window, and other openings, reveals, behind fittings, and other applied items and on metal stud partitions to structure above unless indicated otherwise in the Contract Documents.
- .3 Apply board with long dimension perpendicular to supports, unless otherwise indicated in the Contract Documents.
- .4 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.
- .5 Install board to minimize joints, and align end joints to be the least objectionable (where they are unavoidable), according to the indicated lighting design. Locate joints in ceilings where least prominently discerned, and never line them up with opening edges.
- .6 Form smooth joints at ends and at field cut edges of board panels.
- .7 Fasten board to metal support members by metal gypsum board screws, 9.5 mm (0.374") minimum to, and 12.7 mm (1/2") maximum from, center of joints. Space screws:
 - .1 At fire rated board as per fire-rated assembly.
 - .2 At typical board walls at 400 mm (16") on centre at edges and field unless otherwise required.
 - .3 At typical board ceilings at 305 mm (12") on centre at edges and field unless otherwise required.
- .8 At laminated plain gypsum board locations: Apply adhesive with notched spreader to leave ribbons 10 mm x 13 mm (3/8" x 1/2") at 38 mm (1-1/2") apart over entire back side of face layer. Erect board immediately after spreading adhesive. Temporarily secure face boards with screws

or bracing to ensure adequate bond until adhesive sets. Temporary face screws may also be used. Substrate shall be fully cured and sufficiently dry to allow adhesive to fully cure and not re-emulsify.

- .9 Offset gypsum board joints 150 mm (6") minimum from corners of openings.
- .10 Gypsum panel product joints shall be located so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.4 WATER RESISTANT GYPSUM BOARD APPLICATION

- .1 Apply water resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

3.5 EXTERIOR SHEATHING BOARD APPLICATION – GYPSUM SHEATHING BOARD

- .1 Install sheathing in accordance with manufacturer's instructions and applicable instructions in GA-253, ASTM C1280-13, and ASTM C1397-13. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated in the Contract Documents.
- .2 Use maximum board lengths to minimize number of joints. Sheathing joints shall be staggered, offset by at least one framing member. Offset gypsum board joints 150 mm (6") minimum from corners of openings.
- .3 Install sheathing with exterior board side facing exterior. Butt boards together for a light contact at edges and ends with not more than 1.6 mm (1/16") open space between boards. Do not force into place.
- .4 Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
- .5 Locate fasteners minimum 10 mm (3/8") from edges and ends of sheathing boards.
- .6 Provide clearances between work of this section and structural elements to prevent transference of structural loads, and in no case less than 16 mm (5/8").
- .7 Tolerances:
 - .1 Sheathing where acting as substrate for direct applied or insulated finishing system shall be flat to within 6 mm in 3050 mm (1/4" in 10'), in accordance with ASTM C1397-13.
 - .2 Maximum gap between board joints: 1.6 mm (1/16").

3.6 INTERIOR TILE BACKER BOARD APPLICATION

- .1 Install in accordance with manufacturer's specifications.
- .2 Section 09 31 00 to install tile setting material over tape installed by this section. Install mesh tape centred over tile backer board joints.
- .3 Apply tile backer board full height unless otherwise indicated, and in accordance with manufacturer's installation instructions. Install water barrier sheeting over gypsum board substrates, where applicable.

- .4 Fastener spacing:
 - .1 Walls: fasten at 150 mm (6") on centre at vertical butt joints and 210 mm (8") on centre in field.
 - .2 Ceilings: fasten at 150 mm (6") on centre.
- .5 Maintain 6 mm (1/4") gap between board and tub or shower base as applicable.

3.7 INTERIOR CEMENT BOARD

- .1 Apply cement board with rough side towards interior, as and with ends applicable, and edges over supports. Fit ends and edges closely, but not forced together. Stagger end joints in successive courses.
- .2 Fasten cement board to framing with specified fasteners. Drive fasteners in field of cement board first, working toward ends and edges. Hold cement board in firm contact with framing while driving fasteners. Space fasteners along framing with perimeter fasteners at least 9.5 mm (0.374") and less than 15.9 mm (5/8") from ends and edges. Drive fasteners so bottom of heads are flush with surface of cement board to provide firm board contact with framing. Do not drive fastener heads below panel surface.
 - .1 Maximum fastener spacing as follows:
 - .1 Walls: 200 mm (8").
 - .2 Ceiling: 150 mm (6").
 - .3 Perimeters: minimum 9.5 mm (3/8") and maximum 15.9 mm (5/8") from ends and edges.

3.8 ACOUSTIC WALL ASSEMBLIES

- .1 Sound attenuation insulation:
 - .1 Install sound attenuation insulation to fill cavity unless otherwise indicated in the Contract Documents.
 - .2 Trim insulation to provide close-fit contact to framing assemblies and fill the partition cavity or acoustic insulation assemblies to thicknesses specified or indicated.
 - .3 Maintain air space between backs of sound attenuation insulation and back of opposite partition face layer, as applicable.
 - .4 Cut insulation to provide close-fit contact around electrical boxes, pipes, and other obstructions and penetrations through and within acoustic assemblies.
 - .5 Extend acoustic partition assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.
 - .6 Staple sound attenuation insulation where required by manufacturer's installation instructions.
 - .7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.

- .8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm (6").
- .9 Secure insulation in such a manner that it will not sag or settle away from required locations.

3.9 FINISHING

- .1 Provide levels of gypsum board finish for locations as follows, in accordance with GA- 214.
 - .1 Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
 - .2 Level 2: Gypsum board substrate at applied hard surfaces, except remove tool marks and ridges.
 - .3 Level 4: Exposed gypsum board surfaces, except where another finish level is indicated the in the Contract Documents.
 - .4 Level 5: Exposed gypsum board surfaces where indicated in the Contract Documents.
- .2 Interior gypsum board:
 - .1 Prefill:
 - .1 Use setting-type joint compound. Mix joint compound according to manufacturer's directions.
 - .2 Fill joints between boards flush to top of eased or beveled edge.
 - .3 Fill joints of gypsum board above suspended ceilings in fire rated partitions.
 - .4 Wipe off excess compound and allow compound to harden.
 - .5 Joint gaps not greater than 3.2 mm (1/8") shall be prefilled with either ready- mix or setting type joint compound; joint gaps greater than 3.2 mm (1/8") shall be prefilled with setting-type joint compound.
 - .2 Taping (Level 1):
 - .1 Butter taping compound into inside corners and joints.
 - .2 Center tape over joints and press down into fresh compound.
 - .3 Remove excess compound.
 - .4 Tape joints of gypsum board above suspended ceilings.
 - .3 First coat (Level 2):
 - .1 Use taping or all-purpose drying-type compound.
 - .2 Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's instructions.
 - .3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
 - .4 Fastener heads and accessories shall be covered with 1 coat of joint compound.

- .4 Second coat (Level 3): After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 50 mm (2") beyond edge of first coat.
 - .1 Fastener heads and accessories shall be covered with total of 2 separate coats of joint compound.
- .5 Third coat (Level 4):
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 50 mm (2") beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Finished joints will be accepted with a camber not greater than 1 mm (1/32") and shall be seamless, plumb, true and flush and with square, neat corners.
 - .4 Fastener heads and accessories shall be covered with total of 3 separate coats of joint compound.
- .6 Skim coat (Level 5):
 - .1 After the fourth coat has dried, apply skim coat of topping or all-purpose drying-type compound over exposed surfaces of gypsum board.
 - .2 After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
- .3 Water-resistant gypsum board: Treat fastener heads and joints with setting-type joint compound.
 - .1 For joints to be covered with tile, apply tape and joint compound bedding coat and skim coat only; do not apply finish coats.
 - .2 Do not crown joints or leave excess compound on panels.
 - .3 Remove tool marks and ridges.
 - .4 For fastener heads to be covered with tile, apply one coat of joint compound.
- .4 Interior tile backer board: Prepare and finish joints in accordance with manufacturer's instructions.
- .5 Cement board: Prepare, tape, and finish joints in accordance with manufacturer's instructions.
- .6 Joint compound:
 - .1 Apply finish coat of compound feathering 75 to 100 mm (3" to 4") beyond tape edges.
 - .2 Feather coats onto adjoining surfaces so that camber is maximum 0.79 mm (1/32").
- .7 Trim:
 - .1 Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
 - .2 Install metal corner beads at external corners.
 - .3 Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi exposed, and where gypsum base terminates against dissimilar material.
 - .4 Erect beads plumb or level, with minimum joints.
- .8 Control joints:

- .1 Provide control joints set in board facing. Support control joints with studs or furring channels on both sides of joint.
- .2 Provide control joints in required locations.
 - .1 Review control joint locations with Consultant prior to installation.
- .3 Install control joints where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the building structure.
- .4 Install control joints where a wall or partition runs in an uninterrupted straight plane exceeding 9100 mm (30 linear feet).
- .5 Install control joints in interior ceilings:
 - .1 With perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 15000 mm (50 ft) and total area between control joints shall not exceed 230 m² (2500 ft²).
 - .2 Without perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 9100 mm (30 ft) and total area between control joints shall not exceed 84 m² (900 ft²).
- .6 Install control joints where ceiling framing members change direction.
- .7 Where a control joint occurs in an acoustical or fire-rated system, blocking shall be provided behind the control joint by using a backing material such as 16 mm (5/8") type X gypsum panel products, mineral fibre, or other tested equivalent. Construct through-wall control joints at fire-rated assemblies in accordance with assembly listing requirements.
- .8 Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements, where accepted by the Consultant.
- .9 Install control joints straight and true.
- .10 Ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.
- .11 Board joints shall be located so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.10 FIRE SEPARATIONS

- .1 Install fire-rated assemblies in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by the Authorities Having Jurisdiction.
- .2 Vertical bulkheads in ceiling spaces over fire rated partitions, doors and the like shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated in the Contract Documents.
- .3 Use fire rated gypsum wallboard as specified in the Contract Documents.
- .4 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.

- .5 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed in the Contract Documents.

3.11 ACCESS DOORS

- .1 Install access doors to mechanical and electrical fixtures specified in respective sections of Divisions 21, 22, and 23 and Divisions 26, 27, and 28.
- .2 Access doors shall be as supplied by Divisions 21, 22, and 23 and Divisions 26, 27, and 28. Locations to be reviewed and confirmed by Consultant.
- .3 Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services and consultation with the Consultant.
- .4 Rigidly secure frames to furring or framing systems.

3.12 ADJUSTING AND CLEANING

- .1 Remove debris and rubbish from wall and ceiling cavities before enclosing with board.
- .2 Clean up and remove surplus materials and rubbish resulting from the work of this section upon completion.
- .3 Clean off beads, casings, joint compound droppings and the like, leave the work of this section ready for painting trades.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Hard surface tiling.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing and Scheduling
 - .1 Coordinate installation of tile work with related work.
 - .2 Proceed with tile work only after curbs, vents, drains, piping, and other projections through substrate have been installed and when substrate construction and framing of openings have been completed.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit manufacturer's installation instructions for Products proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit full size samples of each type of tile specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide minimum 2% of each type and colour of tile required for the Work for maintenance use.
 - .2 Maintenance material to be of same production run as installed material.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors:

- .1 Execute work of this section only by a Subcontractor who has adequate plant, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.
- .2 Subcontractor shall be a member company in good standing of the Terrazzo, Tile and Marble Association of Canada and have been a member for at least the past 5 years.

1.6 FIELD CONDITIONS

- .1 Execute work of this section while temperature is maintained within safe working temperatures in accordance with manufacturer's installation instructions for a period of 72 hours before, during and following installation. Avoid concentrated or irregular heating during curing period.
- .2 Protect work of this section against damage by work of other sections for a minimum of 72 hours after application of grouting by prohibiting passage of traffic over tile. Do not immerse in water and protect tilework from freezing for at least 28 days after installation.
- .3 For concrete floor substrates subject to moisture sensitive materials, conduct the following tests in accordance with the following:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710-11 and ASTM F1869-11 or ASTM F2170-11 in accordance with manufacturer's written installation instructions. Results must not exceed the written recommendations of the product manufacturer.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the product manufacturer. Test in accordance with ASTM F710-11.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 square feet) in area, and 1 additional test for each additional 93 m² (1000 square feet) of flooring area.

1.7 EXTENDED WARRANTY

- .1 Warrant work of this section for a period of 2 years in accordance with Article A-15 of the Agreement Between Owner and Contractor.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Terrazzo, Tile and Marble Association of Canada ("TTMAC") Specification Guide 09 30 00 Tile Installation Manual 2012-2014.

2.2 TILE MATERIALS

- .1 Tile company, size and color as noted on the Drawings.

2.3 GROUT AND ADHESIVES

- .1 Acceptable manufacturers:
 - .1 Ardex Canada.
 - .2 Flextile Ltd.
 - .3 LATICRETE International, Inc.
 - .4 MAPEI Corp.
 - .5 TEC Specialty Products, Inc.
 - .6 or equivalent
- .2 Setting adhesives; interior applications:
 - .1 Portland cement/sand/latex mixture, to ANSI A108/A118/A136.1-2013 and with minimum Shear Bond (Porcelain Tile, immersion and dry 28 day cure tests) of 2.3 MPa (340 psi) when tested to ANSI A108/A118/A136.1-2013.
 - .1 Acceptable products:
 - .1 Ardex 'X 77 Microtec Fibre Reinforced'.
 - .2 Flextile '51' mixed with Flextile '44'.
 - .3 Laticrete 'Laticrete 4237 Latex Thin Set Liquid' with 'Portland 211 Crete Filler Powder'.
 - .4 Mapei 'KERALASTIC' mixed with 'KERABOND'.
 - .5 TEC Specialty Products, Inc. 'Super Flex Latex-Modified Thin Set Mortar'.
 - .6 or equivalent.
 - .2 Metal substrate conditions: Epoxy mortar setting mix to ANSI A108/A118/A136.1- 2013.
 - .1 Ardex Canada 'S 16 Rapid Setting Thin Set'.
 - .2 Flextile Ltd. '100 Flex-Epoxy'.
 - .3 Laticrete International Inc. 'Latapoxy 210 Modified Epoxy Adhesive'.
 - .4 Mapei Corp. 'Kerapoxy 9931'.
 - or equivalent.
- .3 Grout:
 - .1 TEC Specialty Products, Inc. '100% Solids Epoxy Mortar and Grout 470'.
 - .1 Sanded, polymer-modified, latex-modified, non-shrink, ANSI A108/A118/A136.1- 2013 and ANSI A108/A118/A136.1-2013.
 - .2 Ardex Canada 'FL Rapid Set, Flexible Sanded'.
 - .3 Flextile Ltd. '600'.
 - .4 Laticrete International Inc. '1500 Series' mixed with '1776 Grout Admix'.
 - .5 Mapei Corp. 'Keracolour S'.

- .6 TEC Specialty Products, Inc. 'AccuColour Premium Sanded'.
 - .7 or equivalent.
- .2 Unsanded, polymer-modified, latex-modified, non-shrink, ANSI A108/A118/A136.1-2013 and ANSI A108/A118/A136.1-2013.
 - .1 Ardex Canada 'FG-C Microtec (unsanded)'.
 - .2 Flextile Ltd. '500'.
 - .3 Laticrete International Inc. '1600 Series' mixed with '1776 Grout Admix'.
 - .4 Mapei Corp. 'Keracolor U'.
 - .5 TEC Specialty Products, Inc. 'AccuColour Premium Unsanded'.
 - .6 or equivalent.
- .3 Epoxy, to ANSI A108/A118/A136.1-2013.
 - .1 Ardex Canada 'WA Epoxy Grout and Adhesive'.
 - .2 Flextile Ltd. '100 Flex-Epoxy 100% Solids Epoxy Grout'.
 - .3 Laticrete International Inc. 'SpectraLOCK™ PRO Grout'.
 - .4 Mapei Corp. 'Kerapoxy' and Kerapoxy CQ'.
 - .5 TEC Specialty Products, Inc. '100% Solids Epoxy Mortar and Grout'.
 - .6 or equivalent.
- .4 Scratch coat (by volume): 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail. Premixed mortar may be used in accordance with manufacturer's instructions. Adjust water volume depending on moisture content of sand to obtain consistency and workability.
- .5 Slurry bond coat: mix Portland cement and water to a creamy paste consistency. Include latex additive where required by TTMAC Detail.
- .6 Mortar bed for walls (by volume): 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail. Premixed mortar may be used in accordance with manufacturer's instructions. Adjust water volume depending on moisture content of sand to obtain consistency and workability.
- .7 Leveling coat (by volume): 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail. Premixed mortar may be used in accordance with manufacturer's instructions.
- .8 Mortar bed for floors; where applicable: 1 part cement, 4 parts sand, 1 part water. Water volume may be adjusted depending on water content of sand.

2.4 ACCESSORIES

- .1 Waterproofing membrane: in accordance with Section 07 13 26.
- .2 Cleavage membrane: 0.11 mm (0.004") thick polyethylene film, to CAN/CGSB 51.34 - M86 (amended 1988).

- .3 Reinforcing wire fabric: galvanized welded wire fabric, 50 mm (2") x 50 mm (2"), WO.3 x WO.3 (16 ASW gauge or 1.6 mm (0.0625") diameter, to ASTM A1064/A1064M-15 and ASTM A1064/A1064M-15, except for minimum wire size.
- .4 Sealant: to CAN/CGSB 25.20-95 and tile and grout manufacturers' recommendations, colour selected by the Consultant.
- .5 Shower Thresholds: white carrera, 19 mm (3/4") thick, beveled edges two sides, honed finish on exposed surfaces, size to suit opening and frame width.
- .6 Transition strips: purpose made metal extrusion, anodized aluminum.
- .7 Reducer strips: purpose made extrusions, anodized aluminum, maximum slope of 1:2.
- .8 Prefabricated movement joints: purpose made, having a Shore A Hardness of not less than 60 and elasticity of $\pm 40\%$ when used in accordance with TTMAC Detail 301EJ- 2002.
- .9 Floor sealer and protective coating: to tile and grout manufacturers' recommendations.
- .10 Water vapour reduction system:
 - .1 100% solids epoxy one coat system, 0 VOC, suitable for application to 100% RH floors per ASTM F2170-11, designed to protect moisture sensitive adhered flooring systems from elevated moisture and alkalinity levels, warranted by manufacturer to cover subsequent flooring materials and labour, compatible with finish flooring products.
 - .2 ASTM E96/E96M-10 water vapour transmission (wet methods) performance shall be documented by independent testing laboratory at a minimum 97% for water vapour transmission reduction compared to untreated concrete.
 - .3 ASTM E96/E96M-10 perm rating shall not exceed a 0.10 Perm rating.
 - .4 ASTM D1308-02(2013) insensitivity to alkaline environment up to, and including, pH 14 in a 14 day bath test.
 - .5 Manufacturer certifies acceptance and exposure to continuous topical water exposure after final cure.
 - .6 Water vapour reduction system shall be a single coat, stand alone system with no requirements for additional components such as sand broadcast for adhesion of flooring systems.
 - .7 System shall reduce Calcium Chloride readings of up to 25lbs/1000 ft²/24 hrs by 97% in one coat. System must be able to perform as required with RH Probe readings of 100%.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Ensure compatibility of Products supplied under this section, and which bear contact with substrate.
- .2 Before work of this section commences, examine the areas to be covered and report any flaw or adverse conditions in writing to the Contractor and the Consultant. Do not proceed with the tilework until surfaces and conditions comply with the requirements indicated in the manufacturer's instructions and in ANSI A108/A118/A136.1-2013) specification.
- .3 Miscalibrated tiles, tiles with chipped corners, tiles with holes, will not be accepted for installation.

- .4 Carefully inspect the tiles for colour variation. Tiles presenting noticeable variations shall be carefully selected, set aside and used in areas where they fit in the pattern homogeneously. Provide for appropriate lighting equipment in addition to existing lighting in the immediate area where the installation is being performed so that any shade differences which are normally very slight can be identified easily.

3.2 PREPARATION

.1 Water vapour reduction system:

- .1 Where concrete substrate exhibits higher than permitted moisture and alkalinity levels, provide water vapour reduction system to protect moisture sensitive flooring system from elevated moisture and alkalinity levels.
 - .1 Shot blast floors to an International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) #3 or #4 and clean surfaces with an industrial vacuum cleaner and remove residues from the substrate. Grinding is allowed only in areas not accessible by shot blasting. Remove defective materials, and foreign matter such as dust, adhesives, levelling compounds, paint, dirt, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, and other deleterious substances. Repair cracks, expansion joints, control joints, and open surface honeycombs and fill in accordance with water vapour reduction system manufacturer's recommendations.
 - .2 Reinforcing fibres, if applicable, that are visible after shot blasting shall be removed and vacuumed leaving no fibres left on the concrete surfaces.
 - .3 Repair concrete prior to moisture vapour reduction system installation by using water vapour reduction system manufacturer's recommended bonding emulsion with approved concrete repair materials. Comply with requirements as listed in water vapour reduction system manufacturer's technical data information. Consult with vapour reduction manufacturer.
 - .4 Shot blast a small test area and review surface profile with the finished flooring applicator. As the water vapour reduction system is not a levelling material, provide feather finish or levelling material to "flatten" or level the water vapour reduction system treated concrete prior to the flooring installation.
 - .5 Apply moisture vapour reduction system monolithically to manufacturer's recommended spreading rate in number of coats to achieve manufacturer's recommended thickness.
 - .6 Consult with vapour reduction manufacturer and comply with requirements as listed in water vapour reduction system manufacturer's technical data information.
 - .7 Review surface profile with the finished flooring applicator. As the water vapour reduction system is not a levelling material, provide feather finish or levelling material to "flatten" or level the water vapour reduction system treated concrete prior to the flooring installation. Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.
 - .8 Verify proper adhesion of flooring adhesives, coatings, and levelling compounds to the final vapour reduction coating system for acceptability.

- .9 Do not proceed with finished flooring installation if moisture vapour transmission exceeds maximum permitted rates.
- .2 Wall surfaces:
 - .1 Roughen surfaces with previously painted glossy finishes by sandpaper or other abrasive medium, and completely remove finishes which are not compatible with products specified under this section.
 - .2 Completely remove contaminants and deleterious substances and debris which may prevent, reduce, and affect adhesion or performance or may act as bond breaker.
 - .3 Prime gypsum, wood or porous concrete with primer, brush or roller applied at full strength in accordance with adhesive manufacturer's recommendations.
- .3 Floor surfaces:
 - .1 Completely remove contaminants and deleterious substances and debris which may prevent, reduce, and affect adhesion or performance or may act as bond breaker.
 - .2 Concrete shall be minimum of 120 days old.
- .4 Wire brush steel substrates to remove deleterious substances and rust, to promote full adhesion to steel.

3.3 MIXING

- .1 Mix mortars, additives and grouts in accordance with manufacturer's requirements.
- .2 Rotating blade mechanical mixer: Pour latex additive, start mixer and add sand first, followed by Portland cement. Mix no mortar in same mixer as a dissimilar type of mortar unless the mixer is first thoroughly washed clean.
- .3 Pail batch mixing with low revolution drill mixers as follows:
 - .1 Premix separately prior to adding to the latex additive.
 - .2 Pour latex additive into clean mixing vessel and add dry materials slowly while mixing into a homogeneous and smooth consistency.

3.4 INSTALLATION - GENERAL

- .1 Install products in accordance with manufacturer's specifications and as indicated herein.
- .2 Install in accordance with TTMAC Specification Guide 09 30 00 Tile Installation Manual 2012-2014, except where specified otherwise.
- .3 Install in accordance with ANSI A108/A118/A136.1-2013 and ANSI A108/A118/A136.1- 2013.
- .4 Lay out tile work as indicated on drawings, and where lay-out not indicated, lay-out tiles so tiles less than 1/2 the least dimension do not occur and with minimum amount of cutting.
- .5 Make joints even, straight, plumb and of uniform width.
- .6 Provide uniform positive slope to floor drains, to minimum allowable slope of 20 mm/m (1/4 inch/ft).

- .7 Provide edge protection at tile edges and corners, unless otherwise indicated, using maximum length pieces.
- .8 Provide edge protection and transition strips at tile transitions, unless otherwise indicated, using maximum length pieces.
- .9 Lap tile at inside corners and seal around doors. Apply sealant in accordance with Section 07 92 00 and manufacturer's instructions. Sealant colour to later selection by the Consultant.
- .10 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.
- .11 Review locations of tile accessories with the Consultant prior to setting tile and comply with directions of the Consultant

3.5 SETTING

- .1 Using a damp towel, wipe off the back side of floor tile to remove any dust or other residue that may be left over from the manufacturing process.
- .2 Place as much tile as possible in one operation before setting bed reaches initial set. Clean back and remove bed when it has set before tile is laid.
- .3 Prime materials and by methods specified by manufacturer of bond coat.
- .4 Line up joints between tile installed on stairs from tread to tread.
- .5 Except where tiles have setting tabs, and except for expansion, control and isolation joints, maintain joint widths as selected by the Consultant.
- .6 Back up tile coves, curbs and other shaped pieces solid with mortar. Rigidly set, reinforce or otherwise make firm and secure such pieces.
- .7 Beat tiles in thoroughly and sufficiently to cause mortar ribs or notches to come together into a continuous void free bed and allow the mortar to flow up partially into the joint space to maximum of 1/3 the thickness of the tile. Sound floor tiles by tapping and reset all tiles with voids in setting bed.
- .8 Tile shall contact setting materials for minimum of 95% coverage.
- .9 Obtain 100% mortar coverage with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108/A118/A136.1-2013 series of tile installation standards for the following:
 - .1 Tile in wet areas:
 - .2 Tile installed with chemical resistant mortars and grouts.
 - .3 Tile having tiles 300 mm (12") or larger in any direction.
 - .4 Tile having tiles with raised or textured backs.
 - .5 Tile having tile installation rated for Heavy or Extra Heavy Duty.
 - .6 Porcelain tiles with more than 20% of the tile backs covered with firing release dust back buttered so that 100% of the back is covered with adhesive mortar rated for C627, Extra Heavy Duty rating.

- .10 Remove any excess setting material from the joint area so that 2/3 of the depth of the tile is available for grouting.
- .11 Remove smudges or smears of setting material from the tile surface with a damp sponge or cloth immediately after final adjustment and beat-in while the mortar is fresh.
- .12 Do necessary cutting and drilling of fixtures, fittings, and built-in or penetrating units without marring the tile. Replace all cracked or damaged tile.
- .13 Form external angles with round edge tile extending over edge of square edge adjacent tile. Internal angles shall be formed square, carrying 1 flat tile past edge of other.
- .14 Extend tile into recesses at windows, doors, or other openings.
- .15 Extend tiles 100 mm (4") behind mirrors, and fully behind cabinets, cupboards and other fixed objects at walls.
- .16 Cut tiles to conform to irregularities in wall lines and vertical planes along outer edges. Smooth cut edges with carborundum block or by other means to provide clean straight edge.
- .17 At floor drains in mortar bed: Provide minimum setting bed of 10 mm (3/8"), sloped to drain at 6 mm (1/4") in 305 mm (12").

3.6 WATERPROOFING MEMBRANE INSTALLATION

- .1 Install waterproofing membrane in shower areas in accordance with manufacturer's instructions and Section 07 13 26.

3.7 CRACK SUPPRESSION MEMBRANE (CRACK ISOLATION MEMBRANE) INSTALLATION

- .1 Install membrane in accordance with manufacturer's instructions.
- .2 Prepare substrate in accordance with manufacturer's instructions.
- .3 Install crack suppression membrane to substrates for tile flooring installations located on suspended structural floor assemblies. Treat substrate with full coverage of crack isolation membrane and reinforcement in accordance with crack isolation membrane manufacturer's installation instructions.

3.8 MORTAR-BED TILING

- .1 Verify 25 mm (1") nominal bed thickness has been allowed. Apply latex-Portland cement thin bed mortar with flat trowel as a slurry bond coat approximately 1.5 mm (1/16") thick over clean concrete slab in compliance with current revision of ANSI A108/A118/A136.1-2013 (A-1 through A-3; A-4.1a.5.2).
- .2 Place latex-Portland cement thick bed mortar over slurry bond coat while bond coat is wet and tacky. Omit reinforcing wire fabric and fully compact bed by tamping.
- .3 Spread latex-Portland cement thin bed mortar with flat trowel over surface of "green"/fresh mortar bed as a slurry bond coat approximately 1.5 mm (1/16") thick.

- .4 Apply latex-Portland cement thin bed mortar slurry bond coat to back of tile or threshold and place each piece/sheet while slurry bond coats are wet and tacky. Beat with a hardwood block or rubber mallet to level/imbed pieces before mortar bed takes initial set.
- .5 Clean excess mortar/adhesive from finished surfaces.
- .6 For installation of tile over cured (pre-floated) latex-Portland cement thick bed mortar, follow Thin Bed Method.

3.9 THIN-SET METHOD

- .1 Install thin-set mortar in compliance with current revisions of ANSI A108/A118/A136.1- 2013) (A-1 through A-3) and ANSI A108/A118/A136.1-2013) (A-4.3).
- .2 Use the appropriate trowel notch size to ensure full bedding of the tile.
- .3 Work thin-set mortar into good contact with the substrate and comb with notched side of trowel.
- .4 Beat each piece/sheet into the thin-set mortar with a beating block or rubber mallet to insure full bedding and flatness.
- .5 Allow installation to set until firm.
- .6 Clean excess thin-set mortar from tile face and joints between pieces.
- .7 Do not cover, bridge or fill tile joints located over expansion joints with adhesive.

3.10 CONTROL JOINTS

- .1 Carry substrate control and movements joints through to tile work.
- .2 Install control joints around the perimeter of tiled areas, around columns and where tile abuts other hard materials, also incorporate control joints over all building expansion joints.
- .3 Cut tiles or stones on both sides along the edges of control or expansion joints.
- .4 Provide control joints equal to width of interior tile joints in floors and walls at perimeters of floor and within 4800 mm to 6100 mm (16 ft to 20 ft) centre to centre by raking out joints to full depth of tile and cleaning joints for application of sealant in accordance with Section 07 92 00. In areas subject to sunlight or exposed to exterior provide control joints within 2400 mm to 3500 mm (8 ft to 12 ft) centre to centre.
- .1 Review locations with the Consultant prior to setting tile and comply with instruction given by Consultant.

3.11 GROUTING OR POINTING

- .1 Install grout to comply with ANSI A108/A118/A136.1-2013 and ANSI A108/A118/A136.1- 2013) unless otherwise specified and in accordance with manufacturer's printed instructions.
- .2 Allow tile installation to cure a minimum of 24 hours at ambient temperature of 21°C prior to grouting.
- .3 Verify grout joints are free of dirt, debris, water or tile spacers and face of tiles are clean

- .4 Apply grout release to face of absorptive, abrasive, non-slip or rough textured tile units that are not hot paraffin coated to facilitate cleaning.
- .5 Spread using a sharp edged, hard rubber float and work grout into joints using 45° diagonal strokes.
- .6 Pack joints full and free of voids/pits. Stroke diagonally to remove excess grout and to avoid pulling grout out of filled joints.
- .7 Once excess grout is removed, begin cleaning grout haze before grout is fully cured. Using a circular motion, lightly scrub grouted surfaces with the damp sponge to dissolve grout film/haze. Drag sponge diagonally over scrubbed surfaces to remove froth. Rinse sponge frequently and change rinse water at least every 2 m² (200 ft²). Repeat cleaning sequence again if grout haze is still present.
- .8 Allow grout joints to become firm. Buff surface of grout with clean coarse cloth. Inspect joint for pinholes/voids and repair them with freshly mixed grout. Within 24 hours, check for remaining haze and remove it with warm soapy water and a nylon scrubbing pad, using a circular motion, to lightly scrub surfaces and dissolve haze/film.
- .9 Chemical resistant, water cleanable tile-grouting epoxy (ANSI A108/A118/A136.1-2013):
 - .1 Install chemical epoxy resistant grout in compliance with current revisions of ANSI A108/A118/A136.1-2013 and ANSI A108/A118/A136.1-2013.
 - .2 Once excess grout is removed, begin cleaning grout haze approximately 20-30 minutes after grouting depending on temperature. Using a circular motion, lightly scrub grouted surfaces with the damp sponge to dissolve grout film/haze. Drag sponge diagonally over scrubbed surfaces to remove froth. Rinse sponge frequently and change cleaning solution at least every 4.7 m² (50 ft²).
 - .3 Within 1 hour of finishing first cleaning, clean the same area again following the same procedure but utilizing a clean white scrub pad and fresh cleaning solution. Rinse scrub pad frequently. Drag a clean sponge diagonally over scrubbed surfaces to remove froth. Use each side of sponge only once before rinsing and change cleaning solution at least every 4.7 m² (50 ft²). Allow cleaned areas to dry and inspect tile surface. Rinse with clean water and allow surface to dry. Inspect grout joint for pinholes/voids and repair them with freshly mixed grout.
- .10 Grout joint width to be 1.5 mm (1/16") unless otherwise indicated in the Contract Documents.
- .11 Grout joint width to be 3.2 mm (1/8") unless otherwise indicated in the Contract Documents.
- .12 Use caution when using sanded grouts to prevent scratching of tile or other material surfaces.
- .13 Do not cover bridge or fill any expansion joints in tile with grout.
- .14 Do not cover bridge or fill any expansion joints in tile with grout.

3.12 INSTALLATION TOLERANCES

- .1 Maximum allowable lippage:
 - .1 Tile up to 152 mm x 152 mm (6" x 6") in size: 0.79 mm (1/32").
 - .2 Tile greater than 152 mm x 152 mm (6" x 6") in size: 1.5 mm (1/16").
- .2 Finish planes shall be straight and plumb to within 6 mm in 3 m (1/4" in 10 feet).

3.13 ADJUSTING AND CLEANING

- .1 Clean installed tile surfaces after grouting has cured.
- .2 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.
- .3 Prohibit traffic during installation and for minimum 48 hours after installation.
- .4 Protect floors from impact and vibration for a minimum of 48 hours after installation.
- .5 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Acoustical tile ceiling systems.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination
 - .2 Cooperate with mechanical and electrical Subcontractors.
- .1 Coordinate layout and installation of acoustic ceiling units and suspension systems components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, partition system, fire suppression system components and other work required to be incorporated in or coordinated with the ceiling system.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit manufacturer's standard details.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, and acoustical unit support at ceiling fixture.
 - .3 Submit reflected ceiling plans for special grid patterns as indicated.
- .4 Samples:
 - .1 Submit sample of each component of ceiling system. Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
 - .2 Submit samples, load test data and design tables for each type of insert to be used in the Work for hanger supports.
- .5 Certificates:
 - .1 Submit certificate of compliance stating that the suspension system provided, including materials and installation, comply with the requirements of the Contract Documents.

1.4 CLOSEOUT SUBMITTALS:

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Maintenance data:

- .2 Submit maintenance and cleaning instructions for acoustical ceiling systems for incorporation into the maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver for maintenance use, 2% of each type and colour of suspension components and acoustical tiles used in the Work.
 - .2 Pack panels in suitable containers, clearly dated and identified as to type and location of installation in the Work, and store where directed by Owner.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Provide work of this section, executed by competent installers with a minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Mock-ups:
 - .1 Construct in locations acceptable to the Consultant a typical sample ceiling installation 10 m2 in area, complete with perimeter wall trim, and cut tegular tile demonstrating rectified edge. Modify sample as directed and as required to obtain approval. Upon acceptance retain sample as standard of quality for acoustical ceiling.
 - .2 Do not begin fabrication and erection of remainder of ceiling system until sample installation has been reviewed and accepted. Accepted sample may become a part of the final Work, subject of approval of the Consultant.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Ship exposed members and mouldings in rigid crates to avoid damage. Bent or deformed material shall be rejected. Baked enamelled members shall be suitably wrapped and protected against damage.
- .2 Deliver acoustical ceiling units to the Place of the Work in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.
- .4 Handle acoustical ceiling units carefully to avoid chipping edges or damaging units.

1.7 FIELD CONDITIONS

- .1 Commence installation after building is enclosed with windows and exterior doors in place and glazed, and roof watertight.
- .2 Interior temperature of building to range from 15°C to 30°C and relative humidity of not more than 70% before and during installation. Maintain uniform temperatures for 72 hours prior to

commencement of the work of this section and maintain temperature until completion of the work of this Section.

PART 2– PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Design suspension systems for a maximum mid-span deflection not exceeding L/360 in accordance with ASTM C635/C635M-13a deflection test.
- .2 Design suspension system to support safely, and without distortion, the superimposed loads of:
 - .1 Air supply diffusers and return grilles.
 - .2 Lighting fixtures.

2.2 GENERAL

- .1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the work of this section shall be from same production run.

2.3 ACOUSTICAL TILES

- .1 ACT-1; Lay-in acoustical tiles:
 - .1 Classification: Type III, Form 2, Pattern C E in accordance with ASTM E1264- 08e1.
 - .2 Size: 600 mm x 1200 mm x 15 mm.
 - .3 NRC: 0.50.
 - .4 Material: wet formed mineral fibre.
 - .5 Surface texture: Fine.
 - .6 Edge: Square.
 - .7 Colour: White.
 - .8 Flame Spread: Class A Flame Spread 25 or under, to CAN/ULC S102.
 - .9 Acceptable Products:
 - .10 Armstrong World Industries 'Dune Square Lay-in 1773M' or equivalent.

2.4 METAL SUSPENSION SYSTEMS

- .1 Hanger anchorage devices: Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.

- .2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, a load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M-15, conducted by a qualified independent testing laboratory.
- .1 ITW Ramset Dynabolt Sleeve Anchor 'TW-1614' or Readi-Tie-Drive 'TD4-112' tie wire anchor by ITW Construction Products Canada or equivalent.
- .2 Kwik-Bolt II 'HCKB 1/4' tie wire anchor by Hilti Corporation or equivalent.
- .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .3 Hangers and tie wire: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm (0.1") (12 gauge).
- .4 Suspension system accessories:
 - .1 Splices, clips, and perimeter moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified in the Contract Documents.
 - .2 Angle wall mouldings; hemmed with prefinished exposed flanges:
 - .1 For 24 mm (15/16") grid applications; angle moulding with exposed bottom flange of 22 mm (7/8").
 - .1 Armstrong World Industries '7803' or equivalent.
 - .2 CGC Inc. 'M7' or equivalent.
- .5 Standard suspension system, non fire-rated:
 - .1 Intermediate duty to ASTM C635/C635M-13a, 24 mm (15/16") interlocking tee system, designed to support acoustical panels in patterns indicated with deflection of main tees less than L/360, consisting of main tees and cross tees. The system shall provide lock joint intersections of cross and main tees.
 - .2 Acceptable Products:
 - .1 Armstrong World Industries 'Prelude XL 15/16" Exposed Tee Systems'.
 - .2 CGC Inc. 'DX'.
 - .3 Or equivalent

2.5 MISCELLANEOUS MATERIALS

- .1 Acoustical sealant: Non-drying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant complying with requirements specified in Section 07 92 00.

2.6 METAL FINISH

- .1 Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing colour. Submit paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies. Colour shall be:
 - .1 Flat white.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with the Contract Documents, notify the Consultant before proceeding with installation.
- .2 Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.

3.2 INSTALLATION - SUSPENSION SYSTEM

- .1 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636 / C636M - 13, CISCA installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
- .2 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .3 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .4 Space hangers for ceilings at maximum 1220 mm (48") on centre in both directions. Provide additional hangers as required to comply with manufacturer's written installation instructions.
- .5 Locate hangers at not more than 150 mm (6") from ends of main tee members.
- .6 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .7 Exposed tees shall be as long as possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.
- .8 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .9 Cooperate in the installation of ceiling systems, making adjustments where required to ensure that the lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.
- .10 Restrict creep inside module panels so that in all cases strips are centred on module lines.
- .11 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.
 - .1 Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing mouldings.
 - .2 Screw attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system. Lap corners accurately and connect securely.

3.3 INSTALLATION - TILES

- .1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.

- .2 Minimize field cutting. Rectify cut tile edges of tile to match factory cut edge profile and colour.
- .3 Install acoustical tiles to form horizontal and level ceiling with all parts flush and joints butted tightly to hairline appearance.
- .4 Distribute variations in colour and texture of panels to obtain a uniform appearance.

3.4 INSTALLATION - TOLERANCES

- .1 Allowable tolerances: to ASTM C636 / C636M - 13.
- .2 Install suspension systems level to tolerance of 1:1200.
- .3 Install edge mouldings level to tolerance of 3 mm in 3660 mm (1/8" in 12'-0").

3.5 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

3.6 ADJUSTING AND CLEANING

- .1 Replace uneven, defective or damaged materials and finishes, eliminate waves, and remove soiled or stained areas.
- .2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

PART 1– GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Interior painting.
 - .2 Exterior painting.
- .2 Extent of Work
 - .1 Paint and finish "paintable" surfaces for area of the Work indicated in the Contract Documents except those exempt by the Contract Documents.
 - .2 The following surfaces are considered "non-paintable" for purposes of this Contract. Omit painter's finishes from following items:
 - .1 Material and equipment furnished completely prime and finish painted by manufacturer;
 - .2 Internal surfaces of steel tanks and stacks;
 - .3 Sprayed fire-resistant materials;
 - .4 Exterior concrete including building walls, building floors and pavements, except as otherwise scheduled.
 - .5 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered aluminum, monel metal;
 - .6 Exposed insulation, glass, plastic, brick, stone, resilient floors, treads and bases, tile and hardware;
 - .7 Prefinished metals, unless required to be colour coded.
 - .8 Metallic and mastic insulation finishes;
 - .9 Abrasive material finishes on floors, stair treads, stair nosings and landings;
 - .10 Insulated electric cables;
 - .11 Machined parts of machinery and equipment.
 - .12 Concealed surfaces.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data and list of Products:
 - .1 At least 60 days before the work of this section commences, submit name of paint manufacturer whose Products are proposed for use in the Work along with a complete list of Products intended for use in Work, prepared by paint manufacturer. Indicate manufacturer's official certification that Products listed thereon are the top quality made by the company unless otherwise indicated herein.

- .2 List shall indicate name of paint manufacturer, the catalogue number, grade, and quality of the Products proposed for use, and be correlated to the schedule furnished by the Consultant.
- .3 List shall be accompanied by manufacturer's Product data sheets for each Product listed.
- .4 Products delivered to the Place of the Work shall conform to the reviewed list of Products.
- .3 Samples:
 - .1 Submit samples of various finishes for the Consultant's approval, at least 30 days before materials are required.
 - .2 Sample surfaces:
 - .1 Use 50 mm (2") concrete block for finishes over concrete or concrete masonry surfaces.
 - .2 Use 3.2 mm (1/8") thick plate steel for finishes over metal surfaces.
 - .3 Use 12.7 mm (1/2") thick birch plywood for finishes over wood surfaces.
 - .4 Use 12.7 mm (1/2") gypsum board for finishes over gypsum board and other smooth surfaces.
 - .3 Where possible identify each sample as to Project, finish, formula, colour name, number, sheen name and gloss values, date and name of the Contractor and painting Subcontractor.
 - .4 Resubmit as required until colours and gloss value are approved.
- .4 Colours:
 - .1 Prior to beginning painting work, Contractor will be furnished with paint colour numbers and copies of colour schedule for surfaces to be painted. Colours will be selected by the Consultant.
- .5 Master Painters Institute (MPI) Architectural Painting Specification Manual (MPI Manual):
 - .1 Submit 1 copy of MPI Manual – latest edition, and maintain at site office for reference.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials
 - .1 Provide two sealed containers, each of four litres (one gallon) capacity of each paint product in each colour used in the work for the Owner's maintenance use. Containers shall be new, clearly labelled with manufacturer's name, type of paint, colour and colour number. Store at the Place of the Work where directed by the Owner.

1.4 QUALITY ASSURANCE

.1 Qualifications

.1 Installers / applicators / erectors:

- .1 Applicators shall have minimum of 5 years proven satisfactory painting experience of projects of similar size and class subject to the Consultant's approval.

.2 Mock-ups:

- .1 Provide full finished mock-up installation of each paint colour, for indicated surfaces and mock-up size, showing colour and finish selected by the Consultant, under lighting conditions matching final area lighting, for acceptance by the Consultant. Locate at the Place of the Work as part of finished installation if accepted.

- .1 Concrete block, concrete and gypsum board: 9.3 m² (100 ft²).
- .2 Hollow metal doors and frames: 1 door and frame for each finish specified.
- .3 Site painted structural steel.

- .2 Upon completion and approval, sample finishes shall serve as a standard for the balance of the work of this section. Subsequent work carried out and not in the Consultant's opinion equal to the standard shall be repainted without charge.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to the Place of the Work in sealed original containers with labels intact and store in space directed by Consultant. Keep stored materials covered at all times. The presence of any unauthorized material or containers for such at the Place of the Work shall be sufficient cause for rejection of all paint materials at the Place of the Work at that time.
- .2 Exercise extreme caution in the storage of materials to prevent fire or that may create fire hazards. Thinners and solvents shall be stored in CSA approved metal safety containers in accordance with governing fire and safety regulations.
- .3 In areas of storage protect floor and wall surfaces from paint drips. Protect floors with sheets or clean plywood or metal pans where mixing is being carried out. Provide and maintain fire extinguishers, accessible in storage and mixing areas.
- .4 Leave storage areas clean and free from evidence of occupancy when these are required for intended use.
- .5 Keep waste rags in metal drums containing water and remove from the Place of the Work at the end of each Working Day.
- .6 Provide labels on each container, correlated to the reviewed list of Products, with the following information
 - .1 Name of title of Product.
 - .2 Manufacturer's stock number.
 - .3 Manufacturer's name.
 - .4 Contents by volume, for major pigment and vehicle constituents.
 - .5 Thinning instructions.
 - .6 Application instructions.

1.6 FIELD CONDITIONS

- .1 Comply with environmental requirements of MPI Manual.
- .2 Areas shall be clean and dust free before painting is commenced.
- .3 Make thorough examination of the complete the Contract Documents to determine intent, extent, materials, types of surfaces, and locations requiring painting and be fully cognizant of requirements.
- .4 Use sufficient clean drop cloths and protective coverings for full protection of floors, furnishings and work not being painted. Protect mechanical, electrical and special equipment and all other components of building which do not require painting from paint spotting and other soiling during painting process. Mask adjoining work adjacent to work being painted or carefully cut in without overlaps. Clean surfaces soiled by spillage of paint and paint spatters. If cleaning operations damage the surface, repair or replace damaged work without cost to the Owner.
- .5 Do not paint over dust, rust, scale, grease, moisture, scuffed surfaces or conditions otherwise detrimental to the formation of a durable paint film.
- .6 Be responsible for damage to the work of this section until the building is complete and accepted by the Consultant. In cases of damage, surfaces shall be cleaned and repainted to the Consultant's approval.
- .7 Do not paint exterior surfaces at temperatures below 10°C for latex products and below 10°C for solvent based products, nor in rainy conditions or high humidity (maximum relative humidity shall be 85%). Avoid applying paint to surfaces when exposed to direct sunlight. Do not paint interior surfaces at temperatures under 10°C, nor on surfaces where condensation has or will form due to presence of high humidity and lack of proper ventilation.
- .8 Provide ventilation to remove odours, evaporating solvents and moisture.
- .9 Check moisture content of surfaces to be painted using electronic moisture meter approved by paint manufacturer, and the Consultant, or other approved method. Maximum moisture contents shall be in accordance with manufacturer's recommendations and as follows:
 - .1 Concrete and concrete masonry: Maximum 12% to 14% for solvent coatings, and as recommended by manufacturer for water based coatings.
 - .2 Gypsum board and plaster: Maximum 12% to 14%.
 - .3 Wood: Maximum 15%.

1.7 EXTENDED WARRANTY

- .1 Warrant work of this, in accordance with Section 01 78 36.
- .2 Throughout the warranty period, painting systems shall remain free from failure due to causes including: material failure; surface preparation less than that specified; and paint film thickness less than that specified, or when not specified, less than that coverage recommended by manufacturer.
- .3 Presence of any of following during the warranty period shall constitute failure: visible corrosion; film peeling, blistering, checking, scaling, embrittling or general film disintegration; and poor adhesion as determined by tape "peel-off" test procedures.

PART 2 - PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Except where more stringent requirements are specified, the following reference standard shall govern the work of this section:
 - .1 Master Painters Institute (MPI) Architectural Painting Specification Manual (MPI Manual), including Identifiers, Evaluation, Systems, Preparation and Approved Product List, latest edition, and referenced herein as the MPI Manual, as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
 - .2 CAN/CGSB 85.100 Painting.
 - .3 Materials, preparation and workmanship shall conform to requirements of latest edition of Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

2.2 MATERIALS

- .1 Acceptable Products:
 - .1 Products by ICI Paints, Benjamin Moore Co. Ltd., Sherwin-Williams Co., or Pratt & Lambert Ltd. shall be used in the Work or equivalent.
 - .2 Paints and coatings materials used within the weatherproofing system shall not exceed the VOC content limits of the following criteria.
 - .1 Interior paints and coatings: to following Green Seal GS-11 VOC limits:
 - .1 Flat coating type: 50 gm/L.
 - .2 Non-flat coating type: 100 gm/L.
 - .2 Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Green Seal Standard GC-03, Anti-Corrosive Paints.
 - .3 Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings
 - .3 Paint and finishing materials shall be highest grade, manufacturer's first line quality (not "Contractor's" first line).
 - .4 Paint and coating materials for each system shall be Products of a single manufacturer.
 - .5 Provide safe and adequate equipment, scaffolding, ladders, plant, tools, brushes, rollers, clean drop cloths and other items required for the completion of the work.
 - .6 Undercoatings and primers shall be made for the purpose by the manufacturer of the finishing materials being used, or as approved by same.
 - .7 Brushes, rollers, and the like shall be the best of their respective kinds, clean and suitable for the work.
 - .8 Joint sealants: in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.
- .2 Check surfaces with electric moisture meter and do not proceed if reading is higher than 12-15% or as otherwise required by paint or coating manufacturer.
- .3 Check surfaces to determine if pH of surfaces meet manufacturer's requirements.
- .4 Inspect surfaces to be coated for gouges, marks, nibs, and other defects and properly prepare patching, filling, smoothing or other surface preparation necessary to ensure satisfactory finish.
- .5 Report in writing any condition adversely affecting this work.
- .6 Proceed with work only when surfaces and conditions are satisfactory. Remove dust, grease, rust, scale and extraneous matter, tool and machine marks and insects from all surfaces which could be detrimental to a satisfactory and acceptable finish.

3.2 PREPARATION

- .1 Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- .2 Prepare existing surfaces to be repainted in accordance with Article 6.2 of CAN/CGSB 85.100-93.
- .3 Clean floors, adjacent surfaces and surfaces to be painted before work is commenced.
- .4 Before commencement of work, remove electric plates, surface hardware, canopies of lighting fixtures, and other escutcheons and appurtenances. Mask adjacent items that are not removable. Replace items removed, when paint is dry and clean them. Use cleaning methods that will not damage finish.
- .5 Use sufficient drop cloths and protective coverings for the full protection of work not to be painted or coated.
- .6 Keep waste rags in covered metal drums containing water and remove from building at end of each day.
- .7 Shut down motors, fans, and mechanical ventilation systems during spray painting. Shut down air intakes in affected areas and ventilate to exterior, when applying noxious smelling or VOC containing paints and coatings.
- .8 Exposed concrete and concrete block walls which are scheduled to be painted or sealed shall not be painted or sealed until the sealant has been applied at control joints and joints with hollow metal frames.
- .9 Materials shall be thoroughly mixed before application and applied without cutting or admixture except as indicated in writing by the manufacturer.
- .10 Metal:
 - .1 Clean unpainted and shop primed metal to provide satisfactory surfaces to receive overcoats and provide permanent adhesion of coatings. Remove rust and scale with emery paper and wire brushes. Prime bare metal, make good shop primed metal where abraded,

feather out edges to make touch-up patches inconspicuous. Thoroughly clean metal surfaces including piping and ductwork of oil and grease with mineral spirits.

- .2 Remove loose paint and scale from shop primed metal work.

.11 Concrete and Masonry:

- .1 Thoroughly clean form oil, parting compounds, curing compounds and other incompatible materials from concrete surfaces.
- .2 Thoroughly clean masonry and concrete surfaces to be painted free of mortar droppings, concrete spotter and extraneous matter.
- .3 Check concrete and masonry surfaces to be painted for alkalinity with pink litmus paper or other recognized method. Where extreme alkalinity occurs (6.8 - 8.0 range) wash surface with tetra potassium solution where latex base paint is to be used and with zinc sulphate solution where oil base paints are to be used. Rinse with clean water and allow to dry thoroughly prior to application of primer.

.12 Gypsum Board:

- .1 Ensure that gypsum board joints are smooth and board is clean and free of jointing compound spatter.
- .2 Test surfaces for alkalinity with pink litmus paper or other recognized method.

.13 Metal Surfaces; Galvanized:

- .1 Apply cold phosphate surface treatment to SSPC-PT2-82 to unpassivated zinc-coated metal.
- .2 For passivated zinc-coated metal ("white rusted"), power wire brush or vigorously hand wire brush to scuff galvanize thoroughly, and solvent clean to SSPC-SP1- 82.
- .3 Prepare exterior exposed galvanized steel and galvanized steel at wet areas to SSPC-SP7 – Sweep Blast.

.14 Woodwork:

- .1 Sand, wipe off dust and grit before prime coat application. Putty nail holes and minimal cracks after primer has dried; sand between primer and top coats with No. 300 sandpaper and remove dust.

3.3 APPLICATION - PRIMERS

- .1 Completely prime surfaces of exterior wood to receive paints or coatings.
- .2 Apply primer coats to steel and galvanized steel surfaces that have and have not received shop coat or primer.
- .3 Finish and back prime wood components prior to their installation.
- .4 When primer sealer is dry, touch up visible suction spots before the next coat is applied and do not proceed with the work until suction spots are sealed.
- .5 Use high-build type primer/sealers at glass mat finished gypsum board substrate.

3.4 INSTALLATION

- .1 Apply to surfaces scheduled to be finished. Apply materials in accordance with manufacturer's printed directions.
- .2 Paint and coating finishes shall be free of defects in materials and workmanship affecting appearance and performance. Defects shall include but not be limited to improper cleaning and preparation of surfaces, entrapped dust and dirt, alligators, blisters, peeling, drips, runs, uneven coverage, misses, poor cutting in, improper use or application of materials.
- .3 Paint shall be applied by means of brushes, except for wall and ceiling surfaces that shall be applied by rollers or spray application. Apply varnish by brush. Apply stain by wiping.
- .4 Consultant shall have the right to prohibit the use of spray painting for such reasons during application as carelessness, poor masking or protective measures, drifting paint fog, disturbance to other trades or failure to obtain a dense even opaque finish.
- .5 Apply coats only when the previous coat is dry/cured, in accordance with manufacturer's printed installation instructions.
- .6 Apply materials evenly, in full coats free from brush and roller marks, sags, runs, crawls, ridges, and other defects. Completed paint or coating shall be uniform in finish, sheen, colour, and texture.
- .7 Areas exhibiting incomplete or unsatisfactory coverage shall have the entire plane painted. Where cutting and patching work has been performed, shall have the entire plane painted. Patching will not be acceptable.
- .8 Permit paint to dry before applying succeeding coats, touch up suction spots and prepare previous coats in accordance with manufacturer's printed instructions. Remove dust of sanding.
- .9 Arrange to have traffic barred from completed areas wherever possible or provide adequate protection to prevent contamination of paints or coatings with foreign substances.
- .10 Tint filler to match wood to receive clear finishes, where filler is required. Work filler well into grain and before it has set wipe excess from surface.
- .11 Prime woodwork designed for painting as soon as possible after woodwork is delivered to site. Prime surfaces of such woodwork, exposed and semi-exposed, before installation. Back-prime woodwork indicated to receive transparent finish with 1 coat of specified transparent finish reduced 25%.
- .12 Sand semi-gloss, medium and high gloss finishes lightly between coats. Sand and dust between each coat to remove defects visible from distance of 1.5 m (5 ft).
- .13 Reseal cut edges of wood doors and seal unfinished tops and bottoms of wood doors with 3 coats polyurethane sealer.
- .14 Finishes and number of coats indicated are the minimum required. Apply further coats until complete uniform coverage is achieved to suit paint products and colours.
- .15 Priming coat shall be colour toned lighter than second coat and the second coat shall be toned lighter than finish coat. Only the finish coat shall match the colour of the accepted samples.
- .16 Paint inside surfaces of light coves white unless otherwise indicated in the Contract Documents.
- .17 Grilles and perforated items shall be spray painted. Do not block perforations and apply evenly to present consistent appearance free from defects visible from distance of 1.5 m (5 ft)

- .18 Do not apply paints and coating over fire rating labels.
- .19 Do not apply paints and coatings over identification labels on mechanical and electrical equipment.
- .20 Paint removable and operable items, such as access panels and doors, grilles, and similar items, while the item is removed or open, so as to not create a paint seal at the juncture of the opening or removable item and its fixed frame or substrate.
- .21 Keep sprinkler heads, fire detection equipment, and smoke detection equipment free of paint.
- .22 Repaint existing surfaces and finishes where scheduled, where alterations or renovations have been carried out, and where surfaces have been disturbed by the alterations or renovations. Repaint surfaces entirely between changes of plane.
- .23 Paint both sides and edges of plywood backboards for equipment before installation.

3.5 MECHANICAL AND ELECTRICAL ITEMS

- .1 Finish paint primed mechanical and electrical items with 2 coats of paint. Include for the following list unless otherwise indicated in the Contract Documents:
 - .1 Conduit
 - .2 Ductwork
 - .3 Hangers
 - .4 Stacks
 - .5 Vents
- .2 Prime and paint exposed insulated and bare pipes. Prime and paint exposed conduits and electrical raceways, fittings, outlet boxes, junction boxes, pull boxes and similar items. Use heat resistant epoxy paint on pipes and surfaces where operating surface temperature exceeds 65°C.
- .3 Coordinate the painting of pipes, and coverings with mechanical contractor applying colour banding, flow arrows and pipe identification after the painting of pipes and coverings.
- .4 Paint work to match adjacent walls and ceilings unless directed otherwise.
- .5 Paint interior surfaces of air ducts and pipe trenches including heating pipes and elements that are visible through grilles and louvres with one coat of flat metal paint to limit of sight-line. Paint to be black or white as directed by the Consultant.
- .6 Gas pipes, whether concealed or exposed, shall be painted in yellow-orange colour, in accordance with gas code.
- .7 Paint fire protection piping for sprinklers with self priming rust paint, Para Paint colour 1133 Red in the following locations:
 - .1 Apparatus bays.
 - .2 Utility room.
 - .3 Generator room.
 - .4 Elsewhere where exposed.

.8 Paint gas piping with self priming rust paint, yellow colour in the following locations:

- .1 Apparatus bays.
- .2 Utility room.
- .3 Generator room.
- .4 Elsewhere where exposed.

3.6 FIELD QUALITY CONTROL

.1 Field quality control shall be in accordance with Section 01 45 00, as supplemented herein.

3.7 PATCHING

- .1 Do retouching to ensure that the work is handed over to the Owner in proper condition, free of runs, spatter, finger marks, rust, watermarks, scratches, blemishes or other disfiguration, with full, even coverage.
- .2 After fully painting, retouching and finishing a room or area, notify the Consultant. After review and acceptance by the Consultant, post sign "Painting Complete - No Admittance Without Permission".

3.8 ADJUSTING AND CLEANING

- .1 Promptly as the work proceeds and on completion of the work, remove paint where spilled, splashed or spattered during the progress of the work keep the premises free from unnecessary accumulation of tools, equipment, surplus materials and debris; at the conclusion of the work leave the premises clean.

3.9 SCHEDULES

- .1 Finish Schedule:
 - .1 Assume full responsibility for painting and varnishing of all materials of the contract exposed in the finished work which do not already have finished surfaces and that normally require paint or varnish finish. Inspect surfaces over which the work of this section is dependent for unevenness, cracks, surface defects, moisture, cleanliness, roughness and other irregularities detrimental to the application and performance of the work. Confirm conditions satisfactory before proceeding. Failure in complying with above or failure to have unsatisfactory conditions corrected before proceeding, shall not relieve the Contractor of responsibility for required results.
 - .2 Exposed means visible in complete work including interiors of cupboards and closets, tops of doors, trim, and the like, whether in sight line or not, including behind surface mounted fixtures and heating units.
 - .3 In instances where materials specified are not suitable for particular application or are contrary to manufacturer's recommendations for use on particular surface, immediately bring to attention of the Consultant for clarification and instructions.

- .4 Where finishing formula for surfaces requiring paint is not specified, follow recommendations of MPI Manual as follows:
 - .1 Interior painting: Custom Grade.
 - .2 Exterior painting: Custom Grade.
- .5 The Consultant shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to the Owner.
- .6 Unless otherwise noted or scheduled in the Contract Documents, walls shall be painted the same colour within a given area.
- .7 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces in terms of colour, texture and sheen, unless otherwise indicated.
- .2 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 maximum
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 minimum
G5	Semi-Gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

3.10 SCHEDULE - INTERIOR FINISHES

- .1 System references listed are based on MPI Manual and are Custom Grade, Low VOC (Green Seal GS-11), unless otherwise indicated in the Contract Documents:
 - .1 Formula 1: for concrete block walls, except those noted for PWF:
 - .1 One coat latex block filler.
 - .2 Two coats latex semi-gloss.
 - .2 Formula 2: for concrete block walls noted to receive PWF gloss finish coat:
 - .1 One coat latex block filler.
 - .2 Two coats high build epoxy coating.
 - .3 Formula 3; for gypsum board walls apply:
 - .1 One coat latex primer sealer.
 - .2 Two coats latex semi-gloss.
 - .4 Formula 4: for gypsum board ceilings apply:
 - .1 One coat latex primer sealer.

- .2 Two coats latex semi-gloss.
- .5 Formula 5: for wood to receive paint finish apply:
 - .1 One coat stain blocking/adhesion promoting primer (waterborne).
 - .2 Two coats latex semi-gloss.
- .6 Formula 6: for primed ferrous metal surfaces apply:
 - .1 One coat latex dryfall.
 - .2 High traffic surfaces – custom system:
 - .1 One coat high performance primer (waterborne).
 - .2 Two coats latex S/G.
- .7 Formula 7: for galvanized and zinc coated metal apply:
 - .1 One coat galvanized primer (waterborne).
 - .2 Two coats latex S/G.
 - .3 For ceiling and ductwork areas apply:
 - .1 One coat galvanized primer (waterborne).
 - .2 One coat latex dryfall.
- .8 Formula 8: for woodwork to receive stained finish apply custom system:
 - .1 One coat stain.
 - .2 Three coats waterborne polyurethane clear.
- .9 Formula 9: for woodwork to receive natural finish apply:
 - .1 Three coats waterborne polyurethane clear.
- .10 Formula 10: for insulation covering apply:
 - .1 One coat latex primer sealer.
 - .2 Two coats latex S/G.

3.11 SCHEDULE - EXTERIOR FINISHES

- .1 System references listed are based on MPI Manual and are Custom Grade, unless otherwise indicated in the Contract Documents:
 - .1 Formula 11 (Alkyd): for pavement markings (parking lines and symbols) on asphalt concrete pavement:
 - .1 Alkyd traffic paint, number of coats according to manufacturer's recommendations.
 - .2 Formula 12 (Alkyd): for shop primed ferrous exterior metal surfaces noted for paint, apply:
 - .1 Touch-up with shop primer as provided by fabricator.
 - .2 One coat oil alkyd metal primer.
 - .3 Two coats exterior alkyd enamel.

- .3 Formula 13 (Alkyd): for galvanized and zinc coated exterior metal surfaces noted for paint:
 - .1 One coat cementitious primer.
 - .2 Two coats exterior alkyd enamel.

3.12 SCHEDULE – COLOURS

- .1 Refer to the Drawings for painting color and location.
- .2 All exposed Steel shall be painted. The Contractor to confirm color with the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Tackboards.
 - .2 Marker boards (whiteboards).
 - .3 Related trim, adhesives, and fastenings.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show proposed system of anchorage and materials being supplied on shop drawings submitted for review.
 - .2 Show dimensional layouts, hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.
- .4 Samples:
 - .1 Submit 305 mm x 305 mm (12" x 12") samples of each Product specified, diagonally cut to show cross section through assembly, complete with accessories and trim.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Erection of materials to be carried out by competent workers supervised by a foreperson with at least 10 years experience in this specialized field and approved in writing by manufacturer for installation of their Product.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Package Products to prevent distortion in shipment and handling. Label and protect finish surfaces by sturdy wrappings.

1.6 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 10 years.

PART 2 - PRODUCTS

2.1 DESIGN/PERFORMANCE REQUIREMENTS

- .1 Trademarks and Labels
 - .1 No trademarks or labels will be accepted on exposed finished work.

2.2 TACKBOARDS

- .1 Krommenie cork tackboard: 12.7 mm (1/2") factory prelaminated consisting of 6 mm (1/4") thick Forbo 'Bulletin Board' linoleum cork laminated to 6 mm (1/4") particle board substrate under mechanical pressure in maximum panel sizes of 1219 mm x 2438 mm (4'-0" x 8'-0"). Bonding of materials by a waterproof adhesive that will not delaminate or rupture at the contact surfaces.
 - .1 Colour of tackboard to be selected by the Consultant from manufacturer's standard colour range.
- .2 Acceptable manufacturers:
 - .1 Architectural School Products (a.s.p.).
 - .2 Delta Products Ltd.
 - .3 Or equivalent.

2.3 MARKER BOARDS (WHITEBOARDS)

- .1 Porcelain enamel board with porcelain enamel writing surface on 0.8 mm (.03") (22 gauge) high quality enameling steel base, 11.1 mm (0.44") impregnated fibreboard core and 0.4 mm (0.02") (28 gauge) stretcher levelled zinc coated back sheet. Writing surface and back sheet laminated in one piece under mechanical or hydraulic pressure to core.
 - .1 White colour writing surface, designed for long lasting heavy duty marker writing surface, free of permanent marker staining.
 - .2 Joints shall be absolutely flush and level, plumb true with edges finished square and fitted as closely as possible. Concealed mechanical joining system: integral, slotted, PVC insert laminated into ends of panels and 25 mm (1") wide, 2 mm (0.08") thick, galvanized steel spline.
 - .3 Particle board backing to CAN3-0188.1-M78, 6 mm (1/4") thick, with sanded faces.

- .4 Porcelain writing surface: 0.076 mm (0.003") thick porcelain enamel to Porcelain Enamel Institute Standards PEI 104. Gloss factor: 6-8 as measured by 45° glossmeter.
- .5 Aluminum trim: in accordance with Trim Components paragraph below.
- .6 Acceptable manufacturers:
 - .1 Architectural School Products (a.s.p.).
 - .2 Delta Products Ltd.
 - .3 Global School Products Inc.
 - .4 Or approved equivalent.
- .7 Skydesign 'Vitracolor Magnetic Markerglass'.
- .8 Substitutions: In accordance with Section 01 25 00.
- .9 Dimensions: Refer to the Drawings.
- .10 Options:
 - .1 Use screws of galvanized steel.

2.4 TRIM COMPONENTS

- .1 Extruded aluminum components, AA6063 T5.
- .2 Tackboards:
 - .1 Aluminum trim and accessories:
 - .1 Perimeter: a.s.p. No. 505. or equivalent.
- .3 Marker boards:
 - .1 Acceptable Products:
 - .1 Perimeter: a.s.p. No. 505.
 - .2 Chalktray: a.s.p. No. 521.
 - .3 Or equivalent.

2.5 FASTENINGS

- .1 Reinforcing anchor plates to be galvanized steel plates conforming to CSA G4-09(2014).
- .2 Use screws, bolts of galvanized steel or aluminum.
- .3 Ferrous metal not specified must be plated or baked enamel and treated with primer conforming to CAN/CGSB 1.140-M91.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Prior to commencement of erection, check surfaces for irregularities, trueness and rigidity and projections and defects and immediately report in writing to the Contractor.
- .2 Commencing installation implies acceptance of surface conditions.

3.2 INSTALLATION - TACKBOARDS

- .1 Secured from behind and mounted in accordance with manufacturer's written instructions to satisfaction of the Consultant.
- .2 Install secure, plumb and square.
- .3 Secure wall brackets to blocking in stud walls, or with zinc plated metal expansion type anchors at masonry back-up.
- .4 Locate seams as directed by the Consultant.

3.3 INSTALLATION –MARKER BOARDS

- .1 Install in accordance with manufacturer's written installation instructions.
- .2 Secure wall brackets to blocking in stud walls, or with zinc plated metal expansion type anchors at masonry back-up.
- .3 Join panels together by use of 14 gauge x 25.4 mm (1") wide steel spline and extruded polyvinyl slotted insert for flush butt joints, with a hairline appearance.
- .4 Locate seams as directed by the Consultant.

3.4 INSTALLATION – TRIM COMPONENTS

- .1 Install in accordance with manufacturer's written installation instructions.
- .2 Attach aluminum trim, where applicable, in such a manner that fastenings shall be concealed. Fastening shall be accomplished by the use of #10 x 25.4 mm (1") steel wood screws with rawl plugs, attached to walls.
- .3 Leave trim and surfaces clean and free of stains or marks and completely cover finished surfaces with "Pliofilm" immediately after installation and remove only at time of final inspection.

3.5 INSTALLATION TOLERANCES

- .1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:
 - .1 Plumb and level: 3 mm (1/8").
- .2 Variation from indicated position: plus/minus 3 mm (1/8").

3.6 ADJUSTING AND CLEANING

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Do not remove protective coatings until final cleaning, or earlier if directed by the Consultant.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at Place of the Work only if approved.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Headrail braced metal toilet compartment (partitions).
 - .2 Wall mounted urinal screens.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show the proposed system of anchorage and materials being supplied on shop drawings submitted for review.
 - .2 Show hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.
- .4 Samples:
 - .1 Submit 3 samples of each colour of panel and samples of hardware items, and a typical base mounted sample of a pilaster and shoe.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 The work of this section shall be performed by a Subcontractor who is regularly engaged in the assembly and installation of toilet compartments. Subcontractor shall demonstrate to the acceptance of the Consultant, that they have successfully performed on comparable projects over the previous 5 years.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Cover exposed stainless steel surfaces with protective masking.

1.6 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- .1 Hadrian Manufacturing Inc.
- .2 Shanahan's Manufacturing Limited.
- .3 Global Partitions – Watrous Inc.
- .4 Or equivalent

2.2 TOILET COMPARTMENT STYLE

- .1 Compartment style:
 - .1 Headrail braced metal toilet compartment.

2.3 URINAL SCREEN STYLE

- .1 Wall mounted urinal screens.

2.4 MATERIALS

- .1 Sheet steel: zinc coated steel, Galvanneal to ASTM A653/A653M-11 GR33, in following base steel thicknesses:
 - .1 Doors and panels: 0.8 mm (0.03") (22 gauge).
 - .2 Urinal screens: 0.8 mm (0.03") (22 gauge).
 - .3 Pilasters: 1.2 mm (0.05") (18 gauge).
- .2 Headrail; for floor mounted headrail braced partitions: 25 mm x 41 mm (1" x 1.625") extruded anodized aluminum with anti-grip design. Wall thickness to be 1.5 mm (0.060") and shall be securely attached to wall and pilasters with manufacturer's fittings. Make joints at pilaster location.
- .3 Pilasters: 32 mm (1-1/4") die formed stainless steel.
- .4 Fastenings: Chrome plated type.
- .5 Core: Honeycomb type, minimum compressive strength 213 kPa (31 psi), minimum cell size 25 mm (1").

.6 Hardware:

- .1 General: Hardware shall be heavy duty, chrome plated, non-ferrous metal castings in a high gloss finish. Chrome finish shall be high gloss uniform finish without discolourations, pits, marks or any other visual defects.
 - .2 Hinges: concealed casting, adjustable 15° door-open angle, self-lubricating, non- rising return movement.
 - .3 Latch set: Emergency entry built in, combination latch, door stop, keeper and bumper. Provide lever type thumbturn at barrier free stalls.
 - .4 Wall and connecting brackets: Either continuous formed type or patch type metal to match finish of hinges.
 - .5 Coat hook: Combination coat hook and door keeper matching design of hinges with a neoprene rubber bumper.
 - .6 Provide style and material matching door pulls for out-swinging doors.
 - .7 Exposed fasteners: Chrome plated screws and bolts of same material as hardware item being secured. Threaded inserts and T-nuts are acceptable for composite core construction.
 - .8 Concealed fasteners: Corrosion resistant zinc plated screws or bolts.
- .7 Steel finish: Epoxy powder or enamel coated, alkali resistant paint finish shall have successfully passed ASTM B117-11. Colour of finish to later selection by Consultant from the manufacturer's full range of colours.

2.5 FABRICATION

- .1 Fabricate toilet partitions doors, urinal screens and compartments to layout dimensions shown.
 - .1 At headrail braced floor mounted partitions, construct partitions to measure 1780 mm (70") to top of doors and side panels, and approximately 318 mm (12.5") between finished floor and bottoms of doors and side panels.
- .2 Fabricate doors, panels, urinal screens and pilasters of sheet steel cemented under pressure to core material. Make pilasters 32 mm (1-1/4") thick; all other doors and panels, 25 mm (1") thick. Use only plywood cores for pilasters and panels on which grab bars are mounted.
- .3 Provide formed edges on doors, panels and pilasters. Weld edges together and seal with continuous oval crown locking strips with corners mitred, welded and ground smooth.
- .4 Provide heavy duty adjustable anchoring device at floor of each pilaster to rigidly secure in place. Anchoring device shall permit vertical adjustment of pilaster. Use minimum 10 mm x 178 mm (0.375" x 7") stud with expansion insert anchoring system.
- .5 Conceal and protect floor fastening with die formed stainless steel pilaster shoe cap, complete with concealed hold-in-place clips. Exposed screws are not to be permitted.
- .6 Reinforce doors, panels and pilasters to accept hardware, tissue holders and fittings.
- .7 Reinforce pilasters and doors of barrier free cubicles to support the wider door without deformation.
- .8 Shop Finishing:

- .1 Clean and phosphatize steel components.
- .2 Continuously finish coat to manufacturer's standards, to smooth hard finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - .1 Maximum Clearances:
 - .1 Pilasters and Panels: 12.7 mm (1/2").
 - .2 Panels and Walls: 25.4 mm (1").
 - .2 Stirrup brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
 - .1 Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - .2 Align brackets at pilasters with brackets at walls.
 - .3 Overhead-braced units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 45 mm (1-3/4") into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
 - .4 Urinal screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.
 - .5 Install hardware components and enclosures with fastenings and screws to manufacturer's standard. Attach panel and pilasters to brackets with through type sleeve bolt and nut.
 - .6 Erect enclosures accurately to dimensions shown, plumbing securely, and anchoring in position. Hang doors, adjust hinges to perform as specified. Re-check doors for emergency feature. Tighten pilaster shoes.
 - .7 Make good finished surfaces damaged during shipment or installation.
 - .8 Install system to be free of rattles and reverberations during normal usage.

3.2 ADJUSTING AND CLEANING

- .1 Hardware adjustment:
 - .1 Adjust hardware so that latches operate smoothly and without binding. Lubricate hardware if required by Supplier's instructions.
 - .2 Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
- .2 Clean exposed surfaces using materials and methods recommended by manufacturer. Provide protection during remainder of construction period.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Corner guards.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Samples:
 - .1 Submit 3 samples, 300 mm (12") long or 300 x 300 mm (12 x 12") in size as applicable, for each Product in specified finish.
- .3 Shop drawings:
 - .1 Submit shop drawings, and colour and finish samples for work of this section in accordance with Section 01 33 00.
 - .2 Clearly indicate fabrication details, plans, elevations, hardware, and installation details.
- .4 Templates:
 - .1 The Contractor shall ensure that their Subcontractors submit templates for use by installers and fabricators as required for proper location and installation of hardware.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Package or crate, and brace Products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.
- .2 The Contractor shall ensure that their Subcontractors deliver Products to location at the Place of the Work.

PART 2- PRODUCTS

2.1 GENERAL

- .1 Incorporate reinforcing, fastenings and anchorage required for building-in of Products.
- .2 Heights of corner guards are to be full wall heights.

2.2 CORNER GUARD PROTECTION

- .1 Surface mounted, 90 mm x 90 mm (3.5" x 3.5"), 1.3 mm thick (0.05") (16 gauge) stainless steel angle in accordance with ASTM A276-15(2015), Type 304, AISI No. 4 satin finish, radius edge.
 - .1 Acceptable Products: Construction Specialties Acrovyn Model CO-8 or equivalent.

PART 3- EXECUTION

3.1 INSTALLATION

- .1 Install work to meet manufacturer's recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .2 Clean substrates to remove dirt, debris and loose particles prior to installation.
- .3 Fit joints and junction between components tightly and in true planes.
- .4 Install units on solid backing as indicated, and erect with materials and components straight, tight and in alignment.
- .5 Corner guards:
 - .1 Corner guard edges shall be smooth.
 - .2 Mechanically fasten corner guards in accordance with guard manufacturer's written instructions.
 - .3 Install corner guard shall be tightly fitted without gaps.
 - .4 Heights of corner guards: 1500 mm above finish floor.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Washroom accessories.
 - .2 Janitor room accessories.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit duplicate samples of each finish specified.
- .4 Shop drawings:
 - .1 Clearly indicate fabrication details, plans, elevations, hardware, and installation details.
- .5 Templates:
 - .1 The Contractor shall ensure that their Subcontractors submit templates for use by their installers and fabricators as required for proper location and installation of hardware.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.
- .2 The Contractor shall ensure that their Subcontractors deliver products to location at the Place of the Work

PART 2 - PRODUCTS

2.1 ACCESSORIES

- .1 Incorporate reinforcing, fastenings and anchorage required for building-in of Products.
- .2 Specified manufacturer's catalogue references are the minimum acceptable standards for work of this section. Where two manufacturers or Products are specified for a given accessory, select one or the other for installation in the Work, but not both.
 - .1 Acceptable product manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - .1 ASI Watrous Inc.
 - .2 Bobrick Washroom Equipment, Inc.

- .3 Swish Maintenance Ltd.
 - .4 Uline Canada
 - .5 Frost Products Ltd.
 - .6 Or equivalent
- .3 Lettering: for identification of accessories and operation instructions shall be silk screened using international symbols unless otherwise specified.
- .4 Washroom Accessory Schedule; locations as indicated or scheduled in Contract Documents.
Exact locations determined by the Consultant:
- .1 Stainless steel hat and coat hook:
 - .1 Shall be Bobrick Washroom Equipment of Canada Ltd. B-6827 Hat and Coat Hook or equivalent.
 - .2 Grab bars:
 - .1 Horizontal: 38mm diameter stainless steel grab bars with concealed mounting and peened gripping surface as manufactured by Bobrick Washroom Equipment of Canada Ltd. or equivalent.
 - .2 L-shaped: 38mm diameter stainless steel grab bars with concealed mounting and peened gripping surface as manufactured by Bobrick Washroom Equipment of Canada Ltd. or equivalent. Grab bars to have 900mm long horizontal and vertical components.
 - .3 130 mm diameter stainless steel grab bars with concealed mounting and peened gripping surface, Model B-5806.99x24 as manufactured by Bobrick Washroom Equipment of Canada Ltd. or equivalent.
 - .4 290 degree grab bar, model B-816722.99 as manufactured by Bobrick Washroom Equipment of Canada Ltd. or equivalent.
 - .3 Surface-mounted shelves:
 - .1 Surface Mounted Stainless Steel Shelf, model B-295x18, as manufactured by Bobrick Washroom Equipment of Canada Ltd. or equivalent. Refer to the Drawings for locations.
 - .4 Tilt mirrors: Tilt Mirror with Stainless Steel Frame, 1170 wide and 1170 High, as manufactured by Bobrick Washroom Equipment of Canada Ltd. or equivalent.
 - .5 Soap Dispenser: Swish Maintenance Ltd - GOJO FMX12 Foam Dispenser Grey 1250ml
 - .6 Towel Dispenser: Swish Maintenance Ltd Hands-Free Roll Tower Dispenser – 772CG
 - .7 Toilet Tissue Dispenser: Swish Maintenance Ltd Wagon Wheel 4 Roll Toilet Tissue Dispenser – 884
 - .8 Recessed Soap Holder:
 - .1 Bobrick Washroom Equipment of Canada Ltd. B-4380 Recessed Heavy-Duty Soap Dish or equivalent.
 - .9 Recessed Shampoo Holder:
 - .1 WetStyle DC Collection NC 14 Shampoo Holder, 356x356 or equivalent.

- .10 Folding shower seat:
 - .1 Bobrick Washroom Equipment of Canada Ltd. B-5191 Folding Shower Seat or equivalent.
- .11 Shower rod and curtain:
 - .1 American Standard 1204-C Rod & 1200-V Curtain or equivalent.

2.2 FABRICATION

- .1 Fabricate Products with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that washroom accessories will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Supply manufacturer's handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with Products specified in this section in order that they function as intended.
- .2 Install work to meet manufacturers' recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .3 Include reinforcing, anchorage and mounting devices required for the installation of each Product.
- .4 Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.

3.2 BARRIER FREE INSTALLATION HEIGHTS

- .1 Install accessories to permit operable parts and controls to be accessed at 1100 mm (43") maximum above finished floor, unless otherwise indicated.

3.3 INSTALLATION OF WASHROOM ACCESSORIES

- .1 Install and secure fixtures rigidly in place using expansion shields in solid masonry or concrete, toggle bolts in hollow masonry or sheet metal screws at metal studs.
- .2 Insulate surfaces to prevent electrolytic action due to contact with dissimilar metals, or concrete or masonry if required. Use bituminous paint or other approved means.
- .3 Install in accordance with manufacturer's installation instructions, on built-in concealed solid backing materials. Grab bar installation shall be able to withstand 250 kg downward force.
- .4 Verify locations and mounting heights with the Consultant before roughing-in.
- .5 Install plumb, level, straight, tight and secured, centred between joints on masonry and tile walls.

3.4 INSTALLATION TOLERANCES

- .1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: 3 mm (1/8").

3.5 ADJUSTING AND CLEANING

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation. Test mechanisms, hinges, locks, and latches and adjust and lubricate to ensure washroom accessories are in perfect working order.
- .2 Do not remove protective coatings until final cleaning, or earlier if directed by the Consultant.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at Place of the Work only if approved.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Prefinished metal lockers.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Indicate thicknesses of metal, fabricating methods, assembled banks of lockers, bases, trim, numbering, filler panels, end panels, and sloped tops.
- .4 Samples:
 - .1 Submit sample of colour and finish on actual base metal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Lockers: to CAN/CGSB 44.40-2001 AMEND.
 - .1 Type: Single tier full-height locker.
 - .2 Size (width x depth x height): 457 mm wide x 610 mm deep x 1830 mm high.
 - .3 Locking system: suitable for padlocks.
 - .4 Metal materials: to ASTM A1008/A1008M-15, free of imperfections.
 - .5 Frame: 1.6 mm (0.06") thick (16 gauge).
 - .6 Door: minimum 2.0 mm (0.07") 20 gauge outer panel and 24 gauge liner, hollow core or honeycomb.
 - .7 Shelves: minimum 0.6 mm (0.02") thick (24 gauge)
 - .8 Hooks: three single prong coat hooks.
 - .9 Coat Rods for each locker
 - .10 Jamb Trim: Refer to detail on drawings. Top trim and side trim.
 - .11 Body: minimum 0.6 mm (0.02") thick (24 gauge).
 - .12 Filler and end panels: minimum 2.0 mm (0.07") 20 gauge
 - .13 Base: manufacturer standard base.

- .14 Number plates shall be inset into the chrome-plated door pull and numbered sequentially, in two sets each starting at "1" for each locker Type as directed by the Consultant.
- .15 Locker finish; exposed and semi-exposed surfaces: baked on polymer powder or alkyd enamel, custom colour to later selection by the Consultant.
- .16 Acceptable manufacturers/Products:
 - .1 General Storage Systems Ltd.: 'Decor Tri-Lok'.
 - .2 Hadrian Manufacturing Inc.: 'Emperor Lockers'.
 - .3 Shanahan's Manufacturing: 'Deluxe Lockers'.
 - .4 Or equivalent.

PART 3- EXECUTION

3.1 INSTALLATION

- .1 Assemble and install lockers complete with metal base in accordance with manufacturer's printed installation instructions.
- .2 Securely fasten at least every third locker through to wall studs, masonry or concrete substrate.
- .3 Install trim and filler panels where required for continuous appearance and where obstructions occur. Specific conditions as indicated in Contract Documents.
- .4 Install finished end panels to exposed ends of locker banks.

3.2 INSTALLATION TOLERANCES

- .1 Install plumb, level, tight and secured. Comply with the following tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: plus/minus 3 mm (1/8").

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Ground-set flagpoles.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination
 - .1 Coordinate with work of other sections to ensure satisfactory and expeditious completion of the work of this section.

1.3 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products and equipment proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Indicate dimensions, finishes, base jointing, anchoring and support systems, cleats, halyard boxes, trucks, finials and base collar for flagpoles.
- .4 Samples:
 - .1 Submit duplicate samples of each finish specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- .1 Ewing Flagpole Co. Inc.
- .2 Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- .1 Aluminum: Aluminum Association alloy AA 6063-T6 seamless extruded aluminum tubing.
- .2 Flagpole; cone tapered: seamless, uniform, straight line tapered section above cylindrical butt section.
 - .1 Height above mounting base:
 - .1 12192 mm (40'-0")
 - .2 Flagpole, bases and anchorage devices, complete with flag to resist minimum wind gust velocity of:
 - .1 145 km/h (90 ml/h)
 - .3 Acceptable Product:
 - .1 Flagpole; Ewing Flagploe's 'SCA-40NS2' Architectural Series.
 - .1 Base: Ewing Flagpoles Co. Inc. 'B5 Fixed'.
 - .2 Halyard: Ewing Flagpoles Co. Inc. 'External' System'.
 - .2 Substitutions: Refer to Section 01 25 00.
 - .4 Finish: Clear anodized to AA Designation AA-M12C22A31.
- .3 Finial; ball: ball of 1.6 mm (3/5") minimum thick, gold colour, 150 mm (6"), spun from aluminum with watertight seams and mounted to rod fitted to revolving truck.
- .4 Cleats: 230 mm (9") size, 2 per halyard, cast aluminum finish to match flagpole.
- .5 Halyard; internal: stainless steel gearless winch, mounted inside flagpole shaft, accessible by removable locking access door, self-locking winch, lockable at any point operable with a removable crank handle through access hole in shaft. Stainless steel cabling throughout, routed through shaft interior and wound on winch.
- .6 Swivel snaps: 2 per halyard; aluminum with neoprene or vinyl covers.
- .7 Cleat box: one per cleat; cast aluminum finish to match flagpole. Furnish hasp for padlock, hinged cover, and tamperproof screws. Include lockable cleat box.
- .8 Base cover: spun aluminum base cover, finish to match flagpole.
- .9 Lightning protection:
 - .1 Copper-plated steel with copper wire bolted to flagpole with stainless steel bolt and galvanized steel washer to insulate cable lug from flagpole.
 - .2 Steel ground spike welded to baseplate is an acceptable alternative.
- .10 Concrete base: under work of Section 32 13 13.

2.3 ALUMINUM FINISHES

- .1 Finish exposed surfaces of aluminum components:
 - .1 Clear anodized to AA Designation AA-M12C22A31.

2.4 FABRICATION

- .1 Supply flagpole as complete unit including mounting brackets anchorage and fittings.
- .2 Fabricate mountings of same metal as flagpoles where exposed and of galvanized steel where concealed.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Submit manufacturer's information and templates required for installation of work of this section, and assist or supervise, or both, the setting of anchorage devices, and construction of other Work incorporated with Products specified in this section in order that they function and perform as intended.
- .2 Install flagpoles, mounting brackets and fittings to reviewed shop drawings and manufacturer's written instructions.
- .3 Check and adjust installed fittings for smooth operation of halyards.
- .4 Provide ground stakes, for positive lightning ground for each ground set flagpole installation.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Roller window sun shades at interior locations.
 - .2 Roller window room darkening (black-out) shades at interior locations.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit manufacturers' installation instructions.
- .3 Shop drawings:
 - .1 Submit shop drawings or fully dimensioned catalogue cuts.
 - .2 Window treatment schedule: Use same designations indicated on the Contract Documents.
 - .3 Clearly indicate general construction, configurations, jointing methods and locations, fastening methods, handing of controls, required blocking locations, banding (tandem shades), and installation details.
- .4 Samples:
 - .1 Submit samples of each material and finish colour selected and each accessory.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Company specializing in manufacturing the Products specified in this section, with a minimum of 10 years' experience.
 - .2 Installers / applicators / erectors:

- .1 Work of this section shall be by forces in the direct employ or under control of the system manufacturer, skilled, trained, and experienced in work of similar scope and complexity.
- .2 Mock-ups:
 - .1 Erect 1 full size mock-up each roller shade type at the Place of the Work for review. Completed and accepted mock-up shall act as the standard to which balance of the work of this section will be judged.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Before delivery to the Place of the Work, check each shade for operation; remove finger marks and smudges.
- .2 Package Products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

1.6 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Subject to compliance with requirements, provide products by one of the following manufacturers:
 - .1 MechoShade Systems, Inc.
 - .2 Solarfective Products Ltd.
 - .3 SunProject Inc.
 - .4 Sun Glow
 - .5 Substitutions: in accordance with Section 01 25 00.

2.2 HARDWARE – MANUAL CONTROLLED SHADES

- .1 Chain operated, with infinite positioning. Left or right hand operation and banding as applicable to suit Place of the Work condition.
 - .1 Drive assembly:
 - .1 Must allow finger tip control and include a built in shock absorber system to prevent chain breakage under normal operating conditions;
 - .2 Factory set for the size and travel of the shades;
 - .3 Capable of being field adjusted from the exterior of the shade unit without having to disassemble the hardware.

- .4 Drive Chain: No. 10 stainless steel bead chain formed in a continuous loop. The chain shall have passed a 40 kg (90 lb) load test. Chain may be positioned at either, or both, ends of the shade without disassembly of the shade unit.
- .5 Provide counter balancing mechanism designed to offset the weight of the shade and give fingertip control.
- .2 Control shades and room darkening shades independently.

2.3 ASSEMBLY

- .1 Provide fully factory assembled shade unit consisting of 2 shade brackets, shade tube, extruded aluminum fascia, hembar and fabric as specified.
- .2 Fabric shall hang straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
- .3 Factory modify housings where necessary to bypass columns.
- .4 End brackets: a two piece molded ABS construction with nylon drive sprocket. Bracket colour shall coordinate with the fascia colour.
- .5 Shade tube: Minimum 1.52 mm (0.060") thick extruded aluminum with three equally spaced continuous stiffening fins, non-sag design, maximum deflection under full load of fabric L/700.
- .6 Fascia: Minimum 1.5 mm (1/6") thick extruded aluminum.
- .7 Hembar: Extruded aluminum with matching plastic end finials.
- .8 Mounting: Removal of shade system shall not require the disassembly of the shade unit.
- .9 Room darkening shade features: 13 mm (1/2") pile mounted in prefinished 38 mm x 28 mm (1-1/2" x 1-1/8") extruded aluminum side and bottom channels finished to match mullions. Include Dynamic hembar to allow for variance in window sill level.

2.4 SHADE MOUNTING SYSTEM

- .1 Extruded aluminum bracket designed to accept preassembled shade system.
 - .1 Brackets to be used to facilitate the alignment with shade opening.
- .2 Modular construction: Shades must be removable as a complete modular unit without any component disassembly required.

2.5 ALUMINUM FINISH

- .1 Exposed aluminum: Clear anodized AA-M12C22A31.
- .2 Unexposed aluminum: mill finish.

2.6 SHADE FABRIC TYPES

- .1 Sun control fabric; dimensionally stable shade fabric:

- .1 Acceptable Products; 3% open area:
 - .1 Solarfective 'Solarblock 300 Series'. or equivalent.
- .2 Colour: as selected by Consultant from manufacturer's full range.
- .2 Room darkening (black-out) fabric; dimensionally stable fabrics:
 - .1 Acceptable Products:
 - .1 Solarfective Products Limited 'SolarStop Blackout Fabric'. or equivalent.
 - .2 Colour: as selected by Consultant from manufacturer's full range.
- .3 Performance: Fabric shall hang flat, without buckling or distortion. Edge, where trimmed, shall hang true and straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
- .4 Flammability:
 - .1 Certified by an independent Laboratory to pass CAN/ULC S109-03 Large Flame Test.

2.7 FABRICATION

- .1 Finished assemblies shall be, square, true to size and free from distortion, twist, or other defects that could affect their strength, operation or appearance. Factory applied finish shall be uniform, smooth and without blemishes.
- .2 The fabric shall be colour fast, retain its shape, not be affected by moisture or heat, and shall be non-flammable. Cut fabric to eliminate glare and reflection from shining surfaces while maintaining exterior view. The top of the fabric is retained in recessed spline of the shade roller and the bottom of the fabric is retained by the hem bar.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install shade systems in plumb, squared, adequately anchored, maintaining uniformed clearances, accurate alignment levels, and parallel with the window plane. Fabric shall not travel more than 3 mm (1/8") in either direction within channels after installation.
- .2 Fabric shall be pre-measured and manufactured off-site.
- .3 Shades shall be snapped into place without screws or visible fasteners.
- .4 Incorporate reinforcing, fastening and anchorage required for installation of shades.
- .5 Securely attach installation fittings to their mounting surfaces with stainless steel or hardened aluminum screws of proper length and type, and durable anchors.
- .6 Install shade roller true and level, and with cloth to hang flat without buckling or distortion.
- .7 Room darkening shades (black-out) to be installed to eliminate passage of light from exterior.

3.2 ADJUSTING AND CLEANING

- .1 Verify that installed shade system functions properly, and adjust it accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.

3.3 CLOSEOUT ACTIVITIES

- .1 Demonstration
 - .1 Before acceptance of system, arrange for demonstration of equipment with authorized representatives of the Owner, to be performed by representative of shade manufacturer to assure proper function, operation and explanation.
 - .2 Conduct comprehensive demonstration for the Owner's staff on operation and care of interior window treatments.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Entrance floor grilles.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Layout of floor grilles including grid and frame, direction of traffic, dimensions, fabrication details, splice locations, profiles, hardware, and accessories.
- .4 Samples:
 - .1 Submit duplicate samples of each finish and each insert specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Package or crate, and brace Products to prevent damage during shipment and handling. Label packages and crates, and protect finish surfaces from environmental conditions where required.

1.5 EXTENDED WARRANTY

- .2 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 C/S Group
- .2 McGill Architectural Products
- .3 Or equivalent.

2.2 FOOT GRILLES

- .1 Acceptable Products: McGill Architectural Products Model 'AG-200' or equivalent.
 - .1 Level base with deep style application, Type D frame, cross supports, hinges, and aluminum drainpan.
 - .2 Finish: standard mill finish.
 - .3 Substitutions: In accordance with Section 01 25 00.

2.3 FABRICATION

- .1 Fabricate products with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that foot grilles will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Do not proceed until unsatisfactory conditions have been corrected.
- .2 The Contractor shall ensure that the manufacturer offers assistance and guidance to provide a template of irregular shaped grid assemblies where applicable to ensure a proper installation.

3.2 INSTALLATION

- .1 Install the work of this section in accordance with the manufacturer's recommendations.
- .2 Mill finish frames in contact with concrete to be primer coated.
- .3 Set grid type at height recommended by manufacturer for most effective cleaning action.
- .4 Coordinate top of grid surfaces with bottom of doors that swing across to provide ample clearance between door and grid.
- .5 Install work to meet manufacturer's written specifications and installation instructions, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .6 Include reinforcing, anchorage and mounting devices required for the installation of each Product.
- .7 Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.
- .8 Back paint components where contact is made with building finishes to prevent electrolysis.

3.3 ADJUSTING AND CLEANING

- .1 Verify that installed Products function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.

END OF SECTION

1. **GENERAL**

1.1. **General Requirements**

1. Conform to the requirements stated in the Contract Documents including all addenda for the Work, including work outside the property line and work within Regional and Municipal right of way unless otherwise noted.

1.2. **Related Work**

- | | | |
|----|---------------------------------------|------------------|
| 1. | Site Grading | Section 31 23 13 |
| 2. | Excavation, Trenching and Backfilling | Section 31 23 10 |
| 3. | Granular Base | Section 32 11 23 |
| 4. | Granular Sub-Base | Section 32 11 19 |
| 5. | Asphalt Paving | Section 32 12 16 |

1.3. **References**

1. ASTM D4791-89, Test Method for Flat or Elongated Particles in Coarse Aggregate.
2. Ontario Provincial Standard Specification 1001.

1.4. **Samples**

1. Submit samples in accordance with Section 01 33 00.
2. Allow continual sampling by Consultant during production.
3. Provide Consultant with access to source and processed material for sampling.
4. Install sampling facilities at discharge end of production conveyor, to allow Consultant to obtain representative samples of items being produced. Stop conveyor belt when requested by Consultant to permit full cross section sampling.

2. **PRODUCTS**

2.1. **Materials**

1. Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
2. Flat and elongated particles of coarse aggregate: to ASTM D4791.
 1. Greatest dimension to exceed five times least dimension.
3. Fine aggregates satisfying requirements of applicable section to be one, or blend of following.
 1. Natural sand.
 2. Manufactured sand.
 3. Screenings produced in crushing of quarried rock, boulders or gravel.
4. Coarse aggregates satisfying requirements of applicable section to be one of or blend of the following:
 1. Crushed rock.
 2. Gravel and crushed gravel composed of naturally formed particles of stone.

2.2. Source Quality Control

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

3. EXECUTION

3.1. Preparation

1. Aggregate source preparation
 1. Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed by Consultant.
 2. Where clearing is required, leave screen of trees between cleared area and roadways as directed.
 3. Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
 4. When excavation is completed, dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
 5. Trim and dress slopes and leave site in neat condition.
2. Processing
 1. Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 2. Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Consultant.
 3. Wash aggregates to meet specifications. Use only approved equipment.
 4. When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
3. Handling
 1. Handle aggregates to avoid segregation, contamination and degradation.
4. Stockpiling
 1. Stockpile aggregates on site in locations as indicated unless directed otherwise by Consultant. Do not stockpile on completed surfaces.
 2. Stockpile aggregates in sufficient quantities to meet project schedules.
 3. Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support materials and handling equipment.

4. Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into work.
5. Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
6. Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Consultant within 48 h of rejection.
7. Stockpile materials in uniform layers of thickness as follows:
 1. Max. 1.5 m for coarse aggregate and base course materials.
 2. Max. 1.5 m for fine aggregate and sub-base materials.
 3. Max. 1.5 m for other materials.
8. Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
9. Do not cone piles or spill material over edges of piles.
10. Do not use conveying stackers.
11. During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.2. **Cleaning**

1. Leave aggregate stockpile site in tidy, well drained conditions, free of standing surface water.
2. Leave any unused aggregates in neat stockpiles as directed by Consultant.

END OF SECTION

PART 1- GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Excavation and backfilling for work in areas within building footprint.

1.2 SUBMITTALS

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Material test reports: For each material proposed for backfill as follows:

- .1 Classification according to ASTM D2487-11.
- .2 Laboratory compaction curve according to:
 - .1 Standard Proctor Maximum Dry Density (SPMDD): ASTM D698-12(2014) e1.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Granular A fill: OPSS 1010 - April 2004, Granular A.
- .2 Granular B fill: OPSS 1010 - April 2004, Granular B Type I or II.
- .3 Clear stone: OPSS 1004 - November 2006, Clear Stone, 19 mm (3/4") Type 1.
- .4 Crusher run limestone, 20 mm.
- .5 Native fill: Clean (meeting chemical criteria for residential land use), native soil, excavated at Place of the Work, as selected and approved by geotechnical engineer, free of organic material including roots and tree or shrub material, particles larger than 200 mm (8"), foreign or building debris, chemicals and infectious substances detrimental to plants, free of deleterious matter, and provided moisture content of fill is controlled and provided fill is capable of being compacted to required density.
- .6 Imported fill: fill material containing no organic material, foreign matter, roots, rocks over 100 mm (4") in diameter, building debris and toxic materials in accordance with OPSS 1010 - April 2004 and ASTM D2487-11. Demonstrate that such fill is compactable to a density of 98% of its Standard Proctor Maximum Dry Density, that it is maintained within 2% of optimum moisture content at time of compaction and meets chemical criteria for residential land use.
- .7 Moisture content of fill shall be within 2% of optimum moisture density test (ASTM D698-12(2014) e1).
- .8 Obtain fill materials from sources approved by geotechnical engineer. Submit reports for acceptance prior to importing fill.

PART 3 - EXECUTION

3.1 DEWATERING

- .1 Bail, pump out or divert water from excavations, from whatever cause, as it accumulates, and until the permanent drainage is operational and foundations are in place.

3.2 EXCAVATING

- .1 Excavate to elevations and dimensions required for installation, construction and inspection of the Work. Remove and dispose of waste, soil and like materials from the Place of the Work and pay dumping costs.
- .2 Removal of existing boulders and/or concrete elements up to a size of 1 m³ (3.28 ft³), encountered below existing grade while excavating, are included as part of the Work.
- .3 Notify Consultant at each time of occurrence when existing boulders and/or concrete elements greater than 1 m³ are encountered below existing grade, providing detailed record of each occurrence in writing. This record must be approved by the Consultant before claims for extras will be considered.
- .4 If upon excavating to the specified elevations, it is found that existing conditions are not fulfilled, adjust the excavations accordingly, but only with the written authorization of the Consultant.
- .5 Remove water, disturbed soil or foreign matter from footing excavations before placement of reinforcement or concrete.
- .6 During cold weather, prevent soil which will be adjacent to or beneath concrete from freezing.
- .7 Excavation will not be considered complete until the soil at founding elevation is inspected and approved by the geotechnical engineer.

3.3 BACKFILLING

- .1 Commence backfilling after areas of Work to be backfilled have been inspected, and pipe and conduit joints tested and accepted by Consultant.
- .2 Areas to be backfilled shall be free from debris, snow, ice, water or frozen ground. Backfill material shall not be frozen or contain ice, snow or debris.
- .3 Prior to placing fill under concrete slabs, proofroll the subgrade as directed by the geotechnical engineer. Remove soft, wet, or other deleterious material and replace with approved fill compacted to 98% of its Standard Proctor Maximum Dry Density, or import granular fill to stabilize the subgrade, and form a working mat, under the supervision of geotechnical engineer.
- .4 Backfill simultaneously each side of walls and other structures to equalize soil pressures.
- .5 Obtain Consultant's acceptance prior to placing backfill against foundation walls enclosing interior space.
- .6 Request reviews by Consultant and geotechnical engineer of excavation prior to beginning backfilling.

- .7 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Consultant.
- .8 Place and compact fill materials in continuous horizontal layers not exceeding 200 mm (8") loose depth.
- .9 Use backfilling methods to prevent disturbing or damaging buried services and site improvements.

3.4 FILL TYPES AND COMPACTION

- .1 Dimensions specified in following paragraphs are minimum dimensions of fill after compaction.
- .2 Compaction shall be to applicable Standard Proctor Maximum Dry Density (SPMDD).
- .3 Concrete floor slab base course:
 - .1 Provide minimum 200 mm (12") base course of 20 mm, Crusher Run Limestone or equivalent fill to underside of slab compacted to at least 98% of its SPMDD and placed to allow maximum concrete floor slab thickness tolerance of ± 10 mm (3/8") in accordance with CSA-A23.1--09.
- .4 Backfill against foundation walls:
 - .1 Provide fill material, compacted to at least 98% SPMDD.
 - .2 Unless otherwise indicated on drawings, fill materials shall consist of the following:
 - .1 Beneath planted landscaping:
 - .1 From the face of foundation enclosing interior space to distance of 900 mm (36") from foundation: Granular B Type II fill.
 - .2 Fill remainder with native fill.
 - .2 Granular B Type II beneath hard finish landscaping.
- .5 Underground services:
 - .1 Fill above protective cover: fill remainder of trench with Granular B Type II (maximum 37.5 mm (1-1/2") sieve) fill.
 - .2 Compaction: Compact fill to 98% of its SPMDD in the upper 1000 mm (40") from road subgrade. Below this level, 95% of its SPMDD is acceptable.
 - .3 Notify Consultant 3 Working Days prior to backfilling of trenches for mechanical and electrical services.

3.5 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Field tests and inspections:
 - .1 Allow inspection and testing services agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

- .2 Footing subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Consultant.
- .3 Inspections:
 - .1 Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - .2 Determine that fill material and maximum lift thickness comply with requirements.
 - .3 Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- .4 Testing:
 - .1 Testing agency will test compaction of soils in place according to requirements of Contract Documents. Tests will be performed at the following locations and frequencies:
 - .1 Paved and building slab areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 200 sq. m (2152 sq. ft.) or less, but in no case fewer than three tests.
 - .2 Foundation wall backfill: At each compacted backfill layer, at least one test for every 30 m (100 feet) or less of wall length, but no fewer than two tests.
 - .3 Trench backfill: At each compacted initial and final backfill layer, at least one test for every 50 m (164 feet) or less of trench length, but no fewer than two tests.

3.6 PROTECTION

- .1 Protect excavated areas from exposure to sun and rain which would cause cave-ins or softening of beds on which foundations and drains rest. Prevent flow of water and earth fines into excavated pits and trenches. Seal or divert flow from springs that fill excavations.
- .2 Protect bottoms of excavations from softening. Should softening occur, remove softened soil and replace with approved material.
- .3 Protect bottoms of excavations from freezing.
- .4 Effect measures to minimize dust as result of the Work.

END OF SECTION

1. **GENERAL**

1.1. **General Requirements**

1. Conform to the requirements of the Contract Documents including all addenda for all Work, including work outside the property line and work within Regional and Municipal right of way unless otherwise noted.

1.2. **Related Work**

- | | |
|------------------------|------------------|
| 1. Site Grading | Section 31 23 13 |
| 2. Water System | Section 33 11 17 |
| 3. Storm Sewers | Section 33 44 00 |
| 4. Aggregates: General | Section 31 05 17 |

1.3. **Definitions**

1. Common excavation: excavation of materials of whatever nature, including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy hydraulic excavating equipment.
2. Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
3. Waste material: excavated material unsuitable for use in work or surplus to requirements.
4. Borrow material: Sub-soil material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work. This material shall be of residential/agricultural origin and shall meet or exceed the confined fill material criteria as per Ontario Ministry of Environment, Conservation and Parks "Fill Quality Guidelines for Lake Filling in Ontario". Contractor shall provide Consultant with one chemical test per source prior to hauling material to the site.
5. Unsuitable materials:
 1. Weak and compressible materials under excavated areas.
 2. Frost susceptible materials under excavated areas.
 3. Frost susceptible materials:
 1. Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1
 2. Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
6. Un-shrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4. **Samples**

1. Submit samples of bedding or other granular backfill materials in accordance with Section 01 33 00.
2. Inform Consultant prior to commencing work, of proposed source of fill materials and provide access for sampling.

1.5. **Protection Of Existing Features**

1. Existing buried utilities and structures:
 1. Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 2. Prior to commencing excavation work, notify Consultant or the Authorities Having Jurisdiction, establish location and state of use of buried utilities and structures. Consultant or the Authorities Having Jurisdiction shall clearly mark such locations to prevent disturbance during work.
 3. Confirm locations of buried utilities by careful test excavations.
 4. Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain direction of Consultant before moving or otherwise disturbing utilities or structures.
 5. Record location of maintained, re-routed and abandoned underground lines.

2. **PRODUCTS**

2.1. **Materials**

1. Granular Base: to Section 32 11 23.
2. Granular Sub-Base: to Section 32 11 19.
3. Fill concrete: to Section 03 30 53 and following requirements:
 1. Minimum compressive strength at 28 days: 15 MPa.
 2. Maximum slump at time and point of discharge: 100 mm.
4. Unshrinkable fill: to the following requirements.
 1. Maximum compression strength at 28 days: 0.4 MPa.
 2. Maximum cement content: 25 kg/m³ of concrete mix.
 3. Slump at time and point of discharge: 150 to 200 mm.
 4. Air content: 4 to 6%
5. Sewer pipe embedment shall be in accordance with OPSD 802.010. Bedding for watermain shall be in accordance with T-708.04.
6. Granular Backfill: Imported granular material conforming to a Granular 'B' Type I, as specified in OPSS 1010, or approved reclaimed granular materials free of organics.
7. Borrow material: See Part 1 – General, Definitions.

3. **EXECUTION**

- 3.1. All trenching, backfilling and compacting is to be completed in accordance with OPSS 514.

3.2. **Site Preparation**

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

3.3. Stockpiling

1. Stockpile fill materials in areas designated by Consultant. Stockpile granular materials in manner to prevent segregation.
2. Protect fill materials from contamination.

3.4. Dewatering

1. Keep excavations free of water while work is in progress.
2. Protect open excavations against 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.
4. Continuously dewater the excavations to control surface runoff or perched water table seepage for concreting and other work to be carried out in the dry condition.
5. Submit for Consultant's review details of proposed dewatering methods, such as dikes or well points.

3.5. Trench Excavation

1. Excavate to lines, grades, locations, elevations and dimensions as indicated in the Contract Documents or directed by Consultant.
2. Remove excavated material and other obstructions encountered during excavation. Excavated trench material may be used as fill material on-site provided it is free from deleterious materials,
3. Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.
4. Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
5. Unless otherwise authorized by Consultant in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
6. Do not obstruct flow of surface drainage or natural watercourses.
7. Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
8. Notify Consultant when bottom of trench excavation is reached.
9. Obtain Consultant approval of completed excavation.
10. Remove unsuitable material from trench bottom to extent and depth as directed by Consultant.
11. Correct unauthorized over-excavation as follows:
 1. Fill under bearing surfaces and footings with concrete specified for footings.
 2. Fill under other areas with Granular 'B' material specified in Section 32 11 19.
12. 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. Clean out rock seams and fill with concrete mortar or grout to approval of Consultant.

3.6. Surplus Excavated Material and Removals

1. The Contractor shall make his own arrangements for the disposal of all excavated materials, removals, grindings and all other debris not suitable for re-use in the construction. If the Contractor enters into an agreement with an individual for the use of land for the disposal of excavated materials or for any other reason, a copy of the said Agreement clearly stating the obligation of all concerned and signed by all parties shall be submitted to the Consultant. The Contractor shall comply with the requirements of all Federal, Provincial and Municipal Laws, Acts, Ordinances, Regulations, Orders-in-Council and By-Laws, which could in any way pertain to the work outlined in the Contract. All costs for disposal of unsuitable or excess material off the site shall be included in the Contract Price and the Contractor shall make the arrangements for the disposal of the materials removed in accordance with *Environmental Protection Act*, R.R.O. 1990, Reg. 347 – General - Waste Management.

3.7. Bedding And Surround Of Underground Services

1. Place and compact granular material for bedding and surround of underground services as indicated and as specified.
2. Place bedding and surround material in unfrozen condition.

3.8. Backfilling

1. Do not proceed with backfilling operations until Consultant has inspected and approved installation.
2. Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
3. Trench backfill is to consist of Granular B Type I as specified in OPSS 1010 or reclaimed granular materials free of organics.
4. Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer to 98% SPMDD.
5. Backfill around installations.
 1. Place bedding and surround material as specified elsewhere.
 2. Do not backfill around or over cast-in-place concrete within 24 hr. after placing of concrete.
 3. Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 0.3 m.
 4. Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 1. Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Consultant or;
 2. If approved by Consultant, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Consultant.
6. Backfill within municipal right of way:
 1. Trench backfill for the storm, sanitary and water servicing connections to municipal servicing shall be un-shrinkable fill.

3.9. Inspection And Testing

1. Testing of materials and compaction will be carried out by testing laboratory designated by Consultant. Frequency of tests will be determined by Consultant.

2. The Owner will pay costs for inspection and testing.

3.10. **Restoration**

1. Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by Consultant. Any disturbed grassed areas are to be restored to original condition or better with 100 mm depth of topsoil, and sod. Damaged concrete or asphalt areas are to be restored to original condition or better. Repaired asphalt areas are to be matched with adjacent asphalt and include a lab joint as per the drawing detail provided.

END OF SECTION

1. **GENERAL**

1.1. **General Requirements**

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Municipal right of way unless otherwise noted in the Contract Documents.

1.2. **Description**

1. Provide all labour, materials, tools and equipment necessary for all excavation and backfill to the full extent of work shown on the plans and this specification, including but not limited to the following:
 1. Grading (cutting and filling) to subgrade elevations including compaction and fine grading of existing earth materials to +/- 25 mm of design subgrade elevations (not uniformly high or low) in accordance with OPSS 206.
 2. Proof rolling of subgrade with geotechnical consultant present.
 3. Excavate and dispose of all excess unsuitable materials off site.
 4. Supply and installation of earth borrow material as required to establish design subgrade elevations.

1.3. **Related Work**

- | | |
|--|------------------|
| 1. Excavating, Trenching and Backfilling | Section 31 23 10 |
| 2. Aggregates: General | Section 31 05 17 |

1.4. **Site Conditions**

1. Protection:
 1. Provide protection (i.e. shoring, cribbing, bracing and planking) to ensure no damage occurs to existing facilities and equipment situated on site. In certain areas only hand tools may be used.
 2. Provide adequate protection around bench marks, layout markers, survey markers, and geodetic monuments.
 3. Protect bottom of excavations from freezing.
 4. Protect bottoms of excavations from softening. Should softening occur, remove softened soil and replace with lean concrete. Keep bottoms of excavations dry at all times.
 5. Direct discharge from pumps, when draining excavations, so that damage to site and adjacent property does not occur.
 6. Do not stockpile excavated material to interfere with site operation or drainage.
 7. Effect approved measures to minimize dust as a result of all grading work and all other construction activities related to this contract.
 8. Protect legal iron bars, bench marks, surface or underground utility lines which are to remain. If damaged, restore to original or better condition unless directed otherwise in the Contract Documents.
 9. Ensure sufficient quantities of wood sheeting, timbers, steel members and other materials are available at all times in order to support, brace or protect utilities,

structure and properties near to or occurring within excavations.

2. The Contractor shall take all the necessary precautions to protect all utilities against damage. The Contractor shall carry out its work in a safe manner with due regard for roadway traffic to the satisfaction of the Consultant, and any Authority Having Jurisdiction.
3. The Contractor shall have full and sole responsibility for the safety of all excavation performed under this Contract until final acceptance of the Work.
4. Utility Lines:
 1. Before beginning work, establish location and extent of underground utility lines in area of excavation. Notify the Consultant of all existing located services encountered, and do not continue with excavation without the Consultant's instructions. Repair and pay for damages to existing utility lines resulting from the work.
 2. Relocate existing lines in area of excavation which must remain active as indicated on the Drawings.
 3. Remove abandoned utility lines, if any, to distance of 2 m from foundations. Cap lines at cut-off points.
 4. Record locations, if any, of maintained, re-routed and abandoned underground utility lines.
 5. Repair and pay for damage to existing underground lines as may result from this work.
5. Examination:
 1. Ensure in examination of the site that all possible factors concerning earthwork are investigated, and that the following are known in particular:
 1. Methods and means available for material handling, disposal, storage, and transportation.
 2. Physical conditions of site, including ground water table and drainage course, extent of removals and grading completed under a previous contract (demolition and site demolition).
 2. Unsatisfactory Soil Conditions:
 2. Any unsatisfactory or questionable soil conditions revealed during excavation shall be reported immediately to the Owner's Consultant and geotechnical engineer.
 3. All foundation and sub-structural work shall cease until the condition has been examined and approval to proceed has been issued.
6. Material Unsuitable for Backfill:
 1. The Contractor shall be responsible for all costs associated with the excavation and removal, off site, of all materials unsuitable for backfill or re-use.
7. Water:
 1. Keep excavation free from water at all times. Provide drainage trenches and sumps as necessary and pump water well away from excavation. Do not discharge water onto private property.
8. Inspection and Testing:
 1. Testing of materials and compaction will be carried out by testing laboratory designated by the Consultant.

1.5. Environmental Requirements

1. Protect and repair exposed excavations where required to prevent adverse effects of rain, freezing weather and other weather conditions on subgrade of subsequent work.
2. Suspend construction operation at times when satisfactory results cannot be obtained on account of rain, snow, freezing weather or other unsatisfactory conditions.
3. Do not carry out filling or backfilling in freezing weather unless authorized by the Consultant. Do not use frozen material nor place material where the material in place is already frozen.
4. Dispose of excess or unsuitable earth materials generated from the site grading in accordance with the *Environmental Protection Act*, Ontario Reg. 558. The Contract Price shall include all costs for disposal of excess or unsuitable material off the site and the Contractor shall make the arrangements for the disposal of the materials removed in accordance with the *Environmental Protection Act*, Ontario Reg. 558.

2. PRODUCTS

2.1. Materials

1. Earth Borrow
 1. Earth borrow shall be earth material obtained from outside the project limits that meets the requirements of Ontario Provincial Standard Specification 212.
2. Backfill
 1. Site or imported material containing no organic or foreign matter, and which the Contractor can demonstrate is compactable to a density of 98% SPMDD.

2.2. Stockpiling

1. Fill Materials
 1. Temporarily Stockpile fill materials in areas designated by the Owner. Stockpile granular materials to prevent segregation.
2. Protection
 1. Protect fill materials from contamination and freezing.

3. EXECUTION

3.1. Stripping of Topsoil

1. Do stripping of topsoil in accordance with this Section and the Consultant's requirements.
2. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by the Consultant.
3. Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.
4. Strip all topsoil. Avoid mixing topsoil with subsoil.
5. Stockpile sufficient topsoil for restoration of all grassed areas impacted by the construction.
6. Remove and dispose of surplus topsoil, off site.
7. All silt fence and erosion control measures to be in place before start of topsoil stripping operation.

3.2. Excavation/Grading

1. Grade to subgrade levels (to a tolerance +/- 25 mm but not consistently high or low) allowing for surface treatment as indicated.
2. Do not place material which is frozen nor place material on frozen surfaces.
3. Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
4. Excavation, placing and compacting of fill materials are to be carried out in accordance with Ontario Provincial Standard Specification (OPSS) 206.
5. Do not disturb soil within branch spread of trees or shrubs to remain.
6. If any soft areas are detected during the proof rolling process, and with the Consultant's direction, sub-excavate as per geotechnical consultant's recommendations. Sub-excavated areas are to be backfilled with suitable native material, or imported approved granular material.

3.3. Proof Rolling

1. Proof rolling shall be carried out on completed subgrade prior to installing granular sub-base materials.
2. Proof rolling shall be carried out using a roller with a minimum static weight of 5 tonnes, and shall consist of a minimum of four passes per unit area. Wet areas or deleterious materials identified during proof rolling shall be sub-excavated and be replaced with engineered fill, consisting of Granular B, Type I as per OPSS 1010 or select native material, compacted to 98% SPMDD in maximum 200 mm lifts.

3.4. Field Quality Control

1. Inspection and testing of materials and compaction will be carried out by the geotechnical consultant engaged by the Owner for this project. Costs of tests will be paid by the Owner.
2. Sieve Analysis
 1. Proposed fill materials will be tested to confirm suitability for intended use and conformity with specifications.
3. Reinstatement
 1. All disturbed areas must be reinstated to the Consultant's and the Owner's satisfaction.
 2. Any damage to the existing rail right-of-way, due to the Contractor's operations, shall be made good at the Contractor's expense.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the General Conditions, Supplementary General Conditions of this Specification and all addenda for all work, including work outside the property line including work within Regional and Municipal right of way unless otherwise noted.

1.2. Related Work

1. Aggregates Section 31 05 17
2. Site Grading Section 31 23 13

1.3. References

1. ASTM D4791-89, Test Method for Flat or Elongated Particles in Coarse Aggregate.
2. Ontario Provincial Standard Specification 1001.

1.4. Samples

1. Submit samples in accordance with Section 01 33 00.
2. Allow continual sampling by Consultant during production.
3. Provide Consultant with access to source and processed material for sampling.
4. Install sampling facilities at discharge end of production conveyor, to allow Consultant to obtain representative samples of items being produced. Stop conveyor belt when requested by Consultant to permit full cross section sampling.

2. PRODUCTS

2.1. Materials

1. Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
2. Clear stone for mud mat and along bottom of silt control fencing: 50 mm clear stone in accordance with OPSS 1001.
3. Geotextile for siltation control fence shall be Class I non-woven geotextile fabric in accordance with OPSS 1860.

2.2. Source Quality Control

1. Inform Consultant of proposed source of aggregates and provide access for sampling at least 28 Days prior to commencing production.
2. If, in opinion of Consultant, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
3. Advise Consultant 28 Days in advance of proposed change of material source.
4. Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

3. EXECUTION

3.1. Installation

1. Mud Mat Installation
 1. Place clear stone to the dimensions indicated on the Drawings to a depth of 300 mm.
 2. Remove and replace top layers of clear stone when they become laden with mud and the mud mat becomes ineffective in removing mud from equipment exiting the site.
 3. The mud mat installation does not alleviate the Contractor's responsibility to clean mud from adjacent roadways as a result of the construction.
2. Silt Control Fence
 1. Install silt control fence along construction site perimeter including tee bars, geotextile filter fabric, clear stone along the upstream side of the fence in the instance the ground is frozen.

3.2. Maintenance

1. Maintain the mud mat and replace clear stone as required during the construction period as required to maintain the function of the mud mat.
2. Maintain silt control fencing for the duration of the construction and replace as required until the site is stabilized.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Geotextiles.

1.2 SUBMITTALS

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Product data sheets:

.1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Installers / applicators / erectors: Provide work of this section, executed by competent installers with minimum 5 years' experience in application of Products, systems and assemblies specified, and with approval and training of Product manufacturers.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Geotextile filter cloth:

- .1 Non-woven geotextile of polypropylene or polyester fibres, or combination of both.
- .2 Permeability: 2.0×10^{-1} K (cm/s) in accordance with CAN/CGSB 4.2 No. 11.1- 94(R2013).
- .3 Grab tensile: 690 N in accordance with CAN/CGSB 148.1, No. 7.3-92.
- .4 Mullen burst: 1.4 MPa in accordance with CAN/CGSB 4.2 No. 11.1-94(R2013).
- .5 E.O.S.: 75 to 150 μ m.
- .6 Acceptable Products:
 - .1 'Terrafix 270R' by Terrafix Geosynthetics Inc.
 - .2 'Mirafi P-150' by Mirafi Construction Products.
 - .3 'Tygar 3341' by Tygar Geotextiles, or
 - .4 Or equivalent

PART 3- EXECUTION

3.1 GEOTEXTILE FILTER CLOTH MEMBRANE ON SUBGRADE

.1 Do not cover final prepared subgrade surface until completion of quality control inspection.

- .2 Entire subgrade surface shall be covered with geotextile filter cloth membrane.
- .3 Install filter cloth in accordance with filter cloth manufacturer's written instructions.
- .4 Geotextile filter cloth shall be placed directly on the prepared subgrade, and shall be in complete intimate contact with the prepared surface. Bridging of small hollows will not be permitted.
- .5 Place geotextile filter cloth on sloping surfaces in one continuous length.
- .6 Overlap filter cloth joints minimum 300 mm (12").
- .7 Secure and protect filter cloth against displacement.
- .8 After installation, cover with overlying layer within 4 hours of placement.
- .9 Replace damaged or deteriorated geotextile to approval of the Consultant.

3.2 PROTECTION

- .1 Do not permit construction equipment on installed geotextiles.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 This Section includes the protection and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.

1.2 QUALITY ASSURANCE

- .1 Qualifications: An experienced tree service firm with a minimum of 5 years' experience, that has successfully completed tree protection and trimming work similar to that required for this project and that will assign an experienced, qualified arborist to project and present at the Place of the Work during execution of tree protection and trimming.
- .2 Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and other Woody Plant Maintenance—Standard Practices (Pruning)."

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Products and remedial care for protection of the trees and plants as specified are to be as recommended by a qualified arborist, must comply with references above, with approval of the Consultant.
- .2 Provide tree protection barrier alternative where indicated on the Drawings and subject to the approval by Urban Forestry Services:
 - .1 Snow fencing to be standard 1220 mm (48") high orange safety fence, and 'T' iron rail stakes (38 mm (1-1/2") x 38 mm (1-1/2") x 5 mm (13/64")) primed with one coat of black zinc rich paint.
- .3 Mulch: Clean, straw mulch from local sources free of weeds and hazardous materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine the Place of the Work before commencement of work and inform the Consultant if site conditions will not permit completion of tree and plant protection work as in accordance with the Contract Documents.
- .2 No ground breaking activities or demolition should occur until all tree preservation requirements have been met.
- .3 All Subcontractors, suppliers, and site personnel shall be informed of the tree and plant protection measures and guidelines prior to their commencing any activities at the Place of the Work.
- .4 The Tree Protection Zone (TPZ) shall be posted with signs.
- .5 Within the Tree Preservation Zone (TPZ) there shall be:

- .1 No construction;
- .2 No altering of grade by adding fill, excavating, trenching, scraping, dumping or disturbance of any kind.
- .3 No storage of construction materials, equipment, soil, construction waste or debris.
- .4 No disposal of any liquids (i.e.: concrete sleuth, gas, oil, paint).
- .5 No movement of vehicles, equipment or pedestrians.
- .6 No parking of vehicles or machinery.
- .7 No activity of any kind without permission of the arborist
- .8 Activity of any kind without permission of the arborist

3.2 TREE PRUNING

- .1 Prune trees and plants indicated to remain that are affected by temporary and permanent construction.
- .2 Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
- .3 Pruning Standards: Prune trees according to ANSI A300.
 - .1 Type of Pruning: Cleaning, Raising, and Reduction.
- .4 Cut branches with sharp pruning instruments; do not break or chop.
- .5 Chip removed tree branches and dispose of off-site.

3.3 TREE PROTECTION

- .1 Protect trees to be preserved from damage during the Work in accordance with the following specifications and make good any damage at no expense to the Owner.
- .2 The location of the tree preservation zone is clearly indicated on the Tree Preservation Plan. Trees to be protected will be confirmed by the Consultant.
- .3 Tree protection shall remain in place until all sitework has been completed, and may not be removed, relocated, or otherwise altered without the written permission of the Consultant.
- .4 The trees to be protected shall be fertilized with a deep root application of a fertilizer approved by the Consultant before construction commences on this project as well as a second fertilization in two years.
- .5 The trees to be protected shall be pruned in accordance with Tree Pruning paragraphs above in this section.
- .6 The arborist shall undertake proper root pruning when and if roots of retained trees are to be exposed, damaged or severed by construction activities. The arborist shall supervise the excavation of soil where roots are to be cut. All roots are to be cut cleanly at the excavation zone and backfilled with an appropriate soil mix. Exposed roots shall be covered with soil or mulch as soon as possible to prevent further damage and desiccation. Root pruning prior to excavation will help prevent unnecessary damage to tree roots.

- .7 In areas where mulch may remain following construction the trees shall have minimum 100 mm (4") of mulch installed over the root system before construction starts, and set back from the trunk by rodent guard. Mulch shall be spread evenly under the canopy to the dripline, to the limits of the protection fence, or as otherwise indicated in the Contract Documents.
- .8 There shall be a source of water provided to ensure that the trees get adequate water during the dry periods. It will be the responsibility of the Contractor to monitor for moisture content in the soil for the duration of the Work.
- .9 The protection zone shall not be breached in any way. There shall be no material stored in the preservation zones, no grade changes and no parking.
- .10 Ensure all trees are protected from compaction of roots or damage to trunk or limbs prior to receipt of permits for removal or remedial care as recommended by arborist.
- .11 Obtain necessary permits, reports, and approvals.
- .12 Proceed with execution of specified work, under direction of the Consultant.
- .13 No rigging cables will be wrapped around or installed in trees. Do not burn waste near trees and do not flush concrete trucks or cement mixing machines over root system.

3.4 TREE REPAIR AND REPLACEMENT

- .1 Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
- .2 Remove and replace trees indicated to remain that die or are damaged during construction operations that Consultant and arborist determine are incapable or restoring to normal growth pattern.
 - .1 Provide new trees of same size and species as those being replaced; plant and maintain as specified by Consultant.
 - .2 Provide new trees of 150 mm (6") calliper size and of a species selected by Consultant when damaged trees more than 150 mm (6") in calliper size, measured 305 mm (12") above grade, are required to be replaced. Plant and maintain new trees as specified by Consultant.
- .3 Aerate surface soil, compacted during construction, 3048 mm (10 ft) beyond drip line and no closer than 914 mm (36") to tree trunk. Drill 50 mm (2") diameter holes a minimum of 305 mm (12") deep at 610 mm (24") on centre. Backfill holes with an equal mix of augured soil and sand.
- .4 General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicative existing tree to be replaced. Comply with ANSI Z60.1-2014; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in lead and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - .1 Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk, crossing trunks; cut-off limbs more than 19 mm (3/4") in diameter; or with stem girdling roots will be rejected.

- .2 Collected Stock: Do not use plants harvested from the wild, from native stands, from an established planting, or not grown in a nursery unless otherwise indicated in the Contract Documents.
- .5 Provide trees of sizes, grades, and all sizes complying with ANSI Z60.1-2014 for types and form of trees required. Plants of a larger size may be used if acceptable to the project landscape architect, with a proportionate increase in size of roots or balls.
- .6 Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1-2014. Root flare shall be visible before planting.

3.5 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

1. **GENERAL**

1.1. **General Requirements**

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted in the Contract Documents.

1.2. **Related Work**

- | | |
|--|------------------|
| 1. Site Grading | Section 31 23 13 |
| 2. Excavation, Trenching and Backfilling | Section 31 23 10 |
| 3. Aggregates: General | Section 31 05 17 |
| 4. Granular Base | Section 32 11 23 |

1.3. **References**

1. ASTM C 117-90, Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
2. ASTM C 131-89, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
3. ASTM C 136-92, Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D 422-63 (1990), Method for Particle-Size Analysis of Soils.
5. ASTM D 698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft-lbf/ft³ 600 kN-m/m³.
6. CAN/CGSB-81.-88, Sieves Testing, Woven Wire, Inch Series.
7. CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
8. Ontario Provincial Standard Specification 1010.

1.4. **Delivery, Storage and Handling**

1. Refer to Section 32 11 23.

2. **PRODUCTS**

2.1. **Materials**

1. Granular sub-base material: Granular 'B', Type II, OPSS 1010, Section 31 05 17 and following requirements.
 1. Crushed, pit run or screened stone, gravel or sand consisting of hard durable angular particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 2. Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	% Passing
150 mm	Type I 100
26.5 mm	50-100
4.75 mm	20-100

1.18 mm	10-100
0.300 mm	2-65
0.075 mm	0-8

2. Other Properties as follows.

1. Plasticity Index ASTM D4318-84.0.
2. Crushed particles: at least 100% of particles by mass within each of the following sieve designation ranges to have at least 1 freshly fractured face for Type II. Not applicable for Type I material to be divided into ranges using methods of ASTM C135-84a.
3. Petrographic Number MTO LS609 Maximum 250.

Passing	Retained on
26.5	4.75 MM
4. Particles smaller than 0.02 mm AASHTO T88-78 maximum 3%.
5. Soaked CBR AASHTO T193-72 Min 40 when compacted to 100% of AASHTO T180.74 Method D.

Where indicated, **structural soil** is to be installed in lieu of granular sub-base. Structural soil as detailed later in this Specification Section.

3. **EXECUTION**

3.1. **Placing**

1. Compact subgrade to 95% of SPMDD. Excavate all weak and soft spots as required and replace with granular sub-base compacted uniformly to 100% of SPMDD.
2. Place granular sub-base after subgrade is inspected and approved by Consultant.
3. Construct granular sub-base to depth and grade in areas indicated in the Contract Documents.
4. Ensure no frozen material is placed.
5. Place material only on clean unfrozen surface, free from snow or ice.
6. Place granular sub-base materials using methods which do not lead to segregation or degradation.
7. For spreading and shaping materials, use spreader boxes having adjustable templates or screens which will place material in uniform layers of required thickness.
8. Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
9. Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
10. Remove and replace portion of layer in which material has become segregated during spreading.

3.2. **Compaction**

1. Compaction equipment to be capable of obtaining required material densities.
2. Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Consultant before use.
3. Equipped with device that records hours of actual work, not motor running hours.

4. Compaction in accordance with ASTM D698 and ASTM D1577.
 1. Pavement Sub-base: Compact to density of not less than 100% SPMDD.
 2. Backfill of subgrade weak or soft spots: Compact to density of not less than 98% of SPMDD.
 5. Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
 6. Apply water as necessary during compaction to obtain specified density.
 7. In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by the Consultant.
 8. Correct surface irregularities by loosening and adding or removing material unit surface is within specified tolerance.
- 3.3. **Site Tolerances**
1. Finished sub-base surface to be within 10 mm of elevation as indicated in the Contract Documents but not uniformly high or low.
- 3.4. **Inspection and Testing**
1. Testing of materials and compaction will be carried out by testing laboratory designated by the Owner. Frequency of tests will be determined by the Consultant.
 2. Owner will pay costs for inspection and testing.
- 3.5. **Protection**
1. Maintain finished sub-base in condition conforming to this Section until succeeding base is constructed, or until granular sub-base is accepted by the Consultant.

SAMPLES AND SUBMITTALS

A. At least 30 days prior to ordering materials, the Contractor shall submit to the Consultant samples, certificates, manufacturer's literature and certified tests for materials specified below. No materials shall be ordered until the required samples, certificates, manufacturer's literature and test results have been reviewed and approved by the Consultant. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Consultant reserves the right to reject, on or after delivery, any material that does not meet these specifications.

1.02 DELIVERY, STORAGE AND HANDLING

A. Do not deliver or place soil in frozen, wet, or muddy conditions. Material shall be delivered at or near optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698). Do not deliver or place materials in an excessively moist condition (beyond 2 percent above optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698).

B. Protect soils and mixes from absorbing excess water and form erosion at all times. Do not store materials unprotected from large rainfall events. Do not allow excess water to enter site prior to compaction. If water is introduced into the material after grading, allow material to drain or aerate to optimum compaction moisture content.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted.

1.2. Related Work

- | | |
|--|------------------|
| 1. Site Grading | Section 31 23 13 |
| 2. Excavation, Trenching and Backfilling | Section 31 23 10 |
| 3. Aggregates: General | Section 31 05 17 |
| 4. Granular Sub-base | Section 32 11 19 |

1.3. References

1. ASTM C 117-90, Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
2. ASTM C 131-89, Test method for Resistance to Degradation of Small-Size Coarse aggregate by Abrasion and Impact in the Los Angeles Machine.
3. ASTM C 136-92, Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D 698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
5. CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
6. CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
7. Ontario Provincial Standard Specification 1010.

1.4. Delivery, Storage and Handling

1. Deliver and stockpile aggregates in accordance with Section 31 05 17 – Aggregates General. Stockpile minimum 50% of total aggregate required prior to commencing operation.
2. Store cement in weathertight bins or silos that provide protection from dampness and easy access for inspection and identification of each.

2. PRODUCTS

2.1. Materials

1. Granular base material: Granular 'A' OPSS 1010, Section 31 05 17 and following requirements:

1. Crushed pit-run or screened stone, gravel or sand consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
2. Gradations to be within limits of specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	% Passing
26.5 mm	100
19 mm	85 - 100
13.2 mm	65 - 90
9.5 mm	50 - 73
4.75 mm	35 - 55
1.18 mm	15 - 40
0.300 mm	5 - 22
0.150 mm	-
0.075 mm	2 - 8

3. Plasticity Index ASTM D4318-840.
4. Los Angeles Abrasion ASTM C131-81 (1987) Gradation 'A' Max. % loss by weight: 60.
5. Crushed particles: at least 50% of particles by mass within each of following sieve designation ranges to have at least 10 freshly fractured face. Material to be divided into ranges using methods of ASTM C136-84a.

Passing	Retained on
19 mm	26.5 mm
4.75 mm	19 mm

6. Petrographic number MTO LS 69, Maximum 250.
7. Soaked CBR: AASHTO T193-72 when compacted to 100% of AASHTO T180-774 Method D, Min 80 for use under Portland cement and Min 100 for use under asphalt concrete.

3. EXECUTION

3.1. Sequence Of Operation

1. Place granular base after finished sub-base surface or subgrade is inspected and approved by Consultant.
2. Placing
 1. Construct granular base to depth and grade in areas indicated in the Contract Documents.
 2. Ensure no frozen material is placed.
 3. Place material only on clean unfrozen surface, free from snow and ice.
 4. Place material using methods which do not lead to segregation or degradation of aggregate.
 5. Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

6. Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 7. Remove and replace that portion of layer in which material becomes segregated during spreading.
 3. Compaction Equipment
 1. Compaction equipment to be capable of obtaining required material densities.
 2. Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Consultant before use.
 3. Equipped with device that records hours of actual work, not motor running hours.
 4. Compacting in accordance with ASTM D 698 and ASTM D 1557.
 1. Compaction of Pavement Base: Compact to density of not less than 100% SPMDD.
 2. Compaction of Concrete Slab on Grade or Concrete Sidewalks Base: Compact to density of not less than 100% of SPMDD.
 3. Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 4. Apply water as necessary during compacting to obtain specified density.
 5. In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Consultant.
 6. Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.2. Site Tolerances

1. Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.3. Proof Rolling

1. For proof rolling use roller of 45,400 kg gross mass with four pneumatic tires each carrying 11,350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 915 mm maximum.
 2. Consultant may authorize use of other acceptable proof rolling equipment.
 3. Proof roll top of base upon completion of fine grading and compaction.
 4. Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 5. Where proof rolling reveals defective areas:
 1. Remove base, sub-base and subgrade material to depth and extent directed by Consultant.
 2. Backfill excavated subgrade with sub-base material and compact in accordance with Section 31 23 10.
 3. Replace sub-base material and compact in accordance with Sections 31 23 10 and 32 11 19.
 4. Replace base material and compact in accordance with this Section.

3.4. Inspection and Testing

1. Testing of materials and compaction will be paid for out under the Cash Allowance Item No. CA1 included in the Bid Form by testing laboratory designated by Consultant. Frequency of tests will be determined by the Consultant.

3.5. Protection

1. Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by the Consultant.

END OF SECTION

1. **GENERAL**

1.1. **General Requirements**

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted in the Contract Documents.

1.2. **Related Work**

- | | | |
|----|---------------------|------------------|
| 1. | Site Grading | Section 31 23 13 |
| 2. | Aggregates: General | Section 31 05 17 |
| 3. | Granular Base | Section 32 11 23 |
| 4. | Granular Sub-Base | Section 32 11 19 |
| 5. | Pavement Markings | Section 32 17 23 |

1.3. **Quality Assurance**

1. Plant requirements: Facilities for production and transportation of asphaltic mixture shall conform to OPSS Form 310.
2. Equipment Requirements: Self-powered mechanical pavers conforming to OPSS Form 310.
3. Rollers conforming to OPSS Form 310.

1.4. **Inspection**

1. Examine areas to receive the work of this Section and do not proceed until unsatisfactory conditions are corrected.
2. Notify the Consultant at least 24 hours prior to commencing work.
3. Do not commence work until the Consultant has inspected and approved surfaces to receive asphalt paving.

1.5. **Condition of Surfaces**

1. Prior to delivery of mixture, base surface shall be dry and free of all loose and foreign material.

1.6. **Temperature Requirements**

1. Prior to placing asphalt, air temperature at the base surface shall be a minimum of 7° C and rising.
2. Temperature of mixture shall not be less than 118° C immediately after spreading prior to initial rolling.
3. The asphalt cement shall be heated at the mixing plant only to the temperature required for satisfactory mixing and shall not exceed 162° C.

1.7. **Protection**

1. Conduct work without damaging other work. If other work is damaged, it shall be corrected to the approval of the Consultant without cost to the Owner.

2. **PRODUCTS**

2.1. **Materials**

1. Asphalt cement: conform to OPSS Form 1101.
2. Aggregates: conform to OPSS Form 1000 and 310.
3. Emulsified Asphalt: SS-1 emulsion conforming to OPSS Form 1103.

2.2. **Asphalt Mixes**

1. Asphalt Binding Course: HL8 conforming to OPSS Form 310.
2. Asphalt Surface Course: HL3 conforming to OPSS Form 310.

3. **EXECUTION**

3.1. **Preparation**

1. Clean surfaces of all loose and foreign materials.
2. Paint cold contact surfaces with emulsified asphalt.

3.2. **Installation**

1. Place asphalt paving in accordance with OPSS Form 310.
2. Compact asphalt to a minimum of 92% Maximum Theoretical Relative Density (MTRD).
3. Rolling shall continue until all roller marks are eliminated and no further compression is possible.
4. Hand tamp the asphalt with vibrating compactors adjacent to buildings, manhole covers and concrete curbs.
5. At the end of each day's work, or prolonged stoppage of asphalt paving, joints shall be formed by laying the asphalt and rolling it against a horizontal edge board of the proper thickness, placed across the entire width of the pavement.
6. Finished asphalt surfaces shall be straight and true to established levels, free from cracks, undrained areas or depressions exceeding 3 mm as measured with a 3 m straight edge in any direction. Asphalt thickness specified shall be maintained as minimum at any point.
7. Edges shall be neat and straight or properly curved as indicated, without broken, disintegrated or loose edges.
8. Backfill all curbs and pathways when complete in accordance with section 31 23 10.

3.3. **Cleaning**

1. Remove asphalt stains from adjacent finished surfaces.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Concrete site work at exterior locations where not indicated on structural Drawings.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Mix designs:
 - .1 Well in advance of the first supply of concrete to the project submit, using the standard RMCAO form for "Concrete Mix Design Submission Form", project concrete mix designs for review. Include following information:
 - .1 Concrete strength.
 - .2 Exposure class.
 - .3 Water-cement ratio.
 - .4 Maximum aggregate size.
 - .5 Slump range.
 - .6 Plastic air range.
 - .2 Describe in detail on the mix design summary and locations where each mix is to be placed in concrete site work.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors: execute the work of this Section only by a Subcontractor, with a minimum of 5 years' experience, who has adequate equipment and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified.
- .2 Mock-ups:
 - .1 Provide 1500 mm x 1500 mm area selected by the Consultant, complete with finish and pigment, in each required colour and finish, to act as trial area for acceptance of remainder of work of this section. When acceptable, quality of workmanship of balance of work of this Section shall match or exceed quality of accepted mock-up area.

PART 2 - PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Construct municipal sidewalks in accordance with the requirements of the Authorities Having Jurisdiction.

2.2 MATERIALS

- .1 Cement: to CSA A3000-03, type 10, normal.
- .2 Water and aggregates: to CAN/CSA A23.1/A23.2-09.
- .3 Admixtures: to ASTM C494/C494M-11 for air entraining admixtures.
- .4 Free Draining Granular Fill: OPSS 1010 - April 2004, Granular 'A' with less than 5% passing the 75 um sieve.
- .5 Granular Fill: OPSS 1010 - April 2004, Granular 'B'.
- .6 Joint filler: 12.7 mm (1/2") thick asphalt impregnated fibreboard to ASTM D1751- 04(2013) e1.
- .7 Joint filler: 12.7 mm (1/2") thick sponge rubber to ASTM D1752-04a (2013).
- .8 Lumber: plywood and wood formwork to CAN/CSA A23.1/A23.2-09, free of defects where exposed.
- .9 Form stripping agent: colourless, mineral oil, free of kerosene, with viscosity minimum 70, maximum 110 second Saybolt Universal at 38 °C, flashpoint minimum 150 °C open cup.
- .10 Curing compound: chlorinated rubber type compound to ASTM C309-11, Type 2 (White), Class A.
- .11 Welded wire fabric: to ASTM A1064 / A1064M-14.
- .12 Billeted steel bars: to CAN/CSA G30.18-09.

2.3 CONCRETE MIXES

- .1 Comply with CAN/CSA A23.1/A23.2-09 and as follows; concrete exposed to chlorides shall be defined as concrete subject to pedestrian and vehicular traffic:
 - .1 Structurally reinforced concrete exposed to chlorides with or without freezing and thawing conditions:
 - .1 Class of exposure (see Table 1): C-1.
 - .2 Minimum compressive strength (see Table 2): 35 MPa at 28 days.
 - .3 Maximum water-to-cementing materials ratio (see Table 2): 0.40.
 - .4 Air content category (see Table 4): Category 1.
 - .2 Non-structurally reinforced (i.e., plain) concrete exposed to chlorides and freezing and thawing:
 - .1 Class of exposure (see Table 1): C-2.
 - .2 Minimum compressive strength (see Table 2): 32 MPa at 28 days.
 - .3 Maximum water-to-cementing materials ratio (see Table 2): 0.45.
 - .4 Air content category (see Table 4): Category 1.
- .3 Concrete in an unsaturated condition exposed to freezing and thawing but not to chlorides:
 - .1 Class of exposure (see Table 1): F-2.

- .2 Minimum compressive strength (see Table 2): 25 MPa at 28 days.
 - .3 Maximum water-to-cementing materials ratio (see Table 2): 0.55.
 - .4 Air content category (see Table 4): Category 2.
- .2 Accelerating admixtures may be used subject to approval in cold weather. If approved by Consultant, use of admixture shall not relax cold weather placement requirements of CAN/CSA A23.1/A23.2-09. Use of calcium chloride is not permitted.

2.4 INSTALLATIONS

- .1 Cast-in-Place Concrete Curbs: Construct to dimensions and in locations as shown on the Drawings.
- .2 Cast-in-Place Concrete Sidewalks: provide to extents indicated, 150 mm (6") thick, unless otherwise indicated.
- .3 Flag Pole Bases: to be cast-in-place concrete, as indicated, with exposed formwork to be Classica 610R breakaway form as supplied by ArtFORMS International Inc., tel: 905- 642-3225.
- .4 Lamp Standard Bases: to be cast-in-place concrete, as detailed on the Drawings, with exposed formwork to be Newavea 510R – High, as supplied by ArtFORMS International Inc., tel: 905-642-3225 or equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Ensure that sub-grade of compacted fill conforms to elevations and sections before placing granular base material.

3.2 GRANULAR BASE

- .1 Place and compact fill materials in continuous horizontal layers not exceeding 200 mm (8") loose depth. Use methods to prevent disturbing or damaging buried services, foundation drainage system, waterproofing or dampproofing. Make good any damage.
- .2 Backfilling: Use granular material, either Granular 'B' or selected excavated material from the Place of the Work approved by geotechnical engineer, to subgrade level. Compact to at least 98% of its SPMDD. Use free draining Granular 'B' against foundation walls.
- .3 Place Granular 'A' base to minimum 150 mm (6") compacted thickness, unless otherwise indicated.
- .4 Compact granular bases to 98% SPMDD to ASTM D698-12(2014) e1 Standard Proctor Maximum Dry Density (SPMDD).

3.3 FORMS

- .1 Construct wood forms for unsupported concrete edges, to provide straight lines and smooth flowing curved lines as indicated. Provide architectural grade formwork and concrete ties in

pattern and design as indicated or as approved by Consultant, for exposed concrete work. Apply form stripping agent to surfaces in contact with concrete. Remove forms when concrete fully cured.

3.4 CONCRETE

- .1 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .2 Screed concrete to required levels, to tolerance of 12.7 mm (1/2") in 3050 mm (10').
- .3 Finish concrete with consistent directional screeded broom finish.
- .4 Tooled crack control joints to walks at 1525 mm (5'0") centre/centre.
- .5 Apply curing compound to exposed concrete surfaces in accordance with manufacturer's installation instructions.

3.5 EXPANSION AND CONTRACTION JOINTS

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals as indicated on the site plan and in accordance with Section 03 30 53.
- .2 Install expansion joints, 12.7 mm thick, at a maximum of 5000 mm on centre for sidewalks, 3600 mm on centre maximum for cast-in-place curbs, and 3000 mm on centre in both directions on the exterior concrete slab on grade.
- .3 Install expansion joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .4 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.
- .5 Place impregnated asphaltic expansion strips in expansion joints.

3.6 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.

3.7 ADJUSTING AND CLEANING

- .1 Clear away excess and waste materials and debris resulting from the work of this Section.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted in the Contract Documents.

1.2. Related Work

- | | | |
|----|---------------------------------------|------------------|
| 1. | Excavating, Trenching and Backfilling | Section 31 23 10 |
| 2. | Granular Base | Section 32 11 23 |
| 3. | Granular Sub-Base | Section 32 11 19 |
| 4. | Asphalt Paving | Section 32 12 16 |

1.3. References

1. Canadian Standards Association (CSA)
 1. CAN/CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction.
2. Canadian General Standards Board (CGSB)
 1. CAN/CGSB-1.2-M89, Boiled Linseed Oil
 2. CAN/CGSB-3.3-M89, Kerosene
3. American Society for Testing and Materials (ASTM).
 1. ASTM D698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³)
4. Ontario Provincial Standard Specification 353.

2. PRODUCTS

2.1. Materials

1. Concrete mixes and material shall conform to Ontario Provincial Standard Specifications 1301, 1302, 1303, 1305, 1306, 1308, 1315, and 1350. Concrete for curb and toe wall construction shall have a minimum compressive strength of 30 MPa after 28 days.
2. Granular Base and Sub-Base: to Section 32 11 23 and 32 11 19 respectively.
3. Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.
4. Fill material: to Section 31 23 10.
5. Boiled linseed oil: to CAN/CGSB-1.2.
6. Kerosene: to CAN/CGSB-3.3.

3. EXECUTION

3.1. Grade Preparation & Sub-Base Course

1. Grading: to Section 32 23 13.
2. Place sub-base course of OPSS Granular 'B', Type I in maximum 150 mm loose lifts and

compact to a minimum of 100% of SPMDD.

3.2. Granular Base

1. Obtain the Consultant's approval of subbase before placing granular base.
2. Place compacted OPSS Granular 'A' to depth, lines and widths as indicated.
3. Compact granular base to a minimum of 100% of SPMDD.

3.3. Concrete

1. Obtain the Consultant's approval of granular base.
2. Do concrete curb construction in accordance with OPSS 353.
3. Provide 1.0m. wide depressions in curb where specified on the Drawings as required to allow surface drainage to be conveyed to adjacent bio-swale areas.

3.4. Tolerances

1. Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5. Expansion and Contraction Joints

1. Joints are to be constructed in accordance with OPSS 353.07.06

3.6. Curing

1. Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by the Consultant.
2. Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
3. Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.
4. Concrete curing is to be in accordance with OPSS 904.

3.7. Linseed Oil Treatment

1. After concrete has cured for specified curing time and when surface of concrete is dry, apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters.

3.8. Backfill

1. Allow concrete to cure for 7 days prior to backfilling.
2. Backfill to designated elevations with material approved by the Consultant. Compact and shape to required contours as indicated or as required by the Consultant.

3.9. Defective Concrete

1. Concrete is defective when:
 1. Containing excessive honeycombing or embedded debris.
 2. Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
 3. Average 28-day strength of any three consecutive strength tests is less than specified minimum 28-day strength.
 4. Any 28-day strength test result is more than 3.5 MPa below the specified minimum 28-day strength.

2. Repair of defective concrete work:
 1. Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by the Consultant.
 2. Grind off high surface variations where required by the Consultant.
3. Remove and replace defective concrete where required by the Consultant:
 1. Remove between joints by sawing through concrete across full width.
 2. Replace with new concrete to this Section as required by the Consultant.
 3. Construct contraction joint between sawn face of existing concrete and face of new concrete.
 4. Install tie bars between old and new concrete as required by the Consultant.

3.10. Field Quality Control

1. Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Consultant in accordance with CAN/CSA-A23.1.
2. The Consultant may take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted in the Contract Documents.

1.2. Related Work

- | | |
|--|------------------|
| 1. Excavating, Trenching and Backfilling | Section 31 23 10 |
| 2. Granular Base | Section 32 11 23 |
| 3. Granular Sub-Base | Section 32 11 19 |
| 4. Asphalt Paving | Section 32 12 16 |

1.3. References

1. Canadian Standards Association (CSA)
 1. CAN/CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction.
2. Canadian General Standards Board (CGSB)
 1. CAN/CGSB-1.2-M89, Boiled Linseed Oil
 2. CAN/CGSB-3.3-M89, Kerosene
3. American Society for Testing and Materials (ASTM).
 1. ASTM D698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³)
 2. Ontario Provincial Standard Specifications 1301, 1302, 1303, 1306, 1308, 1315, and 1350.
 3. Ontario Provincial Standards Drawing No. 310.010

2. PRODUCTS

2.1. Materials

1. Concrete mixes and material: to Section 03 30 53.
2. Joint filler and Curing Compound: to Section 03 30 53
3. Granular Base and Sub-Base: to Section 32 11 23 and 32 11 19 respectively.
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 Section 31 23 10.
6. Boiled linseed oil: to CAN/CGSB-1.2.
7. Kerosene: to CAN/CGSB-3.3.

3. EXECUTION

3.1. Grade Preparation & Sub-Base Course

1. Grading: to Section 31 23 13.

2. Compact subgrade to 95% of Standard Proctor Maximum Dry Density (SPMDD). Excavate and fill all weak and soft spots as required and backfill with compacted granular 'B', Type I to 100% SPMDD.

3.2. Concrete

1. Obtain the Consultant's approval of granular base and reinforcing steel prior to placing concrete.
2. Do concrete work in accordance with Section 03 30 53.
3. Immediately after floating, give concrete walkway surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
4. Provide edging as indicated with 10 mm radius edging tool.
5. Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to the Consultant can be demonstrated. Hand finish surfaces when directed by the Consultant.

3.3. Tolerances

1. Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.4. Expansion and Contraction Joints - Concrete Walkways

1. Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m.
2. Install expansion joints at intervals of 6 m.
3. Install expansion joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
4. Seal expansion joints with sealant approved by the Consultant.

3.5. Curing

1. Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by the Consultant.
2. Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
3. Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.

3.6. Linseed Oil Treatment

1. After concrete has cured for specified curing time and when surface of concrete is dry, apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters.

3.7. Backfill

1. Allow concrete to cure for 7 days prior to backfilling.
2. Backfill to designated elevations with material approved by the Consultant. Compact and shape to required contours as indicated by the Consultant.

3.8. Defective Concrete

1. Concrete is defective when:
 1. Containing excessive honeycombing or embedded debris.

2. Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
 3. Average 28-day strength of any three consecutive strength tests is less than specified minimum 28-day strength.
 4. Any 28-day strength test result is more than 3.5 MPa below the specified minimum 28-day strength.
2. Repair of defective concrete work:
 1. Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by the Consultant.
 2. Grind off high surface variations where required by the Consultant.
3. Remove and replace defective concrete where required by the Consultant:
 1. Remove between joints by sawing through concrete across full width.
 2. Replace with new concrete to this Section as required by the Consultant.
 3. Construct contraction joint between sawn face of existing concrete and face of new concrete.
 4. Install tie bars between old and new concrete as required by the Consultant.

3.9. Field Quality Control

1. Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Consultant in accordance with CAN/CSA-A23.1.
2. Consultant may take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Painted pavement markings and linework including:
 - .1 Parking stall and drive aisle linework.
 - .2 Symbols and markings for barrier free parking.
 - .3 Interior of Vehicle Bay

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Provide work of this Section, executed by competent installers with a minimum of 5 years' experience in application of Products specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Paint: to CAN/CGSB 1.74-2001 AMEND NO.1 Alkyd Traffic Paint - Amendment No. 1, low VOC alkyd traffic paint, in colours to the Consultant's selection.
 - .1 Maximum VOC limits; exterior:
 - .1 Flat paints: <100 g/L.
 - .2 Non-flat paints: <200 g/L.

PART 3- EXECUTION

3.1 PREPARATION

- .1 Substrate surfaces to be free from surface water, frost, ice, dust, oil, grease and other foreign materials.

3.2 APPLICATION

- .1 Lay out pavement and slab markings.

- .2 Apply paint only when air temperature is above manufacturer's recommended temperature and no rain is forecast.
- .3 Symbols, numbers, letters and text to conform to dimensions indicated, 150 mm (6") minimum. Apply letters, numbers and text of legible size to parking stalls and drive aisles. Number sequence and text to the Consultant's selection.
- .4 Symbols and markings for barrier free parking to CAN/CSA B651-12, and to requirements of the Authorities Having Jurisdiction.
- .5 Paint lines to be of uniform colour and density with sharp edges, 100 mm (4") wide, unless otherwise indicated in the Contract Documents.

3.3 ADJUSTING AND CLEANING

- .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- .2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.
- .3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of the Authorities Having Jurisdiction.
- .4 Clean equipment and dispose of wash water/solvents as well as other cleaning and protective materials (e.g. rags, drop cloths, masking papers, and the like), paints, thinners, paint removers/strippers in accordance with safety requirements of the Authorities Having Jurisdiction.

3.4 PROTECTION

- .1 Keep traffic off wet paint for period of time as recommended by paint manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Chain link fences.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings:
 - .1 Drawings to indicate: materials, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, dimensions, details and accessories.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Provide work of this Section, executed by competent installers with a minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.

PART 2- PRODUCTS

2.1 EXTERIOR CHAIN LINK FENCE

- .1 Refer to Chain Link Fence Detail on the Drawings for chain link fence materials.

PART 3- EXECUTION

3.1 PREPARATION

- .1 Clearing: surveying, clearing, grubbing, grading and removal of debris for the fence line or any required clear areas adjacent to the fence
- .2 Stake out: prior to proceeding with fence installation, obtain the approval of the Consultant, in writing, of fence location stake out.

3.2 FRAMEWORK INSTALLATION

- .1 Set posts in concrete footings to the height required in Sonotube forms.
 - .1 Provide post footings according Chain Link Fence Detail on the Drawings.
- .2 Rails:
 - .1 Top rail: Install 6400 mm (21 ft.) lengths of rail continuous thru the line post or barb arm loop top. Splice rail using top rail sleeves minimum 152 mm (6 in.) long. The rail shall be secured to the terminal post by a brace band and rail end.

- .2 Intermediate rail: Field cut and secured to the line posts using boulevard bands or railends and brace bands.
- .3 Terminal posts: End, corner, pull and gate posts shall be braced and trussed for fence 1830 mm (6 ft) and higher and for fences 1525 mm (60") in height not having a top rail. The horizontal brace rail and diagonal truss rod shall be installed in accordance with ASTM F567.
- .4 Tension wire: Shall be installed 100 mm (4") up from the bottom of the fabric. Fences without top rail shall have a tension wire installed 100 mm (4") down from the top of the fabric. Tension wire to be stretched taut, independently and prior to the fabric, between the terminal posts and secured to the terminal post using brace band. Secure the tension wire to the chain link fabric with a 9 gauge hog rings 450 mm (18") on centre and to each line post with a tie wire.

3.3 CHAIN LINK FABRIC INSTALLATION

- .1 Install fabric to side of the framework as per Drawings or to later instruction by the Consultant.
- .2 Attach fabric to the terminal post by threading the tension bar through the fabric; secure the tension bar to the terminal post with tension bands and 8 mm (5/16") carriage bolts spaced no greater than 305 mm (12") on centre.
- .3 Small mesh fabric less than 25.4 mm (1"), attach to terminal post by sandwiching the mesh between the post and a vertical 50 mm (2") wide by 4.76 mm (3/16 in.) steel bar using carriage bolts, thru bolted thru the bar, mesh and post spaced 381 mm (15 in.) on centre.
- .4 Chain link fabric to be stretched taut free of sag. Fabric to be secured to the line post with tie wires spaced no greater than 305 mm (12") on centre and to rail spaced no greater than 450 mm (18") on centre.
- .5 Secure fabric to the tension wire with hog rings spaced no greater than 450 mm (18") apart. Excess wire shall be cut off and bent over to prevent injury.
- .6 Ensure space between bottom of fabric and solid surface is no greater than 50 mm (2") in any location.

3.4 NUTS AND BOLTS

- .1 Carriage bolts used for fittings shall be installed with the head on the secure side of the fence.
- .2 Bolts shall be peened over to prevent removal of the nut.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 This Section specifies the supply and installation of site furnishings.

1.2 RELATED WORK

- .1 Concrete Paving: Section 32 13 13

1.3 SUBMITTALS

- .1 Submit detailed drawings of products including overall dimensions and options for approval by the Consultant.
- .2 Submit samples of products and/ or components upon request by the Consultant.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver products to the site in the manufacturer's original, unopened containers and packaging. Upon delivery, examine packages immediately to ensure all products are complete and undamaged.
- .2 Store products in a protected, dry area in manufacturer's unopened containers and packaging.
- .3 Protect product's finish from damage during handling and installation.

1.5 COORDINATION

- .1 Coordinate installation of site furnishings with site work and other appropriate sections of the specifications to maintain proper provisions of the work specified.
- .2 All site furnishings shall be laid out in the field by the Contractor and approved by the Consultant prior to installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Bench:
 - Manufacturer: Maglin Site Furniture Inc.
 - Model: MLB510-M
 - Colour: Black
 - Mounting: Surface mount to concrete pador equivalent.

.2 Bike Ring:

Manufacturer: Maglin Site Furniture Inc.
Model: MBR200-S
Colour: Black powdercoat
Mounting: Surface mount to concrete pad

or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Place site furnishings for approval by the Consultant prior to installation.
- .2 Do not locate anchor bolts until site furnishings are in place.
- .3 Surface mount site furnishings to concrete pad or wall as per the Drawings and Details and/or the manufacturers' instructions and specifications.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 This Section specifies the layout, loading, hauling, spreading, rolling and fine grading of topsoil and planting bed mixture.

1.2 RELATED WORK

- | | |
|-------------------|------------------|
| .1 Seeding: | Section 32 92 19 |
| .2 Sodding: | Section 32 93 23 |
| .3 Ground Covers: | Section 32 93 00 |
| Shrubs: | Section 32 93 00 |
| Trees: | Section 32 93 00 |

1.3 SCOPE OF WORK

- .1 Topsoil and finished grading shall apply to all areas of the site designated on the construction Drawings to receive sodding and planting.

1.4 SOURCE QUALITY CONTROL

- .1 Inspection and testing of topsoil will be carried out by a testing laboratory chosen and paid for by the Contractor and approved by the Consultant.
- .2 Acceptance of topsoil shall be subject to the soil analysis test results. Do not commence work until topsoil accepted by the Consultant.
- .3 Test topsoil for clay, sand and silt, N, P, K, Mg, soluble salt content, pH value, growth inhibitors and soil sterilants.
 - a. Use 25 mm diameter sampling tube or spade to take a minimum of six (6) samples. Mix samples together thoroughly before submitting for testing.
 - b. Submit 0.5 kg sample of topsoil to testing laboratory and indicate present use, intended use, type of subsoil and quality of drainage. Prepare and ship sample in accordance with provincial regulations and testing laboratory requirements.
 - c. Determine required limestone treatment to bring pH value of soil 6.0 to 7.0 level.
 - d. Submit two copies of soil analysis and recommendations for corrections to the Consultant.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Topsoil: Topsoil for fine grading shall conform to the following qualities: friable, neither heavy clay nor of very light sandy nature consisting of 45% sand, 35% silt, 20% clay and pH value of 6 - 7. Free from subsoil, roots, vegetation, debris, toxic materials, stones over 50 mm diameter.

- .2 On-site Topsoil: Topsoil that is present on the project site can be re-used if it conforms to the above requirements and is approved by the Consultant.
- .3 Peat Moss:
 - .1 Derived from partially decomposed fibrous or cellular stems and leaves of species of sphagnum mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5mm.
- .4 Fertilizer:
 - .1 Complete commercial **organic** fertilizer.
 - .2 Formulation ratio: as recommended in soils report.
 - .3 Bonemeal: finely ground with a minimum analysis of 20% phosphoric acid.
- .5 Bonemeal: Commercial raw bonemeal, finely ground, with minimum analysis of 2% nitrogen and 11% phosphoric acid.
- .6 Manure: well rotted, unleached cattle manure, not less than 8 months and not more than 2 years old, free of harmful chemicals and injurious substances, containing not more than 25% straw, leaves and other foreign matter.
- .7 Lime: agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve. Provide lime in the form of dolomitic limestone.
- .8 Aluminum Sulfate: Commercial grade, unadulterated.

PART 3 - EXECUTION

3.1 PREPARATION OF PLANTING BED MIXTURE

- .1 Thoroughly mix together 5 parts topsoil and 2 parts manure and 1 part peat moss. Shred to a fine, even texture.
- .2 Add bone meal at the rate of .58 kg per cubic metre and mix thoroughly.
- .3 Protect planting mixture to prevent deterioration.

3.2 SPREADING AND FINE GRADING

- .1 Prepare and compact sub-grade.
- .2 Have sub-grade approved by the Consultant prior to commencing topsoil placement.
- .3 Scarify sub-grade surface to a minimum depth of 75mm to facilitate bonding.
- .4 Do not spread topsoil/ planting bed mixture when it is frozen or wet.
- .5 Remove and dispose of all stones, sticks, sub-soil, lumps or other debris in excess of 50mm diameter and all surface litter and live weeds.

- .6 Spread soil to the following minimum depths:

100mm topsoil in areas to be sodded
450mm planting bed mixture in planting beds

- .7 Maintain soil 15mm below top of curb, finished grades of pavement, etc., to allow for sodding.
- .8 Manually spread topsoil around existing trees and shrubs.
- .9 Fine grade topsoil/ planting bed mixture to eliminate rough and low areas to ensure positive surface drainage, blend smoothly with adjacent finished grade elevations and conform to the specified levels and profiles.
- .10 Grade swales and ditches evenly to ensure positive runoff to drainage inlets, without ponding and with smoothly rounded, uniform side slopes.
- .11 Roll topsoil surface of all areas to be seeded or sodded to produce a smooth, uniform surface that is firm against deep foot prints and with a fine, loose texture.
- .12 Have finished surfaces inspected by the Consultant before placing seed or sod.
- .13 Dispose of surplus materials and debris off the site and clean up soil from all paved surfaces.

3.3 SOIL AMENDMENTS

- .1 Apply soil amendments at rate as specified and as determined from soil sample test.
- .2 Mix soil amendments into full depth of topsoil prior to application of fertilizer.

3.4 APPLICATION OF FERTILIZER

- .1 Spread fertilizer uniformly over entire area of topsoil at rate determined on basis of soil sample test.
- .2 Mix fertilizer thoroughly to full depth of topsoil.

3.5 SURPLUS MATERIAL

- .1 Dispose of materials not required at an appropriate off-site facility.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 This Section specifies the installation of seed.

1.2 RELATED WORK

- .1 Topsoil Placement and Grading: Section 32 91 19
- .2 Sodding: Section 32 92 23

1.3 QUALITY ASSURANCE

- .1 Fertilizer: packed in standard bags clearly indicating weight, analysis, and source of supply
- .2 Seed: certified Canada No. 1 under the Seed Act
- .3 Topsoil: see Section 32 91 19 Topsoil Placement and Grading
- .4 Imported Topsoil: see Section 32 91 19 Topsoil Placement and Grading

1.4 TIMING OF WORK

Seeding shall be carried out during periods which are most favourable for the establishment of a healthy stand; for example, during calm weather on ground which is free from frost, snow and water.

First preference: August 15 to September 30.

Second preference: Early spring up to June 15th.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect fertilizers and seed in storage from deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Seed Mixture: Low Native Seed Mixture supplied by Pickseed (or approved equal)
Seed mix shall contain the following:
- | | |
|--------------------|------------------------------------|
| Sideoats grama | (<i>Bouteloua curtipendula</i>) |
| Sand Dropseed | (<i>Sporobolus cryptandrus</i>) |
| Violet Wheatgrass | (<i>Agropyron violaceum</i>) |
| Slender Wheatgrass | (<i>Elymus trachycaulus</i>) |
| Little Bluestem | (<i>Schizachyrium scoparium</i>) |
| Broom Sedge | (<i>Andropogon virginicus</i>) |
- .2 Fertilizer: 0-20-10 commercial fertilizer

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Scarify subgrade to a depth of 75mm.
.2 Remove stones larger than 75mm and all roots, branches and debris.

3.2 INSTALLATION OF TOPSOIL

- .1 Place and spread topsoil over subgrade and compact to 95% Standard Proctor Maximum Dry Density (SPMDD).
.2 Compacted thickness of topsoil shall not be less than 150mm minimum.
.3 Roll smooth and even and grade to drain freely.
.4 Ensure soil is free of lumps and voids and firm under foot.
.5 In areas which do not require regrading, cultivate and turn over all existing turf to remove all vegetation.

3.3 INSTALLATION OF TOPSOIL

- .1 Rake topsoiled areas to scarify surface to a minimum of 30mm
.2 Seed evenly at an application rate of 25 kg/ha

3.4 MAINTNENANCE

- .1 Maintenance for sodded areas shall begin immediately after sod has been installed and shall continue until the date of Total Performance of the Work..
- .2 Maintenance shall include all measures necessary to establish and maintain sod in a vigorous growing condition, including but not limited to:
 - a. Mowing: Shall be at regular intervals as required, to maintain grass at a maximum height of 65mm. Not more than 1/3 of blade shall be cut at any one mowing. Edges of sodded areas shall be neatly trimmed and hand clipped where necessary. Heavy clippings shall be removed immediately after mowing and trimming.
 - b. Watering: Shall be carried out when required and with sufficient quantities to prevent grass and underlying soil from drying out.
 - c. Rolling: Shall be carried out when required to remove any minor depressions or irregularities.
 - d. Weed control: Shall be carried out when required. When herbicides are used they shall be applied in accordance with manufacturer's recommendations. Any damage resulting from the Contractor's use of herbicides shall be remedied at its expense.
 - e. Erosion: Erosion occurring as a result of faulty workmanship and/or materials on the part of the Contractor shall be repaired at its expense.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 This Section specifies the installation of sod.

1.2 RELATED WORK

- .1 Topsoil Placement and Grading: Section 32 91 19
- .2 Seeding: Section 32 92 19

1.3 QUALITY ASSURANCE

- .1 Engage an experienced Installer with a minimum of 5 years' experience on comparable projects.
- .2 Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.

1.4 ACCEPTANCE

- .1 Sodded areas will be accepted at the date of Substantial Performance of the Work provided that:
 - a. Sodded areas are properly established and in a vigorous growing condition.
 - b. Sod is free of bare and dead spots and without weeds.
 - c. No surface soil visible when grass has been cut to height of 50mm.
 - d. Sodded areas have been cut twice.
- .2 Lawns sodded in fall will be accepted the following spring, one month after start of growing season, provided that the conditions of Section 1.4.1 are fulfilled.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Topsoil: see section 32 91 19 Topsoil Placement and Grading
- .2 Imported Topsoil: see section 32 91 19 Topsoil Placement and Grading
- .3 Grass Sod: Shall be a certified No. 1 Grade Turfgrass Nursery Sod, as per Green Horizons Group Eco Solutions: Bluegrass/ Fescue Blend (or equivalent), grown and sold in accordance with the classification of the Nursery Sod Growers Association of Ontario. At time of sale shall have a strong, fibrous root system and shall be free from stones and burned or bare spots.
- .4 Fertilizer: Organic fertilizer as per the soil analysis report provided by the Contractor (refer to Section 32 91 19 Topsoil Placement and Grading). The Contractor shall be prepared to supply all necessary fertilizers, to eliminate any chemical deficiencies as indicated by the soil analysis report of imported topsoil.

- .5 Wooden Pegs: Sod on steep slopes shall be secured with hardwood pegs, 225mm long minimum and approximately 25mm x 25mm square, or approved equal. Pegs shall be of sufficient length to ensure satisfactory anchorage of the sod.
- .6 Water: Potable, free of impurities.

PART 3 - EXECUTION

3.1 CUTTING, HANDLING AND STORAGE

- .1 Sod shall be cut by approved methods in accordance with recommendations of the Nursery Sod Growers Association of Ontario.
- .2 Sod shall be rolled or folded prior to lifting in such a manner as to prevent tearing or breaking.
- .3 Sod shall be protected during transportation to prevent drying out and shall arrive at the site in a fresh and healthy condition.
- .4 Sod shall be installed immediately after arrival. If there is any delay in installation the sod shall be kept moist and cool at all times until installation.
- .5 All commercial fertilizer shall be packed in standard containers, clearly marked with the name of the manufacturer, weight and analysis.
- .6 Fertilizer shall be stored in a weatherproof storage place and in such a manner that it will stay dry and its effectiveness is not impaired.

3.2 INSTALLATION

- .1 All rough grading, filling, spreading of topsoil and fine grading and other preparation work required, shall be executed and completed as described in the appropriate sections of these specifications.
- .2 The specified fertilizer shall be applied to and well worked into the topsoil by discing, raking or harrowing, at the rate specified. This shall be done 48 hours before laying sod.
- .3 The finished surface shall be smooth, firm against footprints, with a fine, loose texture before sod is placed.
- .4 Sodding operations shall take place during suitable weather conditions and on ground which is free from frost, snow and water. Sod shall be laid as soon as possible after delivery to prevent deterioration. Sod shall be laid closely knit together in such a manner that no open joints are visible, or pieces are overlapping. Sod shall be laid smooth and flush with adjoining grass areas and paving and top surface of curbs unless shown otherwise on the drawings.
- .5 On any slopes of 3:1 and steeper, sod shall be laid perpendicular to the slope, and every row shall be pegged with wooden pegs at intervals of not more than 600mm. Pegs shall be driven flush with sod. For drainage swales place 5 pegs per square metre.
- .6 After installation of sod, the area shall be watered immediately with sufficient amounts to saturate the sod and upper 100mm of soil.

- .7 After sod and soil has dried sufficiently to prevent damage, the area shall be rolled with a roller providing 7325kg/m² pressure (1500 lbs./ft²), to ensure a good bond between sod and soil and to remove minor depressions and irregularities.
- .8 Protect all newly laid sod areas until vigorous, hardy, even growth is established to a growth height of 80mm.

3.3 MAINTENANCE

- .1 Maintenance for sodded areas shall begin immediately after sod has been installed and shall continue until the date of Total Performance of the Work.
- .2 Maintenance shall include all measures necessary to establish and maintain sod in a vigorous growing condition, including but not limited to:
 - a. Mowing: Shall be at regular intervals as required, to maintain grass at a maximum height of 65mm. Not more than 1/3 of blade shall be cut at any one mowing. Edges of sodded areas shall be neatly trimmed and hand clipped where necessary. Heavy clippings shall be removed immediately after mowing and trimming.
 - b. Watering: Shall be carried out when required and with sufficient quantities to prevent grass and underlying soil from drying out.
 - c. Rolling: Shall be carried out when required to remove any minor depressions or irregularities.
 - d. Weed control: Shall be carried out when required. When herbicides are used they shall be applied in accordance with manufacturer's recommendations. Any damage resulting from Contractor's use of herbicides shall be remedied at its expense.
 - e. Erosion: Erosion occurring as a result of faulty workmanship and/or materials on the part of the Contractor shall be repaired at its expense.
- .3 Any sodded areas which show deterioration or bare spots shall be repaired immediately.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 This Section specifies the supply and planting of trees, shrubs and ground covers.

1.2 RELATED WORK

- .1 Topsoil Placement and Grading Section 32 91 19

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Supply manufactured items in standard containers, with contents, weight, component analysis, and the name of the manufacturer clearly indicated
- .2 Store manufactured materials which are subject to deterioration in a weatherproof place on site in such a manner that their effectiveness is not impaired.
- .3 Do not plant material on which the rootball has been cracked or broken preparatory to or during the planting process.
- .4 Provide rootballs of the following minimum sizes corresponding to tree size.

<u>Caliper</u>	<u>Height</u>	<u>Root Ball</u>
<u>Deciduous Trees</u>	<u>Coniferous Tree</u>	<u>Diameter</u>
-	1.75 m	60 cm
50 mm	2.00 m	70 cm
60-70 mm	2.25-2.5 m	80 cm
80-90 mm	2.75-3.0 m	90 cm
100 mm	-	1.00 m
125 mm	-	1.50 m

- .5 Provide a root ball depth of a minimum 60 per cent of diameter.
- .6 Cut all roots cleanly when digging plants. Split roots are not acceptable. Cut roots even with the edges of the rootball. Paint all cut roots over 13mm diameter with approved tree wound dressing.
- .7 Protect all plant material from damage and breakage. Protect all parts of the plant material from drying out from the time of digging until they are installed.

1.4 SUBSTITUTIONS

- .1 Supply and install plant material as specified on the plant list. Substitutions of other plant material will **not** be allowed unless approved in writing by the Consultant.

1.5 INSPECTIONS

- .1 Give 48 hours' notice for inspection of plant material and the stakeout of planting locations by the Consultant.
- .2 Partial acceptance will be given when planting would not be in accordance with good horticultural practices. If partial acceptance is desired, give notice to the Consultant in writing.
- .3 Final inspection of all plant material will be made at the end of the specified warranty period. All plants must be in a healthy growing condition at the time of this inspection.

1.6 WARRANTY

- .1 During the warranty period, replace all material that is dead or not in a satisfactory, healthy growing state or which does not meet the requirements of the specifications, at no extra cost to the contract.
- .2 All replacements must be plants of the same size and species as shown on the plant list, supplied and planted in accordance with the drawings and specifications.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- .1 All plant material must be nursery grown and meet the specifications set out in the latest Guide Specifications for Nursery Stock prepared by the Canadian Nursery Trade Association (C.N.T.A.) for size, height, spread, grading, quality and method of cultivation.
- .2 Nomenclature of specified plants shall conform to the International Code of Nomenclature for Cultivated Plants and the latest edition of Standardized Plant Names.
- .3 Plant Material shall be true to name and type, structurally sound, well branched; healthy and vigorous and free from disease, insect infestations and damage, and shall be densely foliated with a healthy, well developed root system. Pruning wounds must show vigorous bark on all edges and all parts must show live and green cambium tissue when cut.
- .4 All material must conform to the sizes shown on the plant list, except that larger material may be used when approved by the Owner. No extra will be paid for use of larger plants.
- .5 Plant material sizes must conform to the following standards:
 - a. caliper - diameter of the trunk measured 150mm above the normal grade around the plant.
 - b. height - measured from the normal grade around the plant to the top of the main foliage mass.
 - c. spread - the diameter of the main foliage mass, as its widest point.

2.2 OTHER MATERIALS

- .1 Topsoil: see Section 32 91 19 Topsoil Placement and Grading

- .2 Planting Bed Mixture: see Section Section 32 91 19 Topsoil Placement and Grading
- .3 Peat moss: partially decomposed fibrous form of cellular stems and leaves of sphagnum moss,
free of woody substance and harmful mineral matter, having a pH range of 4.5 to 6.0.
- .4 Tree Wrap: 225g burlap supplied in strips 150mm minimum to 250mm maximum width or heavy, waterproof crepe paper 100mm to 150mm wide.
- .5 Anchor stakes: 50x50x3000mm spruce stakes
- .6 Rodent/ Trimmer Protection: Flexible plastic collar 100mm dia. x 300mm long
- .7 Landscape Fabric: Commercial grade Weed-X by Dalen Products Inc. or approved equivalent.
- .8 Hemp Rope: 15mm diameter.
- .9 Mulch: Gro-bark SPM or approved equivalent

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Apply planting bed mixture to minimum 450mm depth for shrub beds and ground covers.

3.2 INSTALLATION

- .1 Ensure all planting excavations are 150mm greater on all sides than the width of the rootball.
Do not leave tree pits open overnight.
- .2 Place plant plumb in the centre of the planting pit with a minimum of 150mm of compacted planting soil mixture under the rootball. Face the plant to give the best appearance or relationship to adjacent structures. Cut away all ropes from the root ball at the base of tree.
- .3 Backfill with planting soil in 150mm layers and firmly tamp each layer to ensure the plant stays plumb. Ensure no air pockets remain around the roots.
- .4 Water thoroughly when hole is ½ full of tamped soil mixture, and again when the operation is complete.
- .5 Except for plants in planting beds, construct an earth saucer around each plant equal to the diameter of the rootball and 50mm minimum depth to retain water around the roots.
- .6 Cover all exposed soil with a 50mm minimum depth of shredded wood bark mulch.
- .7 Wrap all trees over 50mm calliper. Apply wrapping in a spiral manner from grade to above the second branch. Secure wrapping with suitable cord.
- .8 Secure all trees as outlined in the drawings and detail.
- .9 Prune plants to remove dead or broken branches. Do not cut a leader. Use only clean and sharp tools.

3.3 CLEAN-UP

- .1 At the completion of planting operations, remove all surplus material from the site at no extra cost to the Owner.
- .2 Make good all damage resulting from planting operations at no extra cost to the Owner.

3.4 MAINTENANCE PRIOR TO SUBSTANTIAL PERFORMANCE OF THE WORK

- .1 The Contractor shall be responsible for maintenance of plant material up to the point of Substantial Performance of the Work, and such maintenance shall be considered as part of the installation work.
- .2 Maintenance shall include all measures necessary to establish and maintain all plants in a vigorous and healthy growing condition, including but not limited to:
 - a. Watering: Water as required to maintain sufficient soil moisture content.
 - b. Weeding: Weed planting beds and tree pits.
 - c. Cultivating: Cultivate planting beds and tree pits.
 - d. Pruning: Prune all dead or broken wood from trees and shrubs.
 - e. Pest control: Employ disease and insect/rodent control measures (chemical and/or mechanical) when required. Use chemical methods in accordance with the manufacturer's directions. Make good any damage resulting from improper use of pesticides at no extra cost to the contract.
 - f. Accessories: Keep all accessories in good condition and properly adjusted. Reset plants to proper grades or upright position and adjusting tree guards and guy wires (if used) as required.
- .3 At the time of Substantial Performance of the Work, all material must be in a healthy vigorous growing condition. Beds and tree pits must be freshly cultivated and free of weeds, rubbish, or debris.

END OF SECTION

1. **GENERAL**

1.1. **General Requirements**

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted.

1.2. **Related Work**

- | | | |
|----|---------------------------------------|------------------|
| 1. | Site Grading | Section 31 23 13 |
| 2. | Excavating, Trenching and Backfilling | Section 31 23 10 |
| 3. | Storm Sewers | Section 33 44 00 |
| 4. | Aggregates: General | Section 31 05 17 |

1.3. **References**

1. ASTM A48-83 (1990), Specification for Gray Iron Castings.
2. ASTM C139-73 (1989), Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
3. ASTM C478M-90, Specification for Precast Reinforced Concrete Manhole Sections
4. CAN/CSA-A5-M88, Portland Cement.
5. CAN/CSA A8-M88, Masonry Cement.
6. CAN/CSA-A23.1-M90, Concrete Materials and Methods for Concrete Construction.
7. CSA A82.56-M1976, Aggregate for Masonry Mortar.
8. CAN3-A165 Series-M85, CSA Standards on Concrete Masonry Units.
9. CAN/CSA-G30.18-M92, Billet Steel Bars for Concrete Reinforcement.
10. CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.
11. Ontario Provincial Standard Specification 407.

2. **PRODUCTS**

2.1. **Materials**

1. Precast manhole units: to ASTM C478M, circular or oval. Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation. Monolithic bases to be approved by the Consultant and set on concrete slabs cast in place.
 1. 1200 mm diameter manhole as per OPSD 701.010.
2. Precast catch basins: to ASTM C478M.
 1. Catch basins as per OPSD 705.010
3. Joints: to be made watertight using rubber rings or cement mortar.
4. Mortar:
 1. Aggregate: to CSA A82.56.
 2. Cement: to CAN/CSA-A8.
5. Ladder rungs: to CAN/CSA-G30.18, No. 25M billet steel deformed bars, hot dipped galvanized to CAN/CSA G164 Rungs to be safety pattern (drop step type).

6. Adjusting rings: to ASTM C478M.
7. Concrete Brick: to CAN3-A165 Series.
8. Frames, gratings, covers to dimensions as indicated and following requirements:
 1. Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 2. Gray iron castings: to ASTM A48, strength class 30B.
 3. Castings: coated with two applications of asphalt varnish.
 4. Storm manhole frames and covers: heavy duty municipal type for road service. Cover cast without perforations and complete with two 25 mm square lifting holes, as per OPSD 400.010, unless otherwise specified in the Contract Documents.
 5. Catchbasin frame and cover: as per OPSD 400.010.
 6. Manhole frame and cover as per OPSD 401.010 Type A.
9. Granular bedding and backfill: Granular B Type I: to OPSS 1010 and Section 31 23 10 – Excavating, Trenching and Backfilling.
10. Unshrinkable fill: to Section 31 23 10 Excavating, Trenching and Backfilling.

3. **EXECUTION**

3.1. **Excavation and Backfill**

1. Excavate and backfill in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.
2. Obtain approval of the Consultant before installing manholes or catch basins.

3.2. **Installation**

1. Construct units in accordance with details indicated, plumb and true to alignment and grade.
2. Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
3. Dewater excavation free of standing water or as directed by the Consultant and remove soft and foreign material before placing concrete base.
4. Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% Corrected Maximum Dry Density.
5. Precast units.
 1. Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with rubber ring gaskets, cement mortar, or combination thereof.
 2. Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 3. Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
6. For sewers:
 1. Place stub outlets and bulkheads at elevations and in positions indicated.
 2. Bench to provide a smooth U-shaped channel in manholes.

7. Compact granular backfill to 98% Corrected Maximum Dry Density.
8. Place frame and cover on top section to elevation as indicated. If adjustment required use concrete ring.
9. Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

3.3. **Leakage Test**

1. Visual inspection of leakage will be carried out. If any leakage is observed, correct leakage as required by the Consultant at no additional cost.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted.

1.2. Description

1. The work included in this Section includes for all labour, equipment and materials required for the watermain construction within the site, and watermain construction within the municipal right of way connecting to existing municipal servicing.
2. Included in the work is coordination and cooperation with Municipal forces as required to complete the work including providing temporary blow offs, isolation valves, pressure testing and chlorination as required by Municipal forces.

1.3. Related Work

1. Excavating, Trenching and Backfilling Section 31 23 10

1.4. References

1. The Municipality Standards and Specifications for watermain construction.

1.5. Scheduling Of Work

1. Schedule work to minimize interruptions to existing services.

2. PRODUCTS

1. All products utilized within the water system to comply with the Municipality Standards and Specifications.

3. EXECUTION

3.1. Preparation

1. Clean pipes, fittings, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of the Consultant. Remove defective materials from site as required by the Consultant.

3.2. Trenching

1. Do trenching work in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.
2. Trench depth to provide cover over pipe of not less than 1.75 metres from finished grade or as indicated.
3. Trench alignment and depth require the Consultants' approval prior to placing bedding material and pipe.

3.3. Granular Bedding

1. Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 300 mm below bottom of pipe or 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 23 10 – Excavating, Trenching and Backfilling with compacted bedding material.

3.4. Pipe Installation

1. Lay pipes to ANSI/AWWA C600 Manual of Practice and manufacturer's standard instructions and specifications. Do not use blocks except as permitted in 3.3.2.
2. Join pipes in accordance with ANSI/AWWA C600, ANSI/AWWA C206, AWWA Manual of Practice and manufacturer's recommendations.
3. Bevel or taper ends of PVC pipe to match fittings.
4. Handle pipe by methods approved by an engineer 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. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. 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 a grade of 2% or greater, face socket ends upgrade.
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. 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 Consultant.
10. Cut pipes in an 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 carefully 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. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced 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 Consultant.

18. Provide necessary fittings and adaptors as required between existing watermain pipe materials and proposed watermain pipe materials.
19. When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
20. Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
21. Do not lay pipe on frozen bedding.
22. The Contractor is responsible for satisfactory completion of hydrostatic and leakage testing to Consultant's approval. The Contractor is also responsible for degree of backfilling complete prior to hydrostatic and leakage testing as well as isolation and correction of any leaks resulting in failed tests.
23. Backfill remainder of trench.

3.5. Cathodic Protection And Tracer Wire

1. Install as per Municipality Standards.

3.6. Hydrostatic And Leakage

1. Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described as required by the Municipality Standards.
2. Notify the Consultant at least 24 h in advance of all proposed tests. Perform tests in presence of the Consultant.
3. Where any 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.
4. Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by the Consultant.
5. Upon completion of pipe laying and after the Consultant has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated by the Consultant.
6. Leave hydrants, valves, backflow preventer, water meter, joints and fittings exposed.
7. When testing is done during freezing weather, protect hydrants, valves, backflow preventer, water meter, joints and fittings from freezing.
8. Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
9. Open valves.
10. Expel air from main by slowly filling main with potable water. Install corporation stops at high points in main where no air-vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs.
11. Thoroughly examine exposed parts and correct for leakage as necessary.
12. Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
13. Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
14. Repeat hydrostatic test until all defects have been corrected.
15. Apply a leakage test pressure of equal to design pressure after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 h.

16. Define leakage as amount of water supplied from water meter in order to maintain test pressure for 2 h.
17. Do not exceed allowable leakage of 0.03 L/mm diameter per 300 m of pipe, including lateral connections, per hour.
18. Locate and repair defects if leakage is greater than amount specified.
19. Repeat test until leakage is within specified allowance for full length of water main.

Pipe Surround

20. Upon completion of pipe laying and after the Consultant has inspected work in place, surround and cover pipes as indicated.
21. Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated. Do not dump material within 5 m of pipe.
22. Place layers uniformly and simultaneously on each side of pipe.
23. Do not place material in frozen condition.
24. Compact each layer from pipe invert to mid height of pipe to at least 95% of SPMDD to ASTM D698.
25. Compact each layer from (mid height) of pipe to underside of backfill to at least 95% of SPMDD and in accordance with Geotechnical Report for site.

3.7. Backfill

1. Place backfill material above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
2. Do not place backfill in frozen condition.
3. Compact native backfill to at least 95% of SPMDD.

3.8. Flushing And Disinfecting

1. The Municipality shall perform all chlorination works.
2. Flush water mains through available outlets with a sufficient flow of potable water to produce a velocity of 1.5 m/s, within pipe for 10 min., or until foreign materials have been removed and flushed water is clear.
3. Flushing flows shall be as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75

4. Provide connections and pumps for flushing as required.
5. Open and close valves, hydrants and service connections to ensure thorough flushing.
6. Complete flushing to satisfaction of the Consultant and The Municipal forces.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the Contract Documents for all work, including work outside the property line including work within Regional and Local Municipality right of way unless otherwise noted in the Contract Documents.

1.2. Related Work

- | | |
|--|------------------|
| 1. Site Grading | Section 31 23 13 |
| 2. Excavating, Trenching and Backfilling | Section 31 23 10 |
| 3. Manholes and Catchbasins | Section 33 05 14 |
| 4. Aggregates: General | Section 31 05 17 |

1.3. References

1. ASTM D3034, Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and fittings.
2. CAN/CSA-B182.2, PVC Sewer Pipe and Fittings (PSM Type),
3. CAN/CSA-B182.11, Recommended Practice for the Installation of Plastic Crain and Sewer Pipe and Pipe Fittings.
4. Ontario Provincial Standard Specification 410.

1.4. Material Certification

1. Submit manufacturer's test data and certification at least 2 weeks prior to commencing work.
2. Certification to be marked on pipe.

1.5. Scheduling of Work

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

2. PRODUCTS

2.1. PVC Pipe

Poly Vinyl Chloride pipe as specified in the Contract Drawings shall be in accordance with OPSS 410, Pipe Sewer Installation in Open Cut.

2.2. Pipe Bedding, Surround and Cover Materials

1. Granular embedment materials to Section 31 05 17 – Aggregates.

2.3. Backfill Material

1. Backfill to Section 31 23 10 – Excavation, Trenching and Backfilling
2. Backfill within the public right of way to be un-shrinkable fill.

2.4. Joint Mortar

1. Portland cement: to CAN/CSA-A5, normal type 10.
2. Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additive.

3. EXECUTION

3.1. Preparation

1. Clean pipes and fittings of debris and water before installation, and remove defective materials from site.

3.2. Trenching

1. Do trenching work in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.
2. Do not allow contents of any sewer or sewer connection to flow into trench.
3. Trench alignment and depth to approval of the Consultant prior to placing bedding material and pipe.

3.3. Granular Bedding

1. Place granular bedding material to details indicated in bedding detail OPSD 802.010 to OPSD 802.054, depending on type of soil and pipe. Use Class B bedding and place bedding in unfrozen condition. Type of soil to be defined in the field as Type 1, 2, 3, or 4 as per Health and Safety Act and Regulations for Construction Projects.
2. Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness.
3. Compact each layer full width of bed to at least 95% corrected maximum dry density.
4. Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
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 common backfill.

3.4. Installation of Sanitary Sewer Pipes

1. Lay and join pipe in accordance with manufacturer's recommendations and to approval of the Consultant.
2. Handle pipe using methods approved by the Consultant. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
3. Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
4. Do not exceed maximum joint deflection recommended by pipe manufacturer.
5. Do not allow water to flow through pipes during construction except as may be permitted by Consultant.
6. Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
7. PVC Pipe as specified in the Contract Drawings shall be installed in accordance with OPSS 410, Pipe Sewer Installation in Open Cut.
8. When any stoppage of work occurs, restrain pipes as required by the Consultant, to prevent "creep" during down time.
9. Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

10. Make watertight connections to manholes and catch basins. Use shrinkage compensating grout when suitable gaskets are not available. Support connections as per OPSD 708.020.
11. Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint to be structurally sound and watertight.
12. Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5. Pipe Surround

1. Place surround material in unfrozen condition.
2. Upon completion of pipe laying, and after Consultant 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. Pipe surround material to extend 300 mm above crown of pipe.
4. Place layers uniformly and simultaneously on each side of pipe.
5. Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.

3.6. Backfill

1. Place backfill material in unfrozen condition.
2. Place backfill material above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

3.7. Field Testing

1. Repair or replace pipe, pipe joint or bedding found defective.
2. When directed required by the Consultant, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
3. Remove foreign material from sewers and related appurtenances by flushing with water.

END OF SECTION

1. GENERAL

1.1. General Requirements

1. Conform to the requirements stated in the Contract Documents.

1.2. Related Work

1. Excavating, Trenching and Backfilling Section 31 23 10
2. Manholes and Catchbasins Section 33 05 14
3. Aggregates: General Section 31 05 17

1.3. References

1. ASTM C14M-90, Specification for Concrete Sewer, Storm Drain and Culvert Pipe.
2. ASTM C76M-90, Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
3. ASTM C443M-85a (1990), Specification for Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets.
4. CAN/CSA-A5-M88, Portland Cement.
5. CAN/CSA-A257, Series M92, Standards for Concrete Pipe.
6. CAN3-G401-M81, Corrugated Steel Pipe products.
7. Ontario Provincial Standard Specification 410.

1.4. Material Certification

1. Certification to be marked on pipe.

1.5. Scheduling of Work

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

2. PRODUCTS

2.1. Concrete Pipe

1. Non-reinforced circular concrete pipe and fittings: to CAN/CSA-A-257-2, ASTM C14M, Class 3 designed for flexible rubber gasket joints to ASTM C443 M and CAN/CSA A257.
2. Reinforced circular concrete pipe and fittings: to CAN/CSA-A257, ASTM C76M, strength classification as indicated in the Contract Drawings, designed for flexible rubber gasket joints to ASTM C443M and CAN/CSA A257.
3. Manufactured tees for pipe to pipe connections.
4. Lifting holes:
 1. Pipe 900 mm and less diameter: no lift holes.
 2. Pipe greater than 900 mm diameter: lift holes not to exceed two in piece of pipe.
 3. Provide pre-fabricated plugs to effectively seal lift holes after installation of pipe.

2.2. PVC Pipe

Poly Vinyl Chloride pipe as specified in the Contract Drawings shall be in accordance with OPSS 410, Pipe Sewer Installation in Open Cut.

2.3. Pipe Embedment, Surround and Cover Materials

1. Granular material to Section 31 05 17 – Aggregates.
2. Granular A to Section 31 23 13 – Site Grading
3. Pipe embedment shall be in accordance with OPSD 802.010

2.4. Backfill Material

1. Backfill shall be granular material as specified in Section 31 23 10 – Excavation, Trenching and Backfilling.

2.5. Joint Mortar

1. Portland cement: to CAN/CSA-A5, normal type 10.
2. Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

3. EXECUTION

3.1. Preparation

1. Clean pipes and fittings of debris and water before installation, and remove defective materials from site.

3.2. Trenching

1. Do trenching work in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.
2. Do not allow contents of any sewer or sewer connection to flow into trench.
3. Trench alignment and depth to approval of the Consultant prior to placing bedding material and pipe.

3.3. Granular Bedding

1. Place granular bedding material to details indicated in bedding detail OPSD 802.010 to OPSD 802.054, depending on type of soil and pipe. Use Class B bedding and place bedding in unfrozen condition.

Type of soil to be defined in the field as Type 1, 2, 3, or 4 as per Health and Safety Act and Regulations for Construction Projects.

2. Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness.
3. Compact each layer full width of bed to at least 95% corrected maximum dry density.
4. Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.

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 granular backfill.

3.4. Installation of Storm Drainage Pipes

1. Lay and join pipe in accordance with manufacturer's recommendations and to approval of the Consultant.
2. Handle pipe using methods approved by the Consultant. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
3. Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
4. Do not exceed maximum joint deflection recommended by pipe manufacturer.
5. Do not allow water to flow through pipes during construction except as may be permitted by the Consultant.
6. Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
7. Joints

1. Poly Vinyl Chloride Pipe

PVC Pipe as specified in the Contract Drawings shall be installed in accordance with OPSS 410, Pipe Sewer Installation in Open Cut.

8. When any stoppage of work occurs, restrain pipes as required by Consultant, to prevent "creep" during down time.
9. Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
10. Make watertight connections to manholes and catch basins. Use shrinkage compensating grout when suitable gaskets are not available. Support connections as per OPSD 708.020.
11. Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint to be structurally sound and watertight.
12. Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5. Pipe Surround

1. Place surround material in unfrozen condition.
2. Upon completion of pipe laying, and after the Consultant 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. Pipe surround material to extend 300 mm above crown of pipe.

4. Place layers uniformly and simultaneously on each side of pipe.
5. Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.

3.6. Backfill

1. Place backfill material in unfrozen condition.
2. Place backfill material above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
3. Trench backfill shall be imported granular material consisting of Granular B Type I, or reclaimed granulars free of organics.
4. Trench backfill within the public right of way is to be unshrinkable fill.

3.7. Field Testing

1. Repair or replace pipe, pipe joint or bedding found defective.
2. When directed required by the Consultant, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
3. Remove foreign material from sewers and related appurtenances by flushing with water.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Supply and installation of precast trench drain systems in the Apparatus Bays where indicated in the Contract Documents.
 - .2 Coordination with Divisions 21, 22, and 23 and the mechanical Drawings to ensure the proper connections are made to the sanitary drain system.

1.2 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.
- .3 Shop drawings:
 - .1 Submit shop drawings showing layout, profiles, product components, base material, surface finish (inside and out), hardware, and attachment and anchorage devices.
 - .2 Shop drawings shall indicate field measurements taken at the Place of the Work prior to fabrication.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Submit special tools required for accessing, assembly/disassembly, maintenance, or removal of precast trench drain systems.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers / applicators / erectors: Provide work of this section, executed by competent installers with a minimum of 5 years' experience in application of Products, systems and assemblies specified, and with approval and training of Product manufacturers.

1.5 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 01 78 36 for a period of 2 years and as specified in Article A-15 – Warranty Period of the Agreement Between Owner and Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Trench drains to be Northstar Industries 'MEADRAIN Supreme - System EN 2000', tel: 1-800-871-4547, or equivalent, and to the following specifications:
 - .1 Channel body polymer concrete in 1000 (39 3/8") lengths, with built-in cast iron black coated steel rail. Stepped system with Profix boltless stainless steel locking system or equivalent. Ductile iron grates to be hot dip galvanized.
 - .2 Catch Basin: FTC-223 with hot dip galvanized grate or equivalent.
 - .3 End caps to be polymer concrete with coated black steel rail.
 - .4 Sealant and installation devices to be used.

PART 3- EXECUTION

3.1 EXAMINATION

- .1 Verify actual measurements/openings by field measurements before fabrication.
- .2 Show recorded measurements on shop drawings.

3.2 INSTALLATION

- .1 Installation shall be in accordance with the manufacturer's instructions.

3.3 CLEANING

- .1 Upon completion of the work of this Section, thoroughly clean all trench drain systems in accordance with the manufacturer's recommendations.
- .2 Remove all rubbish and debris caused by the work of this Section.
- .3 Any cutting or damage done to the work of other sections by the work of this Section, shall be made good to the satisfaction of the affected section and will not be considered or approved as a change in the Work.

3.4 PROTECTION

- .1 Protect the installed trench drain system and finish surfaces from damage during subsequent construction activities.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

- .1 Read and conform to:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended,
 - .2 Division 1 requirements and documents referred to therein.
- .2 Section 21 01 01 applies to and governs the work of all Sections of the Mechanical Division.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the Work.
- .4 The Specifications are integral with the Drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the costliest arrangement.

1.2 DEFINITIONS

- .1 The following are definitions of words found in this specification and on associated Drawings under this Division:
 - .1 "Concealed" - locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
 - .2 "Exposed" - mechanical work normally visible to building occupants.
 - .3 "Furnish" - (and its derivatives) has the same meaning as the term "Supply".
 - .4 "Install" - (and its derivatives) - receive, store and handle at the site, mount and support and connect all required services. Includes adjustment and calibration, testing, commissioning, inspection by authorities having jurisdiction and documentation.
 - .5 "Provide" - (and its derivatives) - supply, install in place, connect the associated required services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.
 - .6 "Supply" - (and its derivatives) purchase and deliver to the site for installation. Includes submittals, manufacturer's field inspection and warranty.
 - .7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.

1.3 WORK INCLUDED

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Cutting and patching of new or existing work
- .3 Excavating and backfilling
- .4 Identification of equipment, piping, ductwork, and valves and controllers
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches.
- .6 Motors required for equipment supplied under this Division.
- .7 Variable frequency drives for motors and equipment supplied under this Division.
- .8 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or

- electrical or electronic components under this Division.
- .9 Disconnect switches for exhaust fans located on the roof complete with;
 - .1 EEMAC 1 enclosure if housed within a weatherproof cabinet,
 - .2 EEMAC 3 enclosure if exposed to weather
 - .10 Take such measures and include in the Contract Price for the proper protection of the existing building and its finishes at all times during alterations and construction of the new addition. Coordinate this protective work with all trades.
 - .11 Refer to Mechanical/Electrical Equipment Schedules shown on the Drawings for extent of wiring and electrical characteristics.
 - .12 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.

1.4 RELATED WORK

- .1 Power wiring, conduit and connections for motors under this Division will be by Electrical Division.
- .2 Power wiring, conduit and connections to variable frequency drives for motors under this Division will be by Electrical Division. Wiring and connections from VFD to motors under this Division will be by Electrical Division.
- .3 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under this Division.
- .4 Painting of exposed piping and ductwork other than for identification will be supplied under Division 9.
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches will be provided under Division 3.

1.5 SUBMITTALS

- .1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction and obtain two (2) copies of approved drawings for retention by Consultant prior to commencement of work under this Division.
- .2 Shop Drawings: Prepare and submit two (2) copies of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return one copy, marked with comments and his review stamp as he deems appropriate. The Contractor shall ensure that the necessary number of copies of the returned set is prepared and distributed to the Owner, the Consultant, the General Contractor, the site, and to subcontractors and suppliers.
 - .1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by the Consultant.
 - .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
 - .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
 - .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:
"This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of its

responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."

- .3 Sleeving Drawings: Prepare and submit 4 copies of sleeving drawings to clearly and accurately indicate the exact location, elevation and size of any and all formed holes, recesses and sleeving required in the work of Mechanical Division. Obtain the Consultant's approval in writing prior to sleeving, forming or cutting any such opening. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
- .4 Composite Wiring Diagrams: Prepare and submit three (3) copies of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.
- .5 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they conform to the requirements of those documents (e.g. NFPA-standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:
 - .1 description of the system (description and type),
 - .2 description of the tests conducted, and results observed, including re-testing, where necessary,
 - .3 description of any corrective measures undertaken,
 - .4 description of materials used (pipe and fittings),
 - .5 list of witnesses for each test conducted,
 - .6 date system left ready for service,
 - .7 signature of installing contractor.
- .6 Directories & Schematics
 - .1 Submit five (5) copies of a neat typewritten directory indicating the valve number, related service, and location of each valve under this Division.
 - .2 Submit five (5) copies of system control schematics for each mechanical system indicating relative locations of equipment and control devices.
 - .3 Enclose one (1) copy of each directory/schematic under glass in a neat polished 18" x24" (460 mm x 610 mm) metal frame, complete with mounting clips.
- .7 Maintenance Data and Operating Instructions
 - .1 Submit three (3) copies of Operation and Maintenance Manual individually bound in hard backed three-ring binders.
 - .2 Ensure the binder spines have typewritten lettering as follows:
OPERATION & MAINTENANCE MANUAL
for
[Insert
name of
project]
[Insert date
of
submission
) [Insert
Division
Title]
 - .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, general contractors, and the Consultant. Include special telephone numbers for service departments on normal and emergency call basis.

- .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.
- .5 Include copies of start-up reports and checklists and all certificates issued with respect to this Contract.
- .6 Ensure operating instructions include the following:
 - .1 General description of each mechanical system.
 - .2 Step by step procedure to follow in putting each piece of equipment into service.
 - .3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.
 - .4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches and relays.
 - .5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.
- .7 Ensure maintenance instructions include the following:
 - .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.
 - .2 Summary list of each item of mechanical equipment requiring lubrication,
 - indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
 - .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
 - .4 Balancing and testing reports.
 - .5 Copy of valve directory.
- .8 As-Built Records: Prepare and submit complete as-built records prior to Substantial Performance of the Work. Refer to paragraph 3.2.5 and to Division 1 for requirements.
- .9 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption from the Owner prior to disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 1 for additional requirements.
- .10 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

1.6 QUALITY ASSURANCE

- .1 Conform to minimum requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:
 - .1 AABC Associated Air Balance Council
 - .2 AMCA Air Moving and Conditioning Association
 - .3 ANSI American National Standards Institute
 - .4 ASA American Standards Association
 - .5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
 - .6 ASME American Society of Mechanical Engineers
 - .7 ASSE American Society of Sanitary Engineers

- .3 Use latest editions and amendments in effect on the Closing Date of the tender of call subject to requirements of OBC.
- .4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
- .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.
- .6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.
- .7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify the Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.8 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of this Division.
- .2 Examine all the Contract Documents to ensure that work of this Division may be satisfactorily completed.
- .3 Notify the Consultant upon discovery of conditions which adversely affect work of this Division. No allowance will be made after the Contract award for any expenses incurred through failure to do so.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications.

1.9 INTERRUPTIONS

- .1 Arrange execution of work to maintain present building operations, and to minimize the effect of work under this Division on existing operations.
- .2 Prior to interrupting any existing service notify the Owner and Consultant, in writing, at least 7 days in advance, and obtain written authorization. Do not interrupt any existing service without Consultant's specific authorization. Refer to Division 1 for requirements.
- .3 Arrange time and duration of interruption through the Owner. Include in the Contract Price for all overtime or premium time hours necessary to minimize duration of service interruption.
- .4 Test and verify the proper operation of existing equipment and systems that are shut down due to work of this project, prior to returning to service.
- .5 Assume responsibility for consequential costs on failure to obtain permission to shut-down and/or start-up any item of equipment, system or service.

1.10 WARRANTY

- .1 Refer to Division 1 and to Section 21 01 01 General Requirements.
- .2 Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .3 Make submissions necessary to register product warranties to the benefit of the

Owner.

- .4 Submit to the Consultant, prior to Substantial Performance of the Work, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

1.11 EXTRAS AND CREDITS

- .1 Accompany all price submissions requested by the Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
 - .1 Materials, quantities and unit costs including any applicable contractors trade discount clearly identified.
 - .2 Labour hours and unit costs.
 - .3 Total materials and labour costs.
 - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under this Division bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.
- .3 Ensure manufacturers and suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site prior to doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 MOTOR STARTERS & CONTROLS

- .1 Mechanical Division shall provide all motor starters and associated controls required and as scheduled on the Drawings and noted for Mechanical Division equipment. Starters and controls shall be Canadian General Electric or equivalent. All starters, contactors, thermal overloads, etc. must be EEMAC rated. All starters shall be of one manufacturer except as specifically approved otherwise for integral pre-wired assemblies.
- .2 Starter and control units shall be equipped with necessary number of auxiliary contacts and relays to provide control sequences described in Mechanical Equipment Starter Schedule on Drawings. Auxiliary contacts shall be interchangeable normally open or normally closed, by conversion in field without additional parts exterior to starter.
- .3 Manual starters may only be provided for single phase equipment operated by control device such as thermostat or limit control when such control device is rated for full electrical load of equipment.
- .4 Manual starters provided for single phase equipment actuated by electric timer or shall have H.O.A. feature. "Hand" position shall permit shunting of time switch. Where such units also

- have protective device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" positions and shall not be shunted.
- .5 Manual starters may only be provided for three phase equipment which is not actuated by pilot control device (pressure switch, float switch, safety limit devices, remote manual control device) unless otherwise noted in Starter Schedule.
- .6 Magnetic starters for manually operated equipment shall have "On/Off" selector switch or "Start-Stop" pushbutton in cover as scheduled.
- .7 Magnetic starters which are started automatically by electric time switch shall include "Hand-Off-Automatic" (H.O.A.) selector switch. "Hand" position shall permit shunting of time switch or E.M.S. Where such units also have protective pilot device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" position and shall not be shunted.
- .8 Magnetic starters which are started automatically by remote pilot device (or interlocked units) such as level controller, pressure switch, thermostat or flow switch shall include "Hand-off-Auto" (H.O.A.) selector switch, and, where scheduled, a "Test" pushbutton. "Hand" position shall permit shunting of remote pilot device and thereby permit operation of starter but only while depressing "Test" button.
- .9 Equip starter apparatus for prime plumbing, heating, air conditioning and ventilating equipment so that these units will automatically restart on resumption of power after power outage. Starters for these units shall have "On/Off" selector switch in cover if not fitted with H.O.A. selector feature or manual starter or otherwise noted.
- .10 Safety control device such as flow switches, pressure switches, high and low limited ("Fire" and "Freeze") shall not be shunted by "Hand" position of switch.
- .11 Manual motor starter shall be toggle operated with following general construction features:
- Quick-Make, Quick-Break mechanism with double-break contracts.
 - Overload protection heaters, one per phase and speed.
 - Enclosure to suit application.
 - Pilot light, neon lamp.
 - Cover engraved with "On-Trip-Off".
- .12 Magnetic motor starters shall comprise electrically-operated motor starters combined with disconnect switch with following general construction features:
- Quick-Make, Quick-Break mechanism with double-break contacts.
 - Fuse holders to accept specified fuses, one per phase.
 - Adjustable overload relays, one per phase.
 - CEMA listed enclosure to suit application. Disconnect with mechanical cover interlocks, line side barriers and switch operated electrical interlocks to disconnect external control voltage unless starter includes suitable approved enclosed contacts and connections.
 - "Reset" button.
 - Pilot Lights of transformer type incandescent with amber safety lens cap.
 - Control transformer with 120 volt fused secondary and sized to suit current rating of associated control devices.
 - Scheduled cover mounted control devices with standard duty double break contact blocks.
 - Minimum of two auxiliary contacts (unused "Seal-in" contact may be included).
- .13 Contactors for non-motor applications shall be built similar to combination magnetic starters, except less overload relays, and with Gould Shawmut AJT time delay HRC1-J fuses, rated for load, and with enclosed continuous current rating of at least 125% of connected full load.
- .14 "Double Voltage Relays" shall be CGE Model CR120 LXMC with general purpose enclosure, number of contacts required and "Mylar" shroud of enclosure of contacts, or equivalent.
- .15 Pilot devices such as "Start-Stop" pushbuttons, "Hand-Off-Auto" selector switches and indicating lights shall be of heavy-duty construction. Indicating lamps shall be transformer type incandescent with amber safety lens caps.
- .16 Each control unit shall be provided with engraved nameplates for designation of device controlled and duty.

- .17 Control wiring shall be 120 volt A.C. maximum. Provide control circuit transformers where these are not included in motor starters. Secondaries of control transformers shall be fused with one side grounded and controls, safety devices and interlocks shall be connected in ungrounded conductor, excepting only integral starter overload devices.
- .18 Single phase motors interlocked to start or operate with other equipment shall be provided with magnetic starters or suitable relays with necessary auxiliary contacts and double voltage relays or be otherwise electrically separated.
- .19 Overload relay heaters for starters shall be selected and field adjusted to trip at maximum value of 115% of actual nameplate full load amperes. Selection of heater elements shall be based on starter manufacturer's recommendations. Obtain data from Mechanical Division. Submit Motor Starter Schedule which shall list following for each motor:
 - Proposed equipment nameplate data
 - Actual full load amperes of motor
 - Speed of motor
 - Temperature Class in degrees Celsius rise and insulation class.
 - Circuit breaker or fuse type and proposed rating
 - Type of motor, duty and service factor.
- .20 Overload relay heaters shall trip in 20 seconds or less from cold or motor-locked rotar condition.
- .21 Where equipment is noted to be electrically interlocked, provide necessary interlocks, double voltage relays (Mylar shroud accepted) to provide specified operation.
- .22 Provide all fuses required to protect equipment. Fuses shall be proper size blade type time delay HRC1-J current limiting. Supply three spare fuses of each size and type and obtain duplicate receipt for same. Fuse clips shall reject standard NEC fuses. Fuses shall be rated in accordance with manufacturer's published data. Fuses to be of one manufacturer throughout.
- .23 Acceptable Alternate Manufacturers
 - 1. Furnas Electric Co.
 - 2. Westinghouse Electric Company
 - 3. Allen Bradley
 - 4. Schneider Electric - Square 'D'
 - 5. Cutler Hammer Canada
 - 6. Klockner-Moeller
 - 7. Commander Electric Inc.
 - 8. Schneider Electric - TelemecaniqueOr equivalent.

2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Please refer to Section 01 25 00 – Product Substitution Procedures.
- .2 The Contract Price shall be based on the product related requirements specified in the Contract Documents.
- .3 Where the Contractor, with the Consultant's approval, uses equipment other than that first named, on which the design is based, it shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. The Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by the Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in the Contract Price.

2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by the Consultant.
- .2 Apply, in writing, to the Consultant for substitution of any products, indicating the following:
 - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
 - .2 Reason for substitution.
 - .3 Any revisions to the contract price made necessary by substitution.
 - .4 Any revisions to the contract time made necessary by substitution.
 - .5 Any revisions to layout, arrangement or services made necessary by substitution.
- .3 No substitutions will be permitted without written authorization from the Consultant.
- .4 Refer to Section 01 25 00 – Product Substitution Procedures for further requirements.

3 Execution

3.1 INSTALLATION REQUIREMENTS

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings prior to installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise in the Contract Documents, install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.
- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.
- .9 Do not use powder activated tools except as permitted by the Consultant and the Owner's workplace health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural Drawings or as directed by the Consultant.

3.2 CONTRACT DRAWINGS

- .1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.
- .2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement.
 - Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, (beams, columns, etc.).

- Obtain the Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to the Contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 m) in any direction without a change to the Contract Price.
- .5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of this Division.
- .6 The drawings of this Division are intended for tender pricing. The quantities and quality to be included in the Contract Price shall be based on the layout and specifications as shown on the mechanical documents. If there is a difference in quantity between the architectural and drawings of this Division, base the contract price on the greater quantity.
- .7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.3 CONSTRUCTION DRAWINGS

- .1 Prepare fully dimensioned drawings showing devices, fixtures, equipment, outlets, sleeves and openings through structure. Indicate locations and weights on load points.
- .2 Prepare fully dimensioned construction drawings of products and services suitably interfaced with work of the sub-trades, in mechanical rooms, service and ceiling spaces, and other critical locations. Coordinate the work with other divisions. Base drawings on reviewed shop drawings and latest architectural drawings. Indicate details pertaining to the following: access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevation of pipes, ducts, conduits.
- .3 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.
- .4 Submit construction drawings to other Divisions. Provide one (1) transparency and four (4) print copies of construction drawings to the Consultant for record purposes.
- .5 Submit construction drawings prior to commencement of work.

3.4 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings. Obtain white prints from the Consultant for this purpose and pay printing costs. Identify each set as "Project Record Copy".
- .2 Record deviations from the Contract Documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of the Consultant's documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a DVD in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.

- .6 Submit the "Project Record Copy" on one or more DVD with white prints of each drawing to the Consultant at the time of Substantial Performance of the Work.

3.5 USE OF EQUIPMENT

- .1 For the duration of this Contract, do not use any piece of equipment provided under this Contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the Owner and the Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.
- .2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.6 SPECIAL TOOLS AND SPARE PARTS

- .1 Within 30 days of award of the Contract, prepare a complete itemized list of special tools and spare parts and submit to the Consultant for review. List will be used as a checklist and should include provision for sign off by the Owner on receipt.
- .2 On completion of the project furnish spare parts to the Owner as follows:
 - .1 One set of mechanical seals for each pump.
 - .2 One casing joint gasket for each pump.
 - .3 One head gasket for each heat exchanger.
 - .4 One glass for each gauge glass installed.
 - .5 One set of v-belts for each piece of machinery.
 - .6 One set of new filters for each filter bank installed.
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of special tools required to service equipment as recommended by
- .5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

3.7 INSTRUCTION

- .1 Instruct and familiarize the Owner's operating personnel with the various mechanical systems.
 - Arrange instruction for each system separately.
- .2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.
- .3 Ensure each instruction period includes, but is not limited to the following;
 - .1 a classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
 - .2 instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
 - .3 demonstration of the proper operating procedures for each item of equipment,
 - .4 explanation of the purpose and function of all safety devices provided,
 - .5 demonstration of all measures required for safe and proper access for operation and maintenance.
- .4 Provide a period of follow-up instruction (on two occasions) approximately one month after completing the Owner's instruction to clarify and reinforce

- earlier instructions.
- .5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to Substantial Performance of the Work.

3.8 START UP AND COMMISSIONING

- .1 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.
- .2 The Startup and Commissioning Team shall be comprised of;
 - .1 The individual, company or agency undertaking the work of each Section,
 - .2 Representatives of the Contractor and its Subcontractors as required,
 - .3 Representatives of equipment manufacturers,
 - .4 Representatives of the Consultants,
 - .5 Representatives of the Owner.
- .4 The Contractor and its Subcontractors shall each assign an individual representing each of the relevant trades to the startup and commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.
- .5 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.
- .6 Each Section shall prepare Check Sheets in accordance with the standards listed above and shall issue them to the commissioning team for use during the commissioning process.
- .7 Three (3) copies of commissioning manuals shall be provided, bound in hard cover D-ring binders with transparent cover on front and spine personalized to indicate;
 - .1 name and logo of Facility,
 - .2 name of the project,
 - .3 the Owner's project number,
 - .4 identification of the system commissioned,
 - .5 the date that the system was commissioned.
- .8 Commissioning manuals shall include machine printable index dividers to organize each manual by system and by commissioning stage.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 21 01 01.

1.2 SECTION INCLUDES

- .1 Pipe, fittings, valves, and connections for fire protection systems.

1.3 REFERENCES

- .1 ASME Boiler and Pressure Vessel Code Section IX - Welding and Brazing Qualifications.
- .2 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- .3 ASME B16.3 - Malleable Iron Threaded Fittings.
- .4 ASME B16.4 - Cast Iron Threaded Fittings.
- .5 ASME B16.5 - Pipe Flanges and Flanged Fittings.
- .6 ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.
- .7 ASME B16.11 - Forged Fittings Socket Welding and Threaded.
- .8 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .10 ASME B16.25 - Buttwelding Ends.
- .11 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- .12 ASTM A135 - Electric-Resistance-Welded Steel Pipe.
- .13 ASTM A47/A47M - Ferritic Malleable Iron Castings.
- .14 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- .15 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .16 ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- .26 AWS A5.8 - Filler Metal for Brazing and Braze Welding.
- .27 AWS D10.10 - Recommended Practices for Local Heating of Welds in Piping and Tubing.
- .28 AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3" (76 mm) through 48" (1219 mm) for Welder.
- .29 AWWA C151 - Ductile Iron Pipe, Centrifugally Cast, for Water.
- .30 NFPA 13 - Installation of Sprinkler Systems.
- .31 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.
- .32 NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances
- .33 ULC - Fire Resistance Directory.
- .34 UL 262 - Gate Valves for Fire-Protection Service.
- .35 UL 312 - Check Valves for Fire-Protection Service.
- .36 UL 405 - Fire Department Connections.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 21 01 01: Procedures for submittals.
- .2 Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- .3 Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Project Record Documents: Record actual locations of components and tag numbering.
- .2 Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with a minimum of 5 years' experience.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to OBC and OFC.
- .2 Sprinkler Systems: Conform work to NFPA 13.
- .3 Standpipe and Hose Systems: Conform to NFPA 14.
- .4 Welding Materials and Procedures: Conform to ASME Code.
- .5 Valves: Bear FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- .6 Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver and store valves in shipping containers, with labelling in place.
- .2 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.9 EXTRA MATERIALS

- .1 Provide two of valve stem packings for each size and type of valve installed.

2 Products

2.1 BURIED PIPING

- .1 Cast Iron Pipe: AWWA C151.
 - .1 Fittings: AWWA C110, standard thickness.
 - .2 Joints: AWWA C111, rubber gasket.
 - .3 Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.
 - .4 Thrust Blocks and Anchors: not later than 1 part cement, 2.5 parts sand, 5 parts stone.

2.2 ABOVE GROUND PIPING

- .1 Steel Pipe: ASTM A53; Schedule 10.
 - .1 joined by welding or by roll grooved pipe and fittings:
 - .1 schedule 10 for sizes 5" (125mm) and smaller,
 - .2 0.134" (3.40mm) for 6" (150mm) diameter,
 - .3 0.188" (4.78mm) for 8" and 10" (200mm and 250mm) diameter.
 - .2 joined with threaded fittings or cut groove pipe and fittings:
 - .1 schedule 40 for sizes 6" (150mm) diameter and smaller,
 - .2 schedule 30 for sizes 8" (200mm) diameter and larger.
- .2 Pipe Fittings:
 - .1 Steel Fittings: ASME B16.9, wrought steel, butt welded;
 - .2 Cast Iron Fittings: ASME B16.1, flanges and flanged fittings;
 - .3 Malleable Iron Fittings: ASME B16.3, threaded fittings.
 - .4 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts,

- nuts, and washers; galvanized for galvanized pipe.
- .5 Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocket and O-ring uniformly compressed into permanent mechanical engagement onto pipe.

2.3 PIPE HANGERS AND SUPPORTS

- .1 Conform to NFPA 13 and NFPA 14.
- .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 mm): Carbon steel, adjustable swivel, split ring.
- .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
- .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- .5 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
- .6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
- .7 Vertical Support: Steel riser clamp.
- .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.4 VALVES - GENERAL

- .1 cUL or ULC and FM approved, listed and labelled.
- .2 All valves controlling connections to water supplies shall be listed indicating valves.
- .3 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .4 Provide valves of the same manufacturer where possible.
- .5 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
- .6 All valves supplied for this project shall have a current and valid Canadian Registration Number for the Province of Ontario with TSSA. Suppliers shall provide a copy of the Statutory Declaration for valves, stamped, signed and dated by TSSA as validation of the CRN registration. This shall be included with the shop drawing submittal package.
- .7 Materials:
- | | |
|---------------|-------------------------------|
| .1 Bronze: | ASTM B62 or B61 as applicable |
| .2 Brass: | ASTM B283 C3770 |
| .3 Cast Iron: | ASTM A126 Class B |
- .8 End Connections:
- | | |
|-----------------------------|------------------------------------|
| .1 Threaded ends: | ANSI B1.20.1 |
| .2 Flanged ends: | ANSI B16.1 (Class 125), ANSI B16.5 |
| .3 Face-to-face dimensions: | ANSI B16.10 |
- .9 Design and Testing:
- | | |
|--------------------------------|-----------|
| .1 Bronze Gate & Check valves: | MSS-SP-80 |
| .2 Cast Iron Gate Valves: | MSS-SP-70 |
| .3 Cast Iron Globe Valves: | MSS-SP-85 |
| .4 Cast Iron Check: | MSS-SP-71 |
| .5 Butterfly Valves: | MSS-SP-67 |
- .10 Acceptable manufacturers:
- | |
|--------------------|
| .1 Kitz |
| .2 Crane, Jenkins. |
| .3 Conbraco. |
| .4 Nibco |
| Or equivalent. |

2.5 ISOLATION VALVES

- .1 Electrically Supervised: ULC listed, FM approved, NO/NC SPDT dry contact switch suitable for electrical supervision on trouble circuit of facility fire alarm system. Valve monitoring switches shall be Potter Electric Signal and Manufacturing Limited or equivalent.

- .2 Up to 2" (50 mm):
 - .1 Construction: ULC listed, FM approved, 300 psig non-shock WOG, ASTM B62 bronze body, solid wedge disc, rising stem, bronze trim, threaded ends, Kitz #25
- .3 2-1/2" (65 mm) and Larger:
 - .1 Construction: ULC listed, FM approved, 175 psi 1210 kPa CWP, outside screw and yoke, cast iron body, stem with ACME double threads, tapered solid wedge disc, flanged ends, renewable bronze seat rings.

2.6 CHECK VALVES

- .1 2-1/2 " (65 mm) and Larger:
 - .1 Construction: ULC listed, FM approved, 175psi (1210 kPa)CWP, iron body and bolted cap, bronze trim, bronze swing disc with replaceable bronze seat rings, flanged ends.
 - OR**
 - .2 Construction: ULC listed, FM approved, 175 psi (1210 kPa), Cast Iron body, 316 stainless steel shaft, Double Door Bronze Disc to B-62, Buna seat, 316 stainless steel spring, wafer style.

2.7 DRAIN VALVES

- .1 Construction: ULC listed and FM approved, brass ball valve with cap and chain, 3/4" (20 mm) hose thread.

3 Execution

3.1 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and foreign material, from inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- .1 Install piping to NFPA 13 for sprinkler systems,
- .2 Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- .3 Install piping to conserve building space, to not interfere with use of space and other work.
- .4 Group piping whenever practical at common elevations.
- .5 Sleeve pipes passing through partitions, walls, and floors.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Inserts:
 - .1 Provide inserts for placement in concrete formwork.
 - .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
 - .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

- .8 Pipe Hangers and Supports:
 - .1 Install to NFPA 13.
 - .2 Install hangers to provide minimum 1/2" (15 mm) space between finished covering and adjacent work.
 - .3 Place hangers within 12" (300 mm) of each horizontal elbow.
 - .4 Use hangers with 1-1/2" (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - .5 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - .7 Provide copper plated hangers and supports for copper piping.
- .9 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .10 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding, maximum VOC content of 250 g/L..
- .11 Do not penetrate building structural members unless indicated.
- .12 Provide sleeves when penetrating footings. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- .13 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .14 Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- .15 Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- .16 Provide ball valves for shut-off or isolating service.
- .17 Provide drain valves at main shut-off valves, low points of piping and apparatus.
- .18 All control, drain and test connection valves shall be provided with permanently engraved and marked weatherproof metal or rigid plastic identification signs, secured with weather resistant chain or other approved method.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 21 01 01.

1.2 SECTION INCLUDES

- .1 System design, installation, and certification.
- .2 Wet-pipe sprinkler assembly.
- .3 Fire department connections.

1.3 REFERENCES

- .1 NFPA 13 - Installation of Sprinkler Systems
- .2 NFPA 13A - Inspection, Testing and Maintenance of Sprinkler Systems
- .3 NFPA 15 - Water Spray Fixed Systems
- .4 NFPA 16 - Installation of Deluge Foam-Water Sprinkler System and Foam-Water Spray Systems
- .5 NFPA 16A - Installation of Closed-Head Foam-Water Sprinkler Systems
- .6 NFPA 25 - Water Based Fire Protection Systems
- .7 NFPA 26 - Supervision of Valves Controlling Water Supplies
- .8 NFPA 72 - Installation, Maintenance and Use of Protective Signaling Systems
- .9 NFPA 72E - Automatic Fire Detectors
- .10 NFPA 72G - Installation, Maintenance and Use of Notification Appliances for Protective Signaling Systems
- .11 NFPA 72H - Testing Procedures for Local, Auxiliary, Remote Station and Proprietary Protective Signaling Systems
- .12 NFPA 75 - Protection of Electronic Computer/Data Processing Equipment
- .13 NFPA 231 - General Storage
- .14 NFPA 231C - Rack Storage of Materials
- .15 NFPA 291 - Fire Flow Testing and Marking of Hydrants
- .16 FM - Factory Mutual Approval Guide.
- .17 ULC - Fire Resistance Directory.
- .18 UL 199 - Automatic Sprinklers for Fire-Protection Service.

1.4 SYSTEM DESCRIPTION

- .1 System to provide coverage for entire building.
- .2 Provide system to the Owner's Insurer's occupancy requirements.
- .3 Determine volume and pressure of incoming water supply from water flow test data.
- .4 Interface system with building fire alarm system.
- .5 Provide fire department connections where indicated in the Contract Documents.

1.5 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data on following components including manufacturers' catalogue information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
 - .1 sprinkler alarm valves
 - .2 flow switches
 - .3 water motor alarm
 - .4 Siamese pumper connection
 - .5 low pressure alarm switch
 - .6 ball drain valve
 - .7 sprinkler heads

- .8 shut-off valves
- .2 Preliminary layout: show finished ceiling areas indicating sprinkler locations coordinated with ceiling installation.
- .3 Hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories, indicating:
 - .1 Sheet number.
 - .2 Sprinkler description and discharge constant K.
 - .3 Hydraulic reference points.
 - .4 Flow l/s.
 - .5 Pipe size.
 - .6 Pipe lengths, center to center of fittings.
 - .7 Equivalent pipe lengths for fitting and devices.
 - .8 Friction loss in kPa at each reference point.
 - .9 Total friction loss between reference points.
 - .10 Elevation head in kPa at each reference point.
 - .11 Required pressure in kPa at each reference point.
 - .12 Velocity pressure and normal pressure if included in calculations.
 - .13 Notes to indicate starting points, reference to other sheets or to clarify data shown.
 - .14 Semi-logarithmic graph paper indicating water supply curves and systems requirements plus inside and outside hose requirements so as to present a graphic summary of complete hydraulic calculations.
- .4 Layout and Installation Drawings: Clearly indicate:
 - .1 Name and department or agency
 - .2 Location, including street address.
 - .3 Point of compass
 - .4 Ceiling construction.
 - .5 Full height cross section.
 - .6 Location of fire walls.
 - .7 Occupancy of each area or room.
 - .8 Location and size of blind spaces and closets.
 - .9 Any questionable small enclosures in which no sprinklers are to be installed.
 - .10 Size of city main in street, pressure and whether dead-end or circulating and if dead-end, direction and distance to nearest circulating main, with city main test results.
 - .11 Other sources of water supply, with pressure or elevation.
 - .12 Make, type and orifice size of sprinklers.
 - .13 Temperature rating and location of high temperature sprinklers.
 - .14 Number of sprinklers on each riser and on each zone.
 - .15 Number of sprinklers on each riser and total per floor.
 - .16 Make, type, model and size of alarm valves.
 - .17 Arrangement and operation of system controls.
 - .18 Kind and location of alarm bells.
 - .19 Cutting lengths of pipe or centre to centre dimensions.
 - .20 Crosses, riser nipples and sizes.
 - .21 Type of hangers, inserts and sleeves.
 - .22 All control valves, checks, drain pipes and test pipes.
 - .23 Small hand hose and hose equipment.
 - .24 When plans include underground pipe indicate: weight or class and size of pipe pits; depth of top of pipe below grade.
 - .25 Provisions for flushing.
 - .26 Name and address of contractor
 - .27 A summary sheet, clearly indicating:
 - .1 Date.
 - .2 Location.
 - .3 Name of department of agency.
 - .4 Building number or other identification.
 - .5 Description of hazard.
 - .6 Name and address of contractor or designer.
 - .7 Name of approving agency.

- .8 System design requirements, including design area of water application, minimum rate of application and area per sprinkler.
- .9 Total water requirements as calculated including allowance for inside hose and outside hydrants.
- .10 Water supply information.
- .5 Submit shop drawings to the Owner's insurance underwriter and authorities having jurisdiction for approval. Submit proof of approval to the Consultant.
- .6 Samples: Submit two of each style of sprinkler specified.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- .2 Contractor's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- .3 Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in the Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- .1 Perform Work to OBC, NFPA 13 and the Owner's Insurer's requirements. Maintain one copy on site.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with a minimum of three years' documented experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.
- .4 Design system under direct supervision of a Professional Engineer experienced in design of this work.

1.8 REGULATORY REQUIREMENTS

- .1 Conform to OBC, OFC, ULC.
- .2 Perform Work to NFPA 13.
- .3 Equipment and Components: Bear ULC and FM label or marking.
- .4 Products Requiring Electrical Connection: CSA Listed and classified by Underwriters Laboratories of Canada Inc., as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 EXTRA MATERIALS

- .1 Provide extra sprinklers to NFPA 13.
- .2 Provide suitable wrenches for each sprinkler type.
- .3 Provide metal storage cabinet located adjacent to alarm valve.

2 Products

2.1 MANUFACTURERS

2.2 SPRINKLERS

- .1 Suspended Ceiling:
 - .1 Type: Semi-recessed pendant type with matching push on escutcheon plate.
 - .2 Finish: Chrome plated.

- .3 Escutcheon Plate Finish: Chrome plated.
- .4 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .2 Exposed Area Type:
 - .1 Type: Standard upright type with guard.
 - .2 Finish: Brass.
 - .3 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .3 Sidewall Type:
 - .1 Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate and guard.
 - .2 Finish: Chrome plated.
 - .3 Escutcheon Plate Finish: Chrome plated.
 - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .4 Dry Sprinklers:
 - .1 Type: Standard pendant type with matching push on escutcheon plate.
 - .2 Finish: Brass.
 - .3 Escutcheon Plate Finish: Brass.
 - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .5 Concealed Pendant:
 - .1 Cover plate attachment with 1/2" (13mm) assembly adjustment.
 - .2 Smooth aesthetic ceiling profile.
 - .3 Factory installed protective cap.
 - .4 Factory painted (confirm colour with architect prior to ordering)
- .6 Guards: Finish to match sprinkler finish.

2.3 PIPING SPECIALTIES

- .1 Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- .2 Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
- .3 Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- .4 Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- .5 Fire Department Connections:
 - .1 Type: Flush mounted wall type with chrome plated finish.
 - .2 Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - .3 Drain: 3/4" (19 mm) automatic drip, outside.
 - .4 Label: "Sprinkler - Fire Department Connection".
- .6 Supervisory Switches: As manufactured by Potter.

3 Execution

3.1 INSTALLATION

- .1 Install to NFPA 13.
- .2 Install equipment to manufacturers instructions.
- .3 Install buried shut-off valves in valve box. Provide post indicator.
- .4 Provide approved reduced pressure principle backflow preventer assembly at sprinkler system water source connection.
- .5 Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- .6 Locate outside alarm gong on building wall as indicated.
- .7 Place pipe runs to minimize obstruction to other work.
- .8 Place piping in concealed spaces above finished ceilings.
- .9 Centre sprinklers in two directions in ceiling tile and provide piping offsets as required.

- .10 Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- .11 Install Dry pipe sprinkler system for the ceiling space, refer to architectural drawings for ceiling/attic details.
- .12 Dry pipe sprinkler system with all required accessories to make it fully operational.
- .13 Flush entire piping system of foreign matter.
- .14 Hydrostatically test entire system.
- .15 Require test be witnessed by Fire Marshall.

3.2 INTERFACE WITH OTHER PRODUCTS

- .1 Ensure required devices are installed and connected as required to fire alarm system.

3.3 OPERATING SEQUENCE FOR WET SPRINKLERS

- .1 In Normal Set Condition: The system piping is filled with water.
 - .1 All water supply control valves open and secured.
 - .2 Alarm test shut-off valve in "ALARM" position.
 - .3 Water gauge valves open.
 - .4 The water supply pressure gauge (lower gauge) equals that of the known service-line pressure. The system pressure gauge (upper gauge) reading is equal to or greater than the water supply pressure gauge reading.
 - .5 Incoming power to all alarm switches on.
 - .6 Main-drain valve, auxiliary drain valves and inspectors test valves tightly closed.
 - .7 The sprinkler head cabinet contains appropriate replacement sprinklers and wrenches.
 - .8 Temperature maintained above freezing for entire system.
 - .9 If Fire Department connection is used, make sure the automatic drip valve is free allowing accumulated water to escape.
 - .10 Sprinklers in good condition and unobstructed.
- .2 In Fire Condition:
 - .1 The heat produced operates a sprinkler allowing the water to flow.
 - .2 The alarm valve clapper is opened by the flow of water allowing pressurized water to enter the alarm port to activate the connected alarm devices.
 - .3 When using variable pressure trim the water flowing through the alarm port overcomes the retarding chamber's drain restriction, filling the retarding chamber then activating the connected alarm devices.
 - .4 The alarms will continue to sound until the flow of water is manually turned off.
- .3 In Service condition:
 - .1 The system should be placed out of service only for repairs.
 - .2 The work to be done must be completed in a manner to minimize the time that the system must be out of service.
 - .3 All hazardous activities in the effected area shall be terminated until the system is placed back in service.
 - .4 Any system impairment shall be coordinated with the Owner, local authority having jurisdiction and other related parties.
 - .5 Provide a roving fire patrol in the area covered by the system until the system is back in service.
 - .6 Prior to turning off any valves or activating any alarms, notify local security guards and/or central alarm station so that a false alarm will not be signaled and result in a local fire department response.

3.4 TESTING AND INSPECTION

- .1 Test automatic sprinkler in accordance with requirements of NFPA 13 and NFPA 25.
 - .1 hydrostatically tested at 50 psi (3.5 bar) in excess of system working pressure and minimum test pressure of 200 psi (13.8 bar) for 2-hr.
 - .2 When cold weather prevents testing with water, an interim test may be conducted with air. The hydrostatic test with water must be conducted subsequently when conditions permit.

- .3 modifications affecting fewer than 20 sprinklers and modifications that cannot be isolated shall not require testing in excess of system working pressure. Modifications affecting more than 20 sprinklers shall be isolated and tested at not less than 200 psi (13.8 bar) for 2-hr.
- .4 loss shall be determined by a drop-in gauge pressure or by visible leakage.
- .2 Arrange and pay for all reviews and inspections required by:
 - .1 Local inspection authority.
 - .2 the Owner's insurance authority.
- .3 Coordinate testing of automatic sprinkler systems with fire alarm system verification to ensure that all devices are fully tested.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Read and conform to:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended in the Contract Documents,
 - .2 Division 1 requirements and documents referred to therein.
- .2 Section 22 01 01 applies to and governs the work of all Sections of Divisions 21, 22 and 23.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among Subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the work.
- .4 The specifications are integral with the Drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the costliest arrangement.

1.2 DEFINITIONS

- .1 The following are definitions of words found in this specification and on associated drawings under this Division:
 - .1 "Concealed" - locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
 - .2 "Exposed" - mechanical work normally visible to building occupants.
 - .3 "Furnish" - (and its derivatives) has the same meaning as the term "Supply".
 - .4 "Install" - (and its derivatives) - receive, store and handle at the site, mount and support and connect all required services. Includes adjustment and calibration, testing, commissioning, inspection by authorities having jurisdiction and documentation.
 - .5 "Provide" - (and its derivatives) - supply, install in place, connect the associated required services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.
 - .6 "Supply" - (and its derivatives) purchase and deliver to the site for installation. Includes submittals, manufacturer's field inspection and warranty.
 - .7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.

1.3 WORK INCLUDED

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Cutting and patching of new or existing work
- .3 Excavating and backfilling
- .4 Identification of equipment, piping, ductwork, and valves and controllers
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches.
- .6 Motors required for equipment supplied under this Division.
- .7 Variable frequency drives for motors and equipment supplied under this Division.
- .8 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under this Division.
- .9 Disconnect switches for exhaust fans located on the roof complete with;
 - .1 EEMAC 1 enclosure if housed within a weatherproof cabinet,
 - .2 EEMAC 3 enclosure if exposed to weather
- .10 Refer to Mechanical/Electrical Equipment Schedule in the Contract Documents for extent of wiring and electrical characteristics.
- .11 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.

1.4 RELATED WORK

- .1 Power wiring, conduit and connections for motors under this Division will be by Electrical Division.
- .2 Power wiring, conduit and connections to variable frequency drives for motors under this Division will be by Electrical Division. Wiring and connections from VFD to motors under this Division will be by Electrical Division.
- .3 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under this Division.
- .4 Painting of exposed piping and ductwork other than for identification will be supplied under Division 9.
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches will be provided under Division 3.

1.5 SUBMITTALS

- .1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction, and obtain two (2) copies of approved drawings for retention by the Consultant prior to commencement of work under this Division.
- .2 Shop Drawings: Prepare and submit two (2) copies of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return one copy, marked with comments and his review stamp as he deems appropriate. The Contractor shall ensure that the necessary number of copies of the returned set are prepared and distributed to the Owner, the Consultant, the site, and to relevant Subcontractors and suppliers.
 - .1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by the Consultant.
 - .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
 - .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
 - .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:
"This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."
- .3 Sleeving Drawings: Prepare and submit 4 copies of sleeving drawings to clearly and accurately indicate the exact location, elevation and size of any and all formed holes, recesses and sleeving required in the work of Divisions 21, 22 and 23. Obtain Consultant's approval in writing prior to sleeving, forming or cutting any such opening. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
- .4 Composite Wiring Diagrams: Prepare and submit three (3) copies of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.
- .5 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they conform to the requirements of those documents (e.g. NFPA-standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:
 - .1 description of the system (description and type),
 - .2 description of the tests conducted and results observed, including re-testing, where

- necessary,
- .3 description of any corrective measures undertaken,
- .4 description of materials used (pipe and fittings),
- .5 list of witnesses for each test conducted,
- .6 date system left ready for service,
- .7 signature of installing Contractor.
- .6 Directories & Schematics
 - .1 Submit five (5) copies of a neat typewritten directory indicating the valve number, related service, and location of each valve under this Division.
 - .2 Submit five (5) copies of system control schematics for each mechanical system indicating relative locations of equipment and control devices.
 - .3 Enclose one (1) copy of each directory/schematic under glass in a neat polished 18" x24" (460 mm x 610 mm) metal frame, complete with mounting clips.
- .7 Maintenance Data and Operating Instructions
 - .1 Submit three (3) copies of Operation and Maintenance Manual individually bound in hard backed three-ring binders.
 - .2 Ensure the binder spines have typewritten lettering as follows:
OPERATION & MAINTENANCE MANUAL for
[Insert name of project]
[Insert date of submission]
[Insert Division Title]
 - .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, the Contractor, and the Consultant. Include special telephone numbers for service departments on normal and emergency call basis.
 - .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.
 - .5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.
 - .6 Ensure operating instructions include the following:
 - .1 General description of each mechanical system.
 - .2 Step by step procedure to follow in putting each piece of equipment into service.
 - .3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.
 - .4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches and relays.
 - .5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.
 - .7 Ensure maintenance instructions include the following:
 - .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.
 - .2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
 - .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
 - .4 Balancing and testing reports.
 - .5 Copy of valve directory.
- .8 As-Built Records: Prepare and submit complete as-built records in CAD copies prior to Substantial Performance of the Work. Refer to paragraph 3.2.5 and to Division 1 for requirements.
- .9 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption

- from the Owner prior to disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 1 for additional requirements.
- .10 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

1.6 QUALITY ASSURANCE

- .1 Conform to minimum requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:
- | | | |
|-----|--------|--|
| .1 | AABC | Associated Air Balance Council |
| .2 | AMCA | Air Moving and Conditioning Association |
| .3 | ANSI | American National Standards Institute |
| .4 | ASA | American Standards Association |
| .5 | ASHRAE | American Society of Heating, Refrigerating, and Air Conditioning Engineers |
| .6 | ASME | American Society of Mechanical Engineers |
| .7 | ASSE | American Society of Sanitary Engineers |
| .8 | ASPE | American Society of Plumbing Engineers |
| .9 | ASTM | American Society of Testing and Materials |
| .10 | AWWA | American Water Works Association |
| .11 | CAN2 | National Standard of Canada (Published by CGSB) |
| .12 | CAN3 | National Standard of Canada (Published by CSA) |
| .13 | CGSB | Canadian General Standards Board |
| .14 | CSA | Canadian Standards Association |
| .15 | EEMAC | Electrical & Electronic Manufacturer's Association of Canada |
| .16 | NBC | National Building Code of Canada |
| .17 | NEBB | National Environmental Balancing Bureau |
| .18 | NFPA | National Fire Protection Association |
| .19 | NEMA | National Electrical Manufacturers Association |
| .20 | OBC | Ontario Building Code |
| .21 | OFC | Ontario Fire Code |
| .22 | OFM | Ontario Fire Marshall |
| .23 | SMACNA | Sheet Metal & Air Conditioning Contractors National Association |
| .24 | TIAC | Thermal Insulation Association of Canada |
| .25 | ULC | Underwriter's Laboratories of Canada Ltd |
| .26 | UL | Underwriter's Laboratories (including cUL) |
- .3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.
- .4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
- .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.
- .6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.
- .7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify the Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.8 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of this Division.
- .2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily

- completed.
- .3 Notify the Consultant upon discovery of conditions which adversely affect work of this Division. No allowance will be made after the Contract Award for any expenses incurred through failure to do so.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications.

1.9 INTERRUPTIONS

- .1 Arrange execution of work to maintain present building operations, and to minimize the effect of work under this Division on existing operations.
- .2 Prior to interrupting any existing service notify the Owner and the Consultant, in writing, at least 7 days in advance, and obtain written authorization. Do not interrupt any existing service without the Consultant's specific authorization. Refer to Division 1 for requirements.
- .3 Arrange time and duration of interruption through the Owner. Include in the Contract Price for all overtime or premium time hours necessary to minimize duration of service interruption.
- .4 Test and verify the proper operation of existing equipment and systems that are shut down due to work of this project, prior to returning to service.
- .5 Assume responsibility for consequential costs on failure to obtain permission to shut-down and/or start-up any item of equipment, system or service.

1.10 WARRANTY

- .1 Refer to Division 1 and to Section 22 01 01 General Requirements.
- .2 Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .3 Make submissions necessary to register product warranties to the benefit of the Owner.
- .4 Submit to the Consultant, prior to Substantial Performance of the Work, manufacturer's written warranties covering periods longer than two years or offering greater benefits than required in specifications and in the Owner's name.

1.11 EXTRAS AND CREDITS

- .1 Accompany all price submissions requested by the Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
 - .1 Materials, quantities and unit costs including any applicable contractors trade discount clearly identified.
 - .2 Labour hours and unit costs.
 - .3 Total materials and labour costs.
 - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under this Division bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.
- .3 Ensure manufacturers and suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site prior to doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 MOTOR STARTERS & CONTROLS

- .1 Mechanical Divisions 21, 22 and 23 shall provide all motor starters and associated controls required and as scheduled on drawings and noted for Mechanical Division equipment. Starters and controls shall be Canadian General Electric or Alternate noted. All starters, contactors, thermal overloads, etc. must be EEMAC rated. All starters shall be of one manufacturer except as specifically approved otherwise for integral pre-wired assemblies.
- .2 Starter and control units shall be equipped with necessary number of auxiliary contacts and relays to provide control sequences described in Mechanical Equipment Starter Schedule on the Drawings. Auxiliary contacts shall be interchangeable normally open or normally closed, by conversion in field without additional parts exterior to starter.
- .3 Manual starters may only be provided for single phase equipment operated by control device such as thermostat or limit control when such control device is rated for full electrical load of equipment.
- .4 Manual starters provided for single phase equipment actuated by electric timer or shall have H.O.A. feature. "Hand" position shall permit shunting of time switch. Where such units also have protective device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" positions and shall not be shunted.
- .5 Manual starters may only be provided for three phase equipment which is not actuated by pilot control device (pressure switch, float switch, safety limit devices, remote manual control device) unless otherwise noted in Starter Schedule.
- .6 Magnetic starters for manually operated equipment shall have "On/Off" selector switch or "Start-Stop" pushbutton in cover as scheduled.
- .7 Magnetic starters which are started automatically by electric time switch shall include "Hand-Off-Automatic" (H.O.A.) selector switch. "Hand" position shall permit shunting of time switch or E.M.S. Where such units also have protective pilot device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" position and shall not be shunted.
- .8 Magnetic starters which are started automatically by remote pilot device (or interlocked units) such as level controller, pressure switch, thermostat or flow switch shall include "Hand-off-Auto" (H.O.A.) selector switch, and, where scheduled, a "Test" pushbutton. "Hand" position shall permit shunting of remote pilot device and thereby permit operation of starter but only while depressing "Test" button.
- .9 Equip starter apparatus for prime plumbing, heating, air conditioning and ventilating equipment so that these units will automatically restart on resumption of power after power outage. Starters for these units shall have "On/Off" selector switch in cover if not fitted with H.O.A. selector feature or manual starter or otherwise noted.
- .10 Safety control device such as flow switches, pressure switches, high and low limited ("Fire" and "Freeze") shall not be shunted by "Hand" position of switch.
- .11 Manual motor starter shall be toggle operated with following general construction features:
 - Quick-Make, Quick-Break mechanism with double-break contacts.
 - Overload protection heaters, one per phase and speed.
 - Enclosure to suit application.
 - Pilot light, neon lamp.
 - Cover engraved with "On-Trip-Off".
- .12 Magnetic motor starters shall comprise electrically-operated motor starters combined with disconnect switch with following general construction features:
 - Quick-Make, Quick-Break mechanism with double-break contacts.
 - Fuse holders to accept specified fuses, one per phase.
 - Adjustable overload relays, one per phase.
 - CEMA listed enclosure to suit application. Disconnect with mechanical cover interlocks, line side barriers and switch operated electrical interlocks to disconnect external control voltage unless starter includes suitable approved enclosed contacts and connections.
 - "Reset" button.
 - Pilot Lights of transformer type incandescent with amber safety lens cap.
 - Control transformer with 120 volt fused secondary and sized to suit current rating of associated control devices.
 - Scheduled cover mounted control devices with standard duty double break contact blocks.
 - Minimum of two auxiliary contacts (unused "Seal-in" contact may be included).
- .13 Contactors for non-motor applications shall be built similar to combination magnetic starters, except less overload relays, and with Gould Shawmut AJT time delay HRC1-J fuses, rated for load, and with enclosed continuous current rating of at least 125% of connected full load.

- .14 "Double Voltage Relays" shall be CGE Model CR120 LXMC with general purpose enclosure, number of contacts required and "Mylar" shroud of enclosure of contacts, or equivalent.
- .15 Pilot devices such as "Start-Stop" pushbuttons, "Hand-Off-Auto" selector switches and indicating lights shall be of heavy-duty construction. Indicating lamps shall be transformer type incandescent with amber safety lens caps.
- .16 Each control unit shall be provided with engraved nameplates for designation of device controlled and duty.
- .17 Control wiring shall be 120 volt A.C. maximum. Provide control circuit transformers where these are not included in motor starters. Secondaries of control transformers shall be fused with one side grounded and controls, safety devices and interlocks shall be connected in ungrounded conductor, excepting only integral starter overload devices.
- .18 Single phase motors interlocked to start or operate with other equipment shall be provided with magnetic starters or suitable relays with necessary auxiliary contacts and double voltage relays or be otherwise electrically separated.
- .19 Overload relay heaters for starters shall be selected and field adjusted to trip at maximum value of 115% of actual nameplate full load amperes. Selection of heater elements shall be based on starter manufacturer's recommendations. Obtain data from Mechanical Divisions 21, 22, and 23. Submit Motor Starter Schedule which shall list following for each motor:
 - Proposed equipment nameplate data
 - Actual full load amperes of motor
 - Speed of motor
 - Temperature Class in degrees Celsius rise and insulation class.
 - Circuit breaker or fuse type and proposed rating
 - Type of motor, duty and service factor.
- .20 Overload relay heaters shall trip in 20 seconds or less from cold or motor-locked rotar condition.
- .21 Where equipment is noted to be electrically interlocked, provide necessary interlocks, double voltage relays (Mylar shroud accepted) to provide specified operation.
- .22 Provide all fuses required to protect equipment. Fuses shall be proper size blade type time delay HRC1-J current limiting. Supply three spare fuses of each size and type and obtain duplicate receipt for same. Fuse clips shall reject standard NEC fuses. Fuses shall be rated in accordance with manufacturer's published data. Fuses to be of one manufacturer throughout.
- .23 Acceptable Alternate Manufacturers
 - 1. Furnas Electric Co.
 - 2. Westinghouse Electric Company
 - 3. Allen Bradley
 - 4. Schneider Electric - Square 'D'
 - 5. Cutler Hammer Canada
 - 6. Klockner-Moeller
 - 7. Commander Electric Inc.
 - 8. Schneider Electric - TelemecaniqueOr equivalent.

2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Please refer to Section 01 25 00 – Product Substitution Procedures.
- .2 The Contract Price shall be based on the product related requirements specified in the Contract Documents.
- .3 Where the Contractor, with the Consultant's approval, uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. The Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by the Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in the Contract Price.

2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products

- by other manufacturers may be permitted by the Consultant.
- .2 Apply, in writing, to the Consultant for substitution of any products, indicating the following:
 - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
 - .2 Reason for substitution.
 - .3 Any revisions to the contract price made necessary by substitution.
 - .4 Any revisions to the contract time made necessary by substitution.
 - .5 Any revisions to layout, arrangement or services made necessary by substitution.
 - .3 No substitutions will be permitted without written authorization from the Consultant.
 - .4 Refer to Section 01 25 00 – Product Substitution Procedures for further requirements.

3 Execution

3.1 RELATIONSHIP WITH OTHER TRADES

3.2 INSTALLATION REQUIREMENTS

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings prior to installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise in the Contract Documents install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.
- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.
- .9 Do not use powder activated tools except as permitted by the Consultant and the Owner's workplace health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural Drawings or as directed by the Consultant.

3.3 CONTRACT DRAWINGS

- .1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.
- .2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain the Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 m) in any direction without a change to the contract price.
- .5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of this Division.
- .6 The drawings of this Division are intended for tender pricing. The quantities and quality to be included in the Contract Price shall be based on the layout and specifications as shown in the Contract Documents. If there is a difference in quantity between the architectural and drawings of

- this Division, base the Contract Price on the greater quantity.
- .7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.4 CONSTRUCTION DRAWINGS

- .1 Prepare fully dimensioned drawings showing devices, fixtures, equipment, outlets, sleeves and openings through structure. Indicate locations and weights on load points.
- .2 Prepare fully dimensioned construction drawings of products and services suitably interfaced with work of the sub-trades, in mechanical rooms, service and ceiling spaces, and other critical locations. Coordinate the work with other divisions. Base drawings on reviewed shop drawings and latest architectural drawings. Indicate details pertaining to the following: access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevation of pipes, ducts, conduits.
- .3 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.
- .4 Submit construction drawings to other Divisions. Provide one (1) transparency and four (4) print copies of construction drawings to the Consultant for record purposes.
- .5 Submit construction drawings prior to commencement of work.

3.5 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings. Obtain white prints from the Consultant for this purpose and pay printing costs. Identify each set as "Project Record Copy".
- .2 Record deviations from the Contract Documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of the Consultants documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a DVD in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.
- .6 Submit the "Project Record Copy" on one or more DVD with white prints of each drawing to the Consultant at the time of Substantial Performance of the Work.

3.6 USE OF EQUIPMENT

- .1 For the duration of this contract, do not use any piece of equipment provided under this Contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the Owner and the Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.
- .2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.7 SPECIAL TOOLS AND SPARE PARTS

- .1 Within 30 days of award of the Contract, prepare a complete itemized list of special tools and spare parts and submit to Consultant for review. List will be used as a checklist and should include provision for sign off by the Owner on receipt.
- .2 On completion of the project furnish spare parts to the Owner as follows:

- .1 One set of mechanical seals for each pump.
- .2 One casing joint gasket for each pump.
- .3 One head gasket for each heat exchanger.
- .4 One glass for each gauge glass installed.
- .5 One set of v-belts for each piece of machinery.
- .6 One set of new filters for each filter bank installed.
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

3.8 INSTRUCTION

- .1 Instruct and familiarize the Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.
- .2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.
- .3 Ensure each instruction period includes, but is not limited to the following;
 - .1 a classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
 - .2 instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
 - .3 demonstration of the proper operating procedures for each item of equipment,
 - .4 explanation of the purpose and function of all safety devices provided,
 - .5 demonstration of all measures required for safe and proper access for operation and maintenance.
- .4 Provide a period of follow-up instruction (on two occasions) approximately one month after completing the Owner's instruction to clarify and reinforce earlier instructions.
- .5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to Substantial Performance of the Work.

3.9 START UP AND COMMISSIONING

- .1 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.
- .2 The Startup and Commissioning Team shall be comprised of;
 - .1 The individual, company or agency undertaking the work of each Section,
 - .2 Representatives of the Contractor and its Subcontractors as required,
 - .3 Representatives of equipment manufacturers,
 - .4 Representatives of the Consultants,
 - .5 Representatives of the Owner.
- .4 The Contractor and its Subcontractors shall each assign an individual representing each of the relevant trades to the startup and commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.
- .5 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.
- .6 Each Section shall prepare Check Sheets in accordance with the standards listed above and shall issue them to the commissioning team for use during the commissioning process.
- .7 Three (3) copies of commissioning manuals shall be provided, bound in hard cover D-ring binders with transparent cover on front and spine personalized to indicate;
 - .1 name and logo of Facility,
 - .2 name of the project,
 - .3 the Owner's project number,
 - .4 identification of the system commissioned,
 - .5 the date that the system was commissioned.
- .8 Commissioning manuals shall include machine printable index dividers to organize each manual by system and by commissioning stage.

End of Section

1 General

1.1 SCOPE / SUMMARY

- 1.1.1 Provide all metering equipment required to monitor consumption by end use type.

1.2 RELATED SECTIONS

- 1.2.1 Division 23 09 13 Instrumentation and Control Devices for HVAC
- 1.2.2 Division 26 09 13 – Electrical Power Monitoring

2 Design Requirements / Products

2.1 END USES TO BE MONITORED

- 2.1.1 Provide water meters for all end uses, including but not limited to:
 - 2.1.1.1 Facility incoming domestic cold water

2.2 METERING EQUIPMENT

2.2.1 Meters

- .1 Provide water meters complete with bypass piping arrangement or other means to remove or isolate for service without interruption to water flow.
- .2 Materials shall be compatible with the systems in which they are installed at all potential operating temperatures and pressures.
- .3 Meters shall provide a pulse output scaled to an appropriate volume. In general, provide a scaled pulse output of 1 litre per pulse unless high consumption would result in pulses too frequent to be reliably captured by the pulse counting equipment.
- .4 Meters requiring power shall be hard-wired. Battery powered units are not acceptable.
- .5 Provide meters with readout of totalized volume.
- .6 Accuracy +/- 1.5% in expected operating flow range.

2.2.2 Pulse Counting Equipment

- .1 Internet Protocol (IP) based data logger complete with:
 - 1. Built-in web server.
 - 2. Capable of operating with a dedicated IP address (to be provided by the Region).
 - 3. Communications Protocols
 - a. HTTP capable of pushing data to 3rd party applications/databases.
 - b. Modbus TCP
 - 4. Built-in real-time and historic graphics accessible with any HTML 5 internet browser (computer, tablet, phone) on the Region's network.
 - 5. Real-time clock with battery backup and email alert for battery end of life.
 - 6. Ability to export all stored trend data to comma separated value (.csv) or Microsoft Excel format for importing into spreadsheets.
 - 7. Published application programming interface (API) allowing data to be retrieved from the pulse counter via non-proprietary means, such as JavaScript Object Notation (JSON).
 - 8. Multiple inputs per unit MJL4. Provide minimum 2 spare inputs for future additional meters. Location of spare inputs to be determined by the Region.

9. Minimum two universal inputs for addition of 0-10V and 0-20mA/4-20mA sensors.
10. Built-in trending and data storage:
 - a. 3 years of consumption data at 5 minute intervals for each input
 - b. Stored in non-volatile memory.
11. Battery/power backup (for pulse counting):
 - a. Lasting a minimum of 72 hours.
 - b. Rechargeable.
 - c. Email alert for battery end of life.
12. No special software required to set up pulse counting equipment or access data.
13. Security:
 - a. Unrestricted access to data and graphics over the Region's network.
 - b. Password protection for access to setup, changing settings/parameters and deleting data.
14. Ability to measure and trend the following data:
 - a. Totalized consumption (m³)

.2 Acceptable product: z3 Controls Inc. NetMeter OMNI or equivalent.

3 Execution

3.1 INSTALLATION REQUIREMENTS

- .1 Install pulse counting equipment in a painted, hinged NEMA 1 enclosure.
- .2 All communication and pulse cables to be continuous. No splicing is allowed.
- .3 Affix York Region Property Services Branch Asset ID tag to data logging unit prior to installation.
- .4 Connect data logging equipment to the Region's IT network.
 1. Meter to be supplied and installed by mechanical contractor with bypass and isolation valves.
 2. A separate meter to be installed downstream of utility water meter for BAS with pulse contacts.
- .5 Commission pulse counting equipment:
 1. Ensure data logger corresponds to physical meter reading
 2. Ensure latest available firmware version is installed in pulse counter.
 3. Obtain Network information from York Region project manager and program into pulse counter, including IP address, subnet mask, default gateway, primary and secondary DNS addresses.
 4. Set pulse counter clock to current local time.
 5. Set up email alerts as requested by the Region's project manager.
 6. Set default homepage to display real-time graphs and consumption statistics.
 7. Verify pulse counter information is viewable through a web browser on a device on the Region's network.
 8. Complete and submit Energy Meter Commissioning Form.
 9. Provide training on pulse counter software use to Region staff including Facilities Operations and Maintenance and Corporate Energy Services.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 22 01 01.

1.2 SECTION INCLUDES

- .1 Pipe, pipe fittings, valves, and connections for piping systems.
 - .1 Storm Sewer.
 - .2 Sanitary Sewer
 - .3 Sanitary Vent
 - .4 Domestic (Potable) Water.
- .2 Disinfection of potable water distribution system.
- .3 Testing and reporting results.

1.3 REFERENCES

- .1 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- .4 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.
- .5 ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- .6 ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems.
- .7 ASTM A74 - Cast Iron Soil Pipe and Fittings.
- .8 ASTM B32 - Solder Metal.
- .9 ASTM B42 - Seamless Copper Pipe, Standard Sizes.
- .10 ASTM B68 - Seamless Copper Tube, Bright Annealed.
- .11 ASTM B75 - Seamless Copper Tube.
- .12 ASTM B88 - Seamless Copper Water Tube.
- .13 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- .14 ASTM B302 - Threadless Copper Pipe, Standard Sizes.
- .15 ASTM B306 - Copper Drainage Tube (DWV).

1.4 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Project Record Documents: Record actual locations of valves.

1.6 QUALITY ASSURANCE

- .1 Perform Work to the Ontario Building Code. Maintain one copy on site.
- .2 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

- .1 Perform Work to Ontario Building Code.
- .2 Conform to applicable code for installation of backflow prevention devices.
- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept valves on site in shipping containers with labelling in place. Inspect for damage.
- .2 Provide temporary protective coating on cast iron and steel valves.
- .3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install underground piping when bedding is wet or frozen.

1.10 EXTRA MATERIALS

- .1 Provide two repacking kits for each size valve.

2 Products

2.1 SANITARY SEWER PIPING, BURIED WITHIN 1500 mm (5 FEET) OF BUILDING

- .1 Cast Iron Pipe: ASTM A74 extra heavy weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- .2 Cast Iron Pipe: CISPI 301, hubless.
 - .1 Fittings: Cast iron.
 - .2 Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- .3 Copper Tube: ASTM B306, DWV.
 - .1 Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
 - .2 Joints: ASTM B32, solder, Grade 50B.
- .4 ABS Pipe: ASTM D2751 or ASTM F628.
 - .1 Fittings: ABS.
 - .2 Joints: ASTM D2235, solvent weld.
- .5 ABS Pipe: ASTM D2661 or ASTM D2751.
 - .1 Fittings: ABS.
 - .2 Joints: ASTM D2235, solvent weld.
- .6 PVC Pipe: ASTM D2665 or ASTM D3034.
 - .1 Fittings: PVC.
 - .2 Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- .7 PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
 - .1 Fittings: PVC.
 - .2 Joints: ASTM F477, elastomeric gaskets.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- .1 Cast Iron Pipe: ASTM A74, service weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: ASTM C564, neoprene gasket system
- .2 Cast Iron Pipe: CISPI 301, hubless, service weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- .3 Copper Tube: ASTM B306, DWV.
 - .1 Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper, or ASME B16.32, solvent.
 - .2 Joints: ASTM B32, solder, Grade 50B.

2.3 WATER PIPING, BURIED WITHIN 1500 mm (5 FEET) OF BUILDING

- .1 Copper Tubing: ASTM B42, hard drawn.
 - .1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - .2 Joints: AWS A5.8, BCuP silver braze.

- .2 Copper Tubing: ASTM B42, annealed.
 - .1 Fittings: ASME B16.26, cast bronze.
 - .2 Joints: Flared.
- .3 Ductile Iron Pipe: AWWA C151.
 - .1 Fittings: Ductile iron, standard thickness.
 - .2 Lining: cement
 - .3 Joints: AWWA C111, rubber gasket with 3/4" (19 mm) diameter rods.

2.4 WATER PIPING, ABOVE GRADE

- .1 Copper Tubing: ASTM B88M, Type L, hard drawn.
 - .1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - .2 Joints: ASTM B32, solder, Grade 95TA.
- .2 Copper Tubing: ASTM B88M, Type L, hard drawn.
 - .1 Fittings: Cast iron, coated.
 - .2 Joints: Grooved mechanical couplings.

2.5 STORM WATER PIPING, BURIED WITHIN 1500 mm (5 FEET) OF BUILDING

- .1 Cast Iron Pipe: ASTM A74 extra heavy weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: ASTM C564, neoprene gasket system or lead and oakum.
- .2 Cast Iron Pipe: CISPI 301, hubless, service weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- .3 ABS Pipe: ASTM D2680 or ASTM D2751.
 - .1 Fittings: ABS.
 - .2 Joints: ASTM D2235, solvent weld, maximum VOC content of 325 g/L.
- .4 PVC Pipe: ASTM D2665 or ASTM D3034.
 - .1 Fittings: PVC.
 - .2 Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- .5 PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
 - .1 Fittings: PVC.
 - .2 Joints: ASTM F477, elastomeric gaskets.

2.6 STORM WATER PIPING, ABOVE GRADE

- .1 Cast Iron Pipe: ASTM A74 extra heavy weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: ASTM C564, neoprene gasket system or lead and oakum.
- .2 Cast Iron Pipe: CISPI 301, hubless, service weight.
 - .1 Fittings: Cast iron.
 - .2 Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.7 FLANGES, UNIONS, AND COUPLINGS

- .1 Pipe Size 3-1/4" (80 mm) and Under:
 - .1 Ferrous pipe: Class 150 malleable iron threaded unions.
 - .2 Copper tube and pipe: Class 150 bronze unions with soldered joints.
- .2 Pipe Size Over 1" (25 mm):
 - .1 Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - .2 Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- .3 Grooved and Shouldered Pipe End Couplings:
 - .1 Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - .2 Sealing gasket: "C" shape composition sealing gasket.
- .4 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.8 PIPE HANGERS AND SUPPORTS

- .1 Plumbing Piping - Drain, Waste, and Vent:
 - .1 Conform to ASME B31.9.
 - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
 - .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .5 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
 - .6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - .7 Vertical Support: Steel riser clamp.
 - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .2 Plumbing Piping - Water:
 - .1 Conform to ASME B31.9.
 - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
 - .3 Hangers for Cold Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Hangers for Hot Pipe Sizes 2" to 4" (50 to 100 mm): Carbon steel, adjustable, clevis.
 - .5 Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 - .6 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 - .7 Multiple or Trapeze Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
 - .8 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
 - .9 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - .10 Wall Support for Hot Pipe Sizes 6" (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 - .11 Vertical Support: Steel riser clamp.
 - .12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - .13 Floor Support for Hot Pipe Sizes to 4" (100 mm): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 - .14 Floor Support for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
 - .15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.9 VALVES - GENERAL

- .1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .2 Provide valves of the same manufacturer where possible.
- .3 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
- .4 Valid CRN (Canadian Registration Number) issued by Province of Ontario required for each valve.
- .5 Materials:
 - .1 Bronze: ASTM B62 or B61 as applicable
 - .2 Brass: ASTM B283 C3770
 - .3 Cast Iron: ASTM A126 Class B
- .6 End Connections:
 - .1 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5
 - .2 Face-to-face dimensions: ANSI B16.10
- .7 Design and Testing:
 - .1 Bronze Gate & Check valves: MSS-SP-80
 - .2 Ball Valves: MSS-SP-110
 - .3 Cast Iron Gate Valves: MSS-SP-70
 - .4 Cast Iron Globe Valves: MSS-SP-85

- .5 Cast Iron Check: MSS-SP-71
- .6 Butterfly Valves: MSS-SP-67
- .8 First named product as indicated in paragraphs below; other acceptable manufacturers are subject to approval by the Consultant or the Owner acting reasonably.

2.10 ISOLATION VALVES

- .1 Up To and Including 2" (50mm) - Ball type
 - .1 Manufacturer: Kitz Corporation #69AMLL or equivalent.
 - .2 Construction: MSS SP-110, Class 150, 600 psi (4140 kPa) CWP, forged brass, two piece body, stainless steel ball and stem, full port, virgin PTFE seats and stem packing, blow-out proof stem, lever handle with balancing stops, stem extensions for insulated piping, solder ends.
- .2 2-1/2" (65 mm) and Larger - Butterfly type:
 - .1 Manufacturer: Kitz Corporation 6122EL or equivalent.
 - .2 Construction: MSS-SP-67, MSS-SP-25 and API-609; lug type having bi-directional "Dead End Service" pressure rating of 1380 kPa (200 psi) with the downstream flange removed; stainless steel stem with top and bottom bushings of dissimilar materials and with positive stem retention mechanism, aluminum bronze disc and molded or bonded style EPDM seat; suitable for both chilled water and hot water operation; supplied with 10 position locking lever handle 2" extended neck to allow for insulation. Provide gear operators for valves 150 mm and larger, and chain-wheel operators for valves mounted over 8-Ft (2400 mm) above floor.

2.11 THROTTLING VALVES

- .1 Up To and Including 2" (50 mm) - Globe type:
 - .1 Manufacturer: Kitz Corporation 10. or equivalent.
 - .2 Construction: MSS SP-80, 860 kPa (125psig) 200 WOG, bronze body to ASTM B62, rising stem, union bonnet, inside screw, PTFE disk, solder ends.
- .2 2-1/2" (65 mm) and Larger - Globe type:
 - .1 Manufacturer: Kitz Corporation 76 (Globe) or equivalent.
 - .2 Construction: Cast iron body globe
- .3 2-1/2" (65 mm) and Larger - Butterfly type
 - .1 Manufacturer: Kitz Corporation 6122EL or equivalent.
 - .2 Construction: MSS-SP-67, MSS-SP-25 and API-609; lug type having bi-directional "Dead End Service" pressure rating of 1380 kPa (200 psi) with the downstream flange removed; stainless steel stem with top and bottom bushings of dissimilar materials and with positive stem retention mechanism, aluminum bronze disc and molded or bonded style EPDM seat; suitable for both chilled water and hot water operation; supplied with 10 position locking lever handle 2" extended neck to allow for insulation. Provide gear operators for valves 150 mm and larger, and chain-wheel operators for valves mounted over 8-Ft (2400 mm) above floor.

2.12 CHECK VALVES

- .1 Up To and Including 3" (75 mm):
 - .1 Manufacturers: Kitz Corporation 23 or equivalent.
 - .2 Construction: MSS SP-80, 860 kPa (125psig) 200 WOG, bronze body to ASTM B62, bronze trim, solder ends
- .2 4" (100mm) and Larger:
 - .1 Manufacturers: Kitz Corporation 78 or equivalent.
 - .2 Construction: MSS SP-71, 1380 kPa Class 125 / 200 WOG, Cast iron body to ASTM A126 Class B, Bronze trim, Bolted Bonnet, flanged ends.

2.13 DRAIN VALVES

- .1 Up to 150 psig - Ball type:
 - .1 Manufacturers: Kitz Corporation 68C or equivalent.
 - .2 Construction: 150 psig (1034 kPa), 600 WOG, brass body to ASTM C37700, two piece body, full port, PTFE seats and stem packing or double "O" ring, blow-out proof stem, Chrome Plated ball, lever handle with cap and chain, (3/4") 20 mm hose connection.

2.14 WATER PRESSURE REDUCING VALVES

- .1 Up to 2" (50 mm):
 - .1 Manufacturers:
 - .1 Armstrong International Inc. Model GD 24.
 - .2 Watts Canada Model Series 223.
 - .3 Substitutions: Refer to Section 01 25 00.
 - .2 MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded ends.
- .2 Over 2" (50 mm):
 - .1 Manufacturers:
 - .1 Armstrong International Inc. Model GD 200.200H.
 - .2 Watts Canada Model Series N223.
 - .3 Substitutions: Refer to Section 01 25 00.
 - .2 MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.15 RELIEF VALVES

- .1 Pressure Relief:
 - .1 Manufacturers:
 - .1 Watts Canada Model Series 40.
 - .2 Substitutions: Refer to Section 01 25 00.
 - .2 AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

2.16 STRAINERS

- .1 Up to 125 psig:
 - .1 Size 2" (50 mm) and Under:
 - .1 Manufacturers: Mueller Steam Specialty 351M or equivalent.
 - .2 Construction : 860 kPa (125 psig) 200 WOG Rating, Bronze body, Screwed Cap, Y Pattern, 304 stainless steel screen with 20 Mesh perforation, Threaded Ends.
 - .2 Size 2-1/2" (65 mm) and larger:
 - .1 Manufacturers: Mueller Steam Specialty 758 or equivalent.
 - .2 Construction : 860 kPa (125 psig)/ 200 WOG Rating, Cast Iron body, Bolted Cover, Y Pattern, 304 stainless steel screen with 1/16 & 1/8 perforation, Threaded Ends.
- .2 Up to 250 psig:
 - .1 Size 2" (50 mm) and Under:
 - .1 Manufacturers: Mueller Steam Specialty 11M or equivalent.
 - .2 Construction: Class 250, 400 psig WOG, cast iron body, Y-pattern, screwed cap and ends, A167 304 stainless steel screen with 1/32" perforations.
 - .2 Size 2-1/2" (65 mm) and larger:
 - .1 Manufacturers: Mueller Steam Specialty 758 or equivalent.
 - .2 Construction: 300 psig non-shock WOG, cast iron, Y-pattern, bolted cover, blow- out plug, A167 304 stainless steel screen with 1/32" perforations, flanged ends.

2.17 DISINFECTION CHEMICALS

- .1 Chemicals: AWWA B300, Hypochlorite.

3 Execution

3.1 EXAMINATION

- .1 Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- .2 Remove scale and dirt, on inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- .4 Install piping to maintain headroom, conserve space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- .8 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with general trades.
- .9 Establish elevations of buried piping outside the building to ensure not less than 4' (1.2 m) of cover.
- .10 Install vent piping penetrating roofed areas to maintain integrity of roof assembly; refer to Division 07.
- .11 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer (maximum VOC content of 80 g/L) to welding.
- .12 Provide support for utility meters to requirements of utility companies.
- .13 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting where required. Coordinate with general trades.
- .14 Excavate and backfill as required for work of this Section.
- .15 Install bell and spigot pipe with bell end upstream.
- .16 Install valves with stems upright or horizontal, not inverted.
- .17 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- .18 Sleeve pipes passing through partitions, walls and floors.
- .19 Inserts:
 - .1 Provide inserts for placement in concrete formwork.
 - .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100 mm).
 - .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- .20 Pipe Hangers and Supports:
 - .1 Install to OBC (Plumbing Code)
 - .2 Support horizontal piping as scheduled.
 - .3 Install hangers to provide minimum 1/2" (15 mm) space between finished covering and adjacent work.
 - .4 Place hangers within 12" (300 mm) of each horizontal elbow.
 - .5 Use hangers with 1-1/2" (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - .6 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

- .8 Provide copper plated hangers and supports for copper piping.
- .9 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- .10 Provide hangers adjacent to motor driven equipment with vibration isolation.
- .11 Support cast iron drainage piping at every joint.

3.4 APPLICATION

- .1 Use grooved mechanical couplings and fasteners only in accessible locations.
- .2 Install unions downstream of valves and at equipment or apparatus connections.
- .3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- .4 Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- .5 Install globe valves for throttling, bypass, or manual flow control services.
- .6 Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- .7 Provide spring loaded check valves on discharge of water pumps.
- .8 Provide plug valves in natural gas systems for shut-off service.
- .9 Provide flow controls in water recirculating systems where indicated.

3.5 ERECTION TOLERANCES

- .1 Establish invert elevations, slopes for drainage to 2 percent minimum. Maintain gradients.
- .2 Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- .1 Disinfect all new and altered water distribution piping.
- .1 Verify that piping system is complete and has been flushed, cleaned, inspected, and pressure tested.
- .2 Isolate existing piping to full extent possible. Ensure that all fixtures, exiting and new that are served from piping being disinfected, are taken out of service and signs are placed at each fixture prohibiting use during the disinfection period.
- .2 Schedule and perform disinfecting activities with start-up, testing, adjusting, balancing, and demonstration procedures. Coordinate with related systems.
- .3 Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- .4 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- .5 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- .6 Maintain disinfectant in system for 24 hours.
- .7 If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- .8 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- .9 Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze to AWWA C651.

3.7 SERVICE CONNECTIONS

- .1 Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- .2 Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves pressure reducing valve.
- .3 Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 1.75 kPa. Provide regulators on each line serving gravity type appliances, sized to equipment.

3.8 SCHEDULES

- .1 Pipe Hanger Schedule:
 - .1 Metal Piping:
 - .1 Pipe size: 1/2" to 1-1/4" (15 to 32 mm):
 - .1 Maximum hanger spacing: 6.5' (2 m).

- .2 Hanger rod diameter: 3/8" (9 mm).
- .2 Pipe size: 1-1/2" to 2" (40 to 50 mm):
 - .1 Maximum hanger spacing: 10' (3 m).
 - .2 Hanger rod diameter: 3/8" (9 mm).
- .3 Pipe size: 2-1/2" to 3" (65 to 75 mm):
 - .1 Maximum hanger spacing: 10' (3 m).
 - .2 Hanger rod diameter: 1/2" (13 mm).
- .4 Pipe size: 4" to 6" (100 to 150 mm):
 - .1 Maximum hanger spacing: 10' (3 m).
 - .2 Hanger rod diameter: 1/2" (15 mm).
- .5 Pipe size: 8" to 12" (200 to 300 mm):
 - .1 Maximum hanger spacing: 14' (4.25 m).
 - .2 Hanger rod diameter: 3/4" (22 mm).
- .6 Pipe size: 14" (350 mm) and Over:
 - .1 Maximum hanger spacing: 20' (6 m).
 - .2 Hanger rod diameter: 1" (25 mm).

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 22 01 01.

1.2 SECTION INCLUDES

- .1 Roof and floor drains.
- .2 Cleanouts.
- .3 Hose bibs.
- .4 Hydrants.
- .5 Backflow preventers.
- .6 Water hammer arrestors.
- .7 Oil Interceptor.
- .8 Trap Seal Primers.

1.3 REFERENCES

- .1 ASME A112.21.1 - Floor Drains.
- .2 ASME A112.21.2 - Roof Drains.
- .3 ASME A112.26.1 - Water Hammer Arrestors.
- .4 ASSE 1011 - Hose Connection Vacuum Breakers.
- .5 ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- .6 ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
- .7 AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- .8 PDI WH-201 - Water Hammer Arrestors.

1.4 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- .2 Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1.5 SUBMITTALS FOR INFORMATION

- .1 Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors
- .2 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with a minimum of three years' documented experience.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept specialties on site in original factory packaging. Inspect for damage.

2 Products

2.1 GENERAL

2.2 ROOF DRAINS

.1 Built - Up Roofs

- .1 Manufacturer: Watts Canada Drainage Model RD100-BED-W-1 or equivalent.
- .2 Assembly: ANSI A112.21.2.
- .3 Body: Lacquered cast iron with sump.
- .4 Strainer: Removable polyethylene dome with vandal proof screws.
- .5 Accessories: Coordinate with roofing type, refer to Division 7:
 - .1 Membrane flange and membrane clamp with integral gravel stop.
 - .2 Adjustable under deck clamp.
 - .3 Roof sump receiver.
 - .4 Adjustable extension sleeve for roof insulation

.2 Landscaped Roofs

- .1 Manufacturer: Watts Canada Drainage Model RD200-GSS-BED or equivalent.
- .2 Assembly: ANSI A112.21.2.
- .3 Body: Lacquered cast iron with sump.
- .4 Strainer: Removable polyethylene dome with vandal proof screws.
- .5 Accessories: Coordinate with roofing type, refer to Division 7.
 - .1 Membrane flange and membrane clamp with integral gravel stop.
 - .2 Adjustable under deck clamp.
 - .3 Roof sump receiver.
 - .4 Adjustable extension sleeve for roof insulation.
 - .5 Perforated stainless steel ballast guard extension.

2.3 FLOOR DRAINS

- .1 Floor Drain (FD):
 - .1 Watts Canada Drainage model FD-100-C-5 or equivalent.
 - .2 ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable round nickel-bronze strainer with removable perforated sediment bucket.
- .2 Floor Drain (FFD):
 - .1 Watts Canada Drainage Model FD-100-C-EG or equivalent.
 - .2 ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with polished bronze elongated funnel.
- .3 Floor Drain (HD):
 - .1 Watts Drainage Model FD-100-C-AS-7-8 or equivalent
 - .2 ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, adjustable nickel-bronze angle strainer, trap primer tapping, and backwater valve.

2.4 TRAP SEAL PRIMERS

- 1. Individual Traps:
 - 1. Watts Canada Drainage model MS-810 or equivalent.
 - 2. Automatic cast brass body, renewable disc and seat rings, vacuum breaker and removable cover.
- 2. Groups of Traps:
 - 1. PPP Inc. Oregon #1 complete with supply tube and/or distribution units or equivalent. Primer suitable for up to 8 drains.

2.5 CLEANOUTS

- .1 Exterior Surfaced Areas:
 - .1 Watts Canada Drainage model CO-200-RFC or equivalent
 - .2 Round cast nickel bronze access frame and non-skid cover.
- .2 Exterior Unsurfaced Areas:
 - .1 Watts Drainage model CO-300-MF or equivalent.
 - .2 Extra Heavy Duty type with epoxy coated cast iron body with two fixed anchor flanges and round heavy duty ductile iron gasketed cover.
- .3 Interior Finished Floor Areas:
 - .1 Watts Drainage model CO-200-R, CO-200-U or equivalent.
 - .2 Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- .4 Interior Finished Wall Areas:
 - .1 Watts Drainage model WUCO or equivalent.
 - .2 Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless-steel access cover secured with machine screw.
- .5 Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.
- .6 Line Cleanouts: lacquered cast iron Malcom type with cleanout ferrule, 1/2" (13mm) thick epoxy coated gasketed cover.
- .7 Caulking for cleanouts: VOC content not to exceed 250g/L.

2.6 HYDRANTS

- .1 Exterior Wall Hydrant, (H-1):
 - .1 Watts Drainage model HY-725 or equivalent.
 - .2 ANSI/ASSE 1019; non-freeze, self-draining type with polished nickel bronze box and cover for recessed mounting, all bronze head, seat casting and internal working parts, 3/4" (20 mm) hose thread spout, key operated, integral vacuum breaker, galvanized wall casing and hydrant key.
- .2 Interior Wall Hydrant, (H-2):
 - .1 Watts Drainage model HY-330 or equivalent.
 - .2 ANSI/ASSE 1019; self-draining type with polished nickel bronze box and cover for recessed mounting, all bronze head, seat casting and internal working parts, 3/4" (20 mm) hose thread spout, key operated, integral vacuum breaker, galvanized wall casing and hydrant key.

2.7 BACKFLOW PREVENTERS

- .1 Reduced Pressure Backflow Preventers:
 - .1 Manufacturers:
 - .1 Watts Canada Model 909.
 - .2 ITT lawler Model RZ.
 - .3 Baukman Model BF-299.
 - .4 Febco Model 825Y
 - .4 Substitutions: Refer to Section 01 25 00.
 - .2 ANSI/ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.8 WATER HAMMER ARRESTORS

- .1 Watts Canada Drainage Series 05 or equivalent.
- .2 ANSI A112.26.1; copper construction, piston type sized to PDI WH-201, precharged suitable for operation in temperature range 99°F to 300°F (-73°C to 149°C) and maximum 150 psi (1000 kPa) working pressure.

2.9 OIL INTERCEPTOR

- 1 Watts Canada Drainage OI-525-X or equivalent.
- 2 Oil interceptor with extra heavy duty cover and extension as required.

2.10 IN-LINE WATER FILTER

- 1 Single housing water treatment system with a drop-in 10" (250 mm) cartridge, reduce sediment down to 0.5 micron and to reduce chlorine, taste & odor at a flow rate of 1.5 gpm for 15,000 gallons, scale inhibiting technology, protection against the precipitation and accumulation of scale and provides a protective barrier to help guard against corrosion, high capacity activated carbon filtration, stainless steel mounting bracket and full-flow inlet shut-off valve, built-in pressure gauge, 1/2" (15 mm) inlet and outlet connection. OptiPure FXI-11 or equivalent.
- 2 Provide two (2) replacement filter cartridges for each installed water cooler filter. OptiPure CTOS-10 or equivalent.

3 Execution

3.1 GENERAL

- 1 Install all products in accordance with the plumbing code and with manufacturer's instructions.

3.2 CLEANOUTS

- 1 Cleanouts shall be the same size as the pipe up to 4" (100mm) and not less than 4" (100mm) for larger pipes.
- 2 Provide cleanouts at the end of mains and branches, at changes in direction, in long straight runs and at the base of all soil stacks and rainwater leaders and where required by code.
- 3 Extend cleanouts to finished floor or wall surface.
- 4 Encase exterior cleanouts in concrete flush with grade.
- 5 Install floor cleanouts at elevation to accommodate finished floor.
- 6 Cleanouts in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
- 7 Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
- 8 Ensure clearance at cleanout for rodding of drainage system.

3.3 FLOOR DRAINS

- 1 Provide floor drains where indicated on architectural and plumbing floor plans.
- 2 Inspect locations where floor drains are shown to determine that floor is sloped appropriately. Report concerns to Consultant prior to installation of drains.
- 3 Coordinate installation with general trades.
- 4 Trap and vent all floor drains in accordance with Ontario Building Code .
- 5 Provide trap seal priming for each floor drain trap.
- 6 Floor drains in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
- 7 Floor drains, traps and drain pipes installed in slabs on grade shall be embedded in concrete and made water-tight to prevent water seepage.

3.4 ROOF DRAINS

- 1 Locate roof drains where indicated on roofing plans.
- 2 Inspect locations where roof drains are shown to determine that roof is sloped appropriately. Report concerns to the Consultant prior to installation of drains. Coordinate installation with roofing trade.
- 3

3.5 WALL HYDRANTS

- .1 Locate wall hydrants where indicated in the Contract Documents.
- .2 Coordinate installation with general trades.

3.6 WATER HAMMER ARRESTORS

- .1 Install water hammer arrestors complete with an accessible isolation valve on hot and cold water supply piping to;
 - .1 plumbing fixtures and fixture groups,
 - .2 the Owner's equipment and appliances with flush valves, solenoid valves or other quick closing valves,
 - .3 Downstream of each backflow preventer,
 - .4 Wherever necessary to prevent water hammer.

3.7 TRAP SEAL PRIMERS

- .1 Traps may be primed from the flush tube of a flush valve or from the waste of a drinking fountain.
- .2 No more than three (3) traps may be primed from one flush valve or one drinking fountain.
- .2 Condensate drains from cooling units may not be used to prime traps.
- .3 Trap seal primers shall be provided where flush valves and/or drinking fountains are not available.
- .4 Group trap primers shall be provided where specifically shown and where agreed with the Consultant.

3.8 INTERCEPTORS

- .1 Install interceptors so as to be accessible for cleaning and all other maintenance and repair which may be required.
- .2 Make all piping connections. Vent in accordance with Ontario Building Code.
- .3 Fill with appropriate media as required and turn over spare media to the Owner.

3.9 BACKFLOW PREVENTION

- .1 Backflow prevention includes backflow preventers, anti-siphon devices and vacuum breakers.
- .2 Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur;
 - .1 on boiler feed water lines,
 - .2 housekeeping faucets,
 - .3 fire sprinkler systems,
 - .4 premise isolation,
 - .5 irrigation systems,
 - .6 flush valves,
 - .7 interior and exterior wall hydrants (hose bibs).
 - .8 Where require by codes, regulations and/or standards.
- .3 Pipe relief or drain from backflow prevention device to nearest drain.
- .4 Install a strainer upstream of each backflow preventer.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 22 01 01.

1.2 SECTION INCLUDES

- .1 Water closets, seats, tanks, flush valves, supplies, carriers
- .2 Urinals, tanks, flush valves
- .4 Lavatories, faucets, spouts, waste, carriers
- .5 Stainless steel sinks, faucets, spouts,
- .6 Service sinks, traps, faucets, spouts, accessories
- .7 Eye and Face wash, valves, fittings, accessories, signs

1.3 REFERENCES

- .1 ANSI Z124.1 - Gel-Coated Glass-Fibre Reinforced Polyester Resin Bathtub Units.
- .2 ANSI Z124.2 - Gel-Coated Glass-Fibre Reinforced Polyester Resin Shower Receptor and Shower Stall Units.
- .3 ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.
- .4 ARI 1010 - Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- .5 ASME A112.6.1 - (Floor Affixed) Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- .6 ASME A112.18.1 - Plumbing Fixture Fittings.
- .7 ASME A112.19.1 - Enamelled Cast Iron Plumbing Fixtures.
- .8 ASME A112.19.2 - Vitreous China Plumbing Fixtures.
- .9 ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- .10 ASME A112.19.4 - Porcelain Enamelled Formed Steel Plumbing Fixtures.
- .11 ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

1.4 SUBMITTALS FOR REVIEW

- .1 Product Data:
 - .1 Provide catalogue illustrations of fixtures,
 - .2 sizes,
 - .3 rough-in dimensions,
 - .4 service sizes (capacities)
 - .5 trim,
 - .6 finishes.

1.5 SUBMITTALS FOR INFORMATION

- .1 Manufacturer's Instructions: Indicate installation methods and procedures.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- .2 Warranty: Submit manufacturer warranty and ensure forms have been completed in the Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with a minimum of five years' documented experience.
- .2 Installer Qualifications: trades licence with a minimum of five years documented experience.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Transport, handle, store, and protect products.
- .2 Accept fixtures on site in factory packaging. Inspect for damage.
- .3 Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2 Products

2.1 MANUFACTURERS

1. All plumbing fixtures, fixture trim and accessories shall be products of one manufacturer to the extent that this is possible.
2. Vitreous China fixtures:
 - .1 Manufacturer: American Standard.
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Crane Plumbing Corporation
 - .2 Kohler Co.
 - .3 Toto Ltd
 - .4 EljerOr equivalent.
3. Stainless Steel fixtures:
 - .1 Manufacturer: Acorn Engineering Company
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Bradley Corporation
 - .2 Willoughby IndustriesOr equivalent
4. Seats
 - .1 Manufacturer: Centoco Manufacturing Corporation
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Benecke
 - .2 Olsonite
 - .3 Kohler Co.
 - .4 Bemis Manufacturing Company or equivalent.
5. Mechanical Flush Valves
 - .1 Manufacturer: Sloan Valve Company "Regal"
 - .2 Other acceptable manufacturers offering equivalent products:
 - .1 Zurn Industries
 - .2 Cambridge Brass Inc.
 - .3 Watts - PowersOr equivalent
6. Diverter Valves
 - .1 Manufacturer: Watts - Powers
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Kohler Co.
 - .4 Sloan Valve Company
 - .5 Substitutions: Refer to Section 01 25 00.
7. Carriers
 - .1 Manufacturer: Watts Ancon
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Zurn Industries
 - .2 Jay R. Smith Manufacturing Co.
 - .3 MIFAB Inc.
 - .4 Substitutions: Refer to Section 01 25 00.Or equivalent

2.2 WATER CLOSET FLOOR MOUNTED - FLUSHOMETER – EXPOSED – MANUAL (W-1) (BF)

1. **American Standard Madera Flowise Right Height Elongated 419mm high #3461.001.020 HET Toilet**, white vitreous china with EverClean antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew, floor mounted, siphon jet flush action, operates in the range of 4.2L to 4.8L per flush, condensate channel, 305mm x 254mm (12" x 10"), 54mm (2-1/8") fully glazed internal trapway, floor outlet, bolt caps, 38mm (1-1/2") dia. Top

- spud or equivalent.
2. **Centoco Manufacturing Corporation #820STS.001 heavy duty toilet seat**, for elongated bowl open front, white solid plastic, with cover, reinforced stainless steel check hinges, metal flat washers stainless steel posts and nuts.
 3. **Sloan Valve Company Regal #111-XL-CP**, exposed manual Flushometer for Top Spud toilet, chrome plated, 4.8L maximum factory set flow, quiet action diaphragm type, non-hold open feature, A. D. A oscillating handle, back-check angle stop (screwdriver operated), flush tube for 292mm (11-1/2") rough-in, vacuum breaker or equivalent.
 4. **Provide Floor Flange**, (same material as the connecting pipe drain), with all brass bolts and with rubber gasket

2.3 COUNTER MOUNTED SEMI COUNTER BASIN –TWO HANDLE FAUCET POINT OF USE THERMOSTATIC MIXING VALVE (L1)

1. **American Standard Mezzo #9960.803 basin**, 3 holes, 8" (203 mm) center, 559 mm x 546 mm x 210 mm (22" x 21-1/2" x 8-1/4") high, semi-counter, rear overflow, faucet ledge, space saving design, mounting kit or equivalent. **Provide basin rim sealant.**
2. **Chicago Faucets #404-317XKABCP two (2) Handle Faucet**, chrome plated, 8" (203 mm) centerset, lead free solid brass with one piece concealed rough body, 1/4 turn ceramic disc valve cartridges, 1.9LPM at 414 Kpa pressure compensating Softflo aerator outlet, 127 mm (5") projection cast brass spout, 102 mm (4") metal vandal proof wristblade handles with blue and red index buttons or equivalent.
3. **Lawler Manufacturing Co. #570-86820, Point of Use Thermostatic Water Mixing Valve**, nickel plated bronze body, temperature adjusting spindle, 10 mm (3/8") inlets and outlet FNPT connections, integral checks, offer temperature range between 35 °C (95 °F) and 46 °C (114.8 °F) or equivalent. Set valve temperature at 46 °C (114.8 °F). **Provide tee, adaptors and flex. copper tubing to suit installation. Provide tempered water to hot side of faucet.**
4. **McGuire Manufacturing Co., Inc #155WC Offset Open Grid Drain**, cast brass one piece top, 17 GA. (1.5 mm) mm tubular 32 mm (1-1/4") tailpiece or equivalent.
5. **McGuire Manufacturing Co., Inc #LFH170BV, Faucet Supplies**, chrome plated polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm (5") horizontal extension tubes, combination V.P. Loose key handles, escutcheon and flexible copper risers or equivalent.
6. **McGuire Manufacturing Co., Inc #8872C P-Trap**, heavy cast brass adjustable body, with slip nut, 32 mm (1-1/4") size, shallow wall flange and seamless tubular wall bend or equivalent.
7. **McGuire Manufacturing Co., Inc PROWRAP #PW2000WC Sanitary Covering vandal-resistant**, flexible seamless moulded closed-cell PVC resin, formulated with anti-microbial additive to limit the growth of fungus and bacteria, to exposed piping (to protect against heat/contusions) as per local codes or equivalent.

2.4 SHOWER WALL MOUNTED SHOWER SEAT VALVE AND HANDSHOWER (SH1)

1. **Chicago Faucets #SH-PB1-00-000/151-WB-WS**, pressure balancing, washerless ceramic drip-free disc valve cartridge, metal wall escutcheon or equivalent.
2. **Chicago Faucets #151-VB-WS hand shower slide bar, 24" (610 mm)**, 6 LPM maximum, spray head, 60" (1524 mm) flexible metal hose, wall supply elbow with flange, in-line vacuum breaker or equivalent.
3. **Chicago Faucets #620-LCP Showerhead**, chrome plated finish, 5.7 LPM (1.5 GPM) flow rate @ 80 psi, pressure compensating flow control device, swivel ball joint or equivalent.
4. **Chicago Faucets #763-CP In-wall 3-Way Diverter Trim and valve kit**, metal lever handle, brass valve construction, rotational control to alternate water flow between three (3) different shower outlets equivalent.
5. **Watts Water Technologies Inc. #FD-100-C-A Floor Drain**, epoxy coated cast iron, anchor flange, 5" (127 mm) adjustable round nickel bronze strainer, reversible clamping collar with primary & secondary weepholes or equivalent.
6. **Provide floor drain at entrance to shower and built-up floor. Provide P-Trap**, same material as the connecting pipe drain.

2.5 COUNTER MOUNTED SINK- TWO HANDLE FAUCET (S1)

1. **Franke Kitchen Systems LLC. Commercial #LBS6808-1/3 Single Bowl Countertop Mount Sink**, 3 holes, 8" (203 mm) center, 508 mm (20") wide x 521 mm (20-1/2") x 203 mm (8") high deep, counter mounted, backledge, grade 18-10 20 GA. (0.9 mm) type 302 stainless steel, self-rimming, satin finish rim and bowls, mounting kit provided, fully undercoated to reduce condensation and resonance, factory applied rim seal, 3-1/2" (89 mm) crumb cup waste assembly with 1-1/2" (38 mm) tailpiece or equivalent.
2. **Chicago Faucets #1100-L9-317XKABCP two (2) Handle Faucet**, chrome plated, 8" (203 mm) centerset, lead free cast brass body, ceramic 1/4 turn operating cartridge, 5.7 LPM at 414 Kpa pressure compensating Softflo aerator outlet, 229 mm (9") projection L type swing spout, 102 mm (4") metal vandal proof wristblade handles with blue and red index buttons. **Supply Provide Faucet Supplies**, chrome plated all metal construction, light duty residential angle stops, escutcheons and flexible metal risers, **low lead** or equivalent.
3. **Provide P-Trap**, adjustable all metal construction, 38 mm (1-1/2") size, and escutcheon or equivalent.

2.6 SERVICE / MOP SINK - TWO HANDLE FAUCET (MS1)

1. **Stern Williams Co. Inc. #SB-300 Service / Mop Sink**, 610 mm (24") wide x 914 mm (36") x 305 mm (12") high deep, floor mounted, terrazzo composed of pearl gray marble chips and Portland cement ground smooth, sealed to resist stain, one piece stainless steel cast integral on all sides, without tiling flange, cast brass drain with stainless steel strainer, 3" (76 mm) outlet or equivalent.
Chicago Faucets #897-XK-CP Wall Mounted two (2) Handle Faucet, chrome plated, 8" (203 mm) centerset, solid brass exposed body, 1/4 turn ceramic disc valve cartridges, unrestricted hose end outlet, 203 mm (8") projection spout with atmospheric vacuum breaker and bucket hook, 60 mm (2-3/8") metal vandal proof lever handles with blue and red index buttons. **Stern Williams Co. Inc. T-35 Hose and Wall Hook** 36" (914 mm) long hose with 3/4" (19 mm) chrome coupling, stainless steel wall bracket. **Stern Williams T-40 Mop Hanger** stainless steel #4 finish, 24" (610 mm) long with 3 rubber spring loaded clips. **Stern Williams Co. Inc. BP Back Splash Panel** 20 GA. (0.9 mm) type 304 stainless steel or equivalent.
2. **Provide P-Trap**, same material as the connecting pipe drain.

2.7 EMERGENCY EYE WASH WALL HUNG (EW1)

1. **Guardian #G1750**, Wall Mounted, eye/face wash, 11-1/2" (292 mm) diameter, stainless steel bowl, two (2) FS-Plus spray heads with fliptop dust cover and filter, powder coated cast aluminum flag handle activation, 1/2" (13 mm) IPS chrome plated brass stay-open ball valve with Teflon seal, heavy duty cast aluminum wall bracket with corrosion resistant powder coated finish, 1-1/4" (32 mm) NPT female outlet - Unit is third party certified by IAPMO to meet ANSI Z358.1-2014, the Uniform Plumbing Code cUPC and the National Plumbing Code of Canada or equivalent.
2. **Eyewash/Facewash fixture should be installed 4 to 10 feet from the mixing valve. McGuire Manufacturing Co. Inc. #8872C P- Trap**, heavy cast brass adjustable body, with slip nut, 32 mm (1-1/4") size, shallow wall flange and seamless tubular wall bend. **Watts #FD-100-C-A Floor Drain**, epoxy coated cast iron, anchor flange, 5" (127 mm) adjustable round nickel bronze strainer, reversible clamping collar with primary & secondary weepholes or equivalent.
3. **Provide p-trap for drain**. For Thermostatic Mixing Valve, Lawler model # 911E/F or equivalent.

2.8 EMERGENCY EYE WASH TEMPERED WATER MIXER STATION

1. **Lawler Manufacturing Co. #911E/F, Emergency Thermostatic Mixing Valve for Eyewash or Eye/Face Wash**, lead-free brass and stainless steel design, vandal-resistant temperature adjustment, stainless steel sliding piston control device allow cold flow through both the fixed and variable bypass, 13 mm (1/2") N.P.T. Outlet, positive hot water shut-off, liquid-filled thermostatic motor control mechanism, 29 °C (84.2 °F) factory set temperature, standard

21 °C (69.8 °F) - 32 °C (89.6 °F) temperature range, 26 LPM (6.9 GPM) flow capacity at 30 psi (207 kPa) pressure drop across the valve, 7.57 LPM (2.0 GPM) min. Flow rate, 18 LPM (4.8 GPM) bypass flow rate at 30 psid. (See 911E/F) or equivalent.

3 Execution

3.1 EXAMINATION AND PREPARATION

- .1 Section 22 01 01: Verification of existing conditions before starting work.
- .2 Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- .3 Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- .1 Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- .1 Install each fixture with trap, easily removable for servicing and cleaning.
- .2 Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- .3 Install components level and plumb.
- .4 Install and secure floor mounted fixtures in place with bolts.
- .4 Install and secure wall hung fixtures in place with wall carriers and bolts.
- .5 Seal fixtures to wall and floor surfaces with sealant having VOC content not exceeding 250 g/L, colour to match fixture.
- .6 Solidly attach water closets to floor with lag screws.

3.4 ADJUSTING

- .1 Section 01 77 00 - Execution Requirements: Adjusting installed work.
- .2 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

- .1 Section 01 77 00 - Execution Requirements: Cleaning installed work.
- .2 Clean plumbing fixtures and equipment.

3.6 PROTECTION OF FINISHED WORK

- .1 Section 01 77 00 - Execution Requirements: Protecting installed work.
- .2 Do not permit use of fixtures.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 22 01 01.

1.2 SECTION INCLUDES

- .1 Anti-Scale System
- .2 Fuel Fired Domestic Water Heater
- .3 Domestic Hot Water Re-Circulation Pump.

1.3 RELATED SECTIONS

- .1 Section 01 33 00 –Submittal Procedures.
- .2 Section 01 60 00 – Products and Workmanship.
- .3 Section 01 78 00 - Project Closeout.
- .4 Section 23 05 48 - Vibration Isolation.

1.4 REFERENCES

- .1 ASHRAE 90A - Energy Conservation in New Building Design.
- .2 ASME Section 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Procedures for submittals.
- .2 Product Data:
 - .1 Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - .2 Indicate pump type, capacity, power requirements.
 - .3 Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - .4 Provide electrical characteristics and connection requirements.
- .3 Shop Drawings:
 - .1 Indicate heat exchanger dimensions, size of tappings, and performance data.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Section 01 33 00: Procedures for submittals.
- .2 Project Record Documents: Record actual locations of components.
- .3 Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in the Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- .3 Ensure products and installation of specified products are to recommendations and requirements of the following organizations:
 - .1 American Gas Association (AGA).
 - .2 National Sanitation Foundation (NSF).
 - .3 American Society of Mechanical Engineers (ASME).
 - .4 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - .5 National Electrical Manufacturers' Association (NEMA).
 - .6 Underwriters Laboratories (UL).
- .4 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.8 REGULATORY REQUIREMENTS

- .1 Conform to ASME Section 8D for manufacture of pressure vessels for heat exchangers.
- .3 Conform to ASME Section 8D for tanks.
- .4 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated in the Contract Documents.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 60 00: Transport, handle, store, and protect products.
- .2 Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 WARRANTY

- .1 Section 01 78 36.
- .2 Provide five year manufacturer warranty for domestic water heaters packaged water heating systems in-line circulator.

1.11 EXTRA MATERIALS

- .1 Section 01 77 00.
- .2 Provide two of pump seals.

2 Products

2.1 FUEL FIRED DOMESTIC WATER HEATERS

- .1 Manufacturer: A.O.Smith Watwer Product Company – Model No. BTH 120 (A) (Natural Gas) – Cyclone MXi modulating with 95% thermal efficiency or equivalent.
- .2 Other acceptable manufacturers offering equivalent products with similar or higher efficiencies.
 - .1 Leslie Controls Inc.
 - .2 Armstrong International Inc.
 - .3 Graham CorporationOr equivalent.

2.4 ANTI-SCALE SYSTEM

- .1 Manufacturer: Watts Canada Model OF1665-75 (75 GPM).
- .2 Equivalent products by other manufacturers.

2.5 DHW RECIRCULATION PUMP P-1

- .1 Manufacturer: Taco Comfort Solutions Model Plumb 'n' plug c/w aquastat 4 USGPM @3FT HEAD, 1/25 HP 115 V – 1 PHASE
- .2 Equivalent products by other manufacturers

3 Execution

3.1 INSTALLATION

- .1 Install water heaters to manufacturer's instructions and to AGA requirements.
- .2 Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- .3 Domestic Water Heat Exchangers:
 - .1 Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
 - .2 Support unit on pipe stand.
 - .3 Pipe relief valves and drains to nearest floor drain.
 - .4 Connect steam branch line from top of main. Pipe in flexible manner, pitched with steam flow, with pipe union connections. Provide steam pressure gauge at exchanger inlet.
 - .5 Provide steam traps and valves as indicated.
 - .6 Pitch shell for condensate drain to traps.

- .4 Domestic Hot Water Storage Tanks:
 - .1 Provide steel pipe support, independent of building structural framing members.
 - .2 Clean and flush prior to delivery to site. Seal until pipe connections are made.
- .5 Anti-Scale System:
 - .1 Install Anti-Scale System as per manufacturers installation instructions.
- .6 Domestic Hot Water Re-Circulation Pump: P-2
 - .1 Install re-circulation pump as per manufacturers installation instructions.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 22 01 01.

1.2 SECTION INCLUDES

- .1 Pipe and pipe fittings.
- .2 Valves.
- .3 Accessories.

1.3 REFERENCES

- .1 ANSI B31.1 - Power Piping.
- .2 ANSI B31.9 - Building Service Piping.
- .3 ASME SEC IX - Welding and Brazing Qualifications.
- .4 ASME B16.3 - Malleable Iron Threaded Fittings.
- .5 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- .6 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .7 NFPA 31 - Installation of Oil-Burning Equipment.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 22 01 01: Procedures for submittals.
- .2 Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.5 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Procedures for submittals.
- .2 Contractor's material and test certificates.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Section 22 01 01: Procedures for submittals.
- .2 Project Record Documents: Record actual locations of piping system, storage tanks, and system components.
- .3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in the Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- .1 Welding Materials and Procedures: Conform to ASME Code.
- .2 Welders Certification: To ASME SEC IX.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .5 Valves: Manufacturer's name and pressure rating marked on valve body.

1.8 REGULATORY REQUIREMENTS

- .1 Conform to CSA B149.1 Natural Gas and Propane installation code
- .2 Conform to ANSI B31.1 for installation of fuel oil piping.
- .3 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 22 01 01: Transport, handle, store, and protect products.
- .2 Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation.

1.10 WARRANTY

- .1 Section 22 01 01 and Article A-15 of the Agreement Between Owner and Contractor.

1.11 EXTRA MATERIALS

- .1 Section 22 01 01.
- .2 Provide two repacking kits for each size valve.

2 Products

2.1 BURIED PIPING

- .1 Copper Tubing: ASTM B88M, Type K,.
 - .1 Fittings: ASME B16.18, cast copper alloy or ASTM B16.22 wrought copper or bronze.
 - .2 Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- .2 Copper Tubing: ASTM B88M, Type K, annealed.
 - .1 Fittings: ASME B16.26, cast bronze.
 - .2 Joints: Flared.
- .3 Steel Pipe: ASTM A53, Schedule 40 black.
 - .1 Fittings: ASTM A234/A234M, wrought carbon steel and alloy steel welding type.
 - .2 Joints: ANSI B31.1 welded.
 - .3 Jacket: AWWA C105 polyethylene or double layer, half-lapped 0.25 mm polyethylene tape.

2.2 ABOVE GROUND PIPING

- .1 Copper Tubing: ASTM B88M, Type K, hard drawn.
 - .1 Fittings: ASME B16.18, cast copper alloy or ASTM B16.22 wrought copper and bronze.
 - .2 Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- .2 Copper Tubing: ASTM B88M, Type K, annealed.
 - .1 Fittings: ASME B16.26, cast bronze.
 - .2 Joints: Flared.
- .3 Steel Pipe: ASTM A53 or ASME B36.10, Schedule 40 black.
 - .1 Fittings: ASTM B16.3, malleable iron, or ASTM A234/A234M, wrought carbon steel and alloy steel welding type.
 - .2 Joints: NFPA 30, threaded or welded to ANSI B31.1.

2.3 PIPE HANGERS AND SUPPORTS

- .1 Conform to NFPA 31.
- .2 Hangers for Pipe Sizes 1" - 1-1/2" (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
- .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
- .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- .5 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
- .6 Vertical Support: Steel riser clamp.
- .7 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .8 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.4 FLANGES, UNIONS, AND COUPLINGS

- .1 Pipe Size 2" (50 mm) and Under:
 - .1 Ferrous pipe: 1034 kPa malleable iron threaded unions.
 - .2 Copper tube: 1034 kPa bronze unions with brazed joints.
- .2 Pipe Size Over 2" (50 mm):
 - .1 Ferrous pipe: 1034 kPa forged steel slip-on flanges; 1/16" (1.6 mm) thick preformed neoprene gaskets.
 - .2 Copper tube: 1034 kPa slip-on bronze flanges; 1/16" (1.6 mm) thick preformed neoprene gaskets.

2.5 VALVES - GENERAL

- .1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .2 Provide valves of the same manufacturer where possible.
- .3 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
- .4 Valid CRN (Canadian Registration Number) required for each valve.
- .5 Materials:
 - .1 Bronze: ASTM B62 or B61 as applicable
 - .2 Brass: ASTM B283 C3770
 - .3 Cast Iron: ASTM A126 Class B
- .6 End Connections:
 - .1 Threaded ends: ANSI B1.20.1
 - .2 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5
 - .3 Face-to-face dimensions: ANSI B16.10
- .7 Design and Testing:
 - .1 Ball Valves: MSS-SP-110
 - .2 Cast Iron Check: MSS-SP-71
- .8 First named product as indicated in paragraphs below; other acceptable manufacturers, subject to equivalent products include:
 - .1 Kitz Corporation
 - .2 Crane & Jenkins Valve Group Inc.
 - .3 Conbraco Industries Canada
 - .4 Nibco Inc.

2.6 NATURAL GAS PRV

- .1 Provide NG regulators, one for the building line and another for the Generator.
- .2 Building NG line regulator from 5 PSI to 1.75KPA (7" W.C.)
- .3 Generator NG line regulator from 5 PSI to 3.5 KPA (14" W.C.)
- .4 PRV's by Watts Canada or equivalent product by other manufacturers.

3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- .2 Remove scale and dirt, on inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.
- .4 Excavate for work of this Section.
- .5 Backfill for work of this Section.

3.3 INSTALLATION

- .1 Install to code.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals. Install to NACE RP-01-69.
- .3 Route piping in orderly manner and maintain gradient.
- .4 Install piping to conserve building space and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Provide clearance for installation of insulation and access to valves and fittings.
- .8 Provide flexible pipe connections at the generator.
- .9 Establish elevations of buried piping outside the building to ensure not less than 1m of cover.
- .10 Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- .11 Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- .12 Identify piping systems including underground piping.
- .13 Install valves with stems upright or horizontal, not inverted.
- .14 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- .15 Paint all finished natural gas piping with yellow paint and identify piping with proper markings.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Read and conform to:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended,
 - .2 Division 1 requirements and documents referred to therein.
- .2 Section 23 01 01 applies to and governs the work of all Sections of Divisions 21, 22, and 23.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among Subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the work..
- .4 The specifications are integral with the Drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the most costly arrangement.

1.2 DEFINITIONS

- .1 The following are definitions of words found in this specification and on associated drawings under this Division:
 - .1 "Concealed" - locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
 - .2 "Exposed" - mechanical work normally visible to building occupants.
 - .3 "Furnish" - (and its derivatives) has the same meaning as the term "Supply".
 - .4 "Install" - (and its derivatives) - receive, store and handle at the site, mount and support and connect all required services. Includes adjustment and calibration, testing, commissioning, inspection by authorities having jurisdiction and documentation.
 - .5 "Provide" - (and its derivatives) - supply, install in place, connect the associated required services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.
 - .6 "Supply" - (and its derivatives) purchase and deliver to the site for installation. Includes submittals, manufacturer's field inspection and warranty.
 - .7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.

1.3 WORK INCLUDED

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Cutting and patching of new or existing work
- .3 Excavating and backfilling
- .4 Identification of equipment, piping, ductwork, and valves and controllers
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches.
- .6 Motors required for equipment supplied under this Division.
- .7 Variable frequency drives for motors and equipment supplied under this Division.
- .8 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under this Division.
- .9 Disconnect switches for exhaust fans located on the roof complete with;
 - a. EEMAC 1 enclosure if housed within a weatherproof cabinet.
 - b. EEMAC 3 enclosure if exposed to weather
- .10 Take such measures and include in Bid Price for the proper protection of the existing building and its finishes at all times during alterations and construction of the new addition. Coordinate this

protective work with all trades.

- .11 Refer to Mechanical/Electrical Equipment Schedule in the Contract Documents for extent of wiring and electrical characteristics.
- .12 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.

1.4 RELATED WORK

- .1 Power wiring, conduit and connections for motors under this Division will be by Division 26.
- .2 Power wiring, conduit and connections to variable frequency drives for motors under this Division will be by Division 26. Wiring and connections from VFD to motors under this Division will be by Division 26.
- .3 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under this Division.
- .4 Painting of exposed piping and ductwork other than for identification will be supplied under Division 9. Concrete equipment bases, housekeeping pads, sump pits and trenches will be provided under Division 3.

1.5 SUBMITTALS

- .1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction, and obtain two (2) copies of approved drawings for retention by Consultant prior to commencement of work under this Division.
- .2 Shop Drawings: Prepare and submit two (2) copies of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return one copy, marked with comments and his review stamp as he deems appropriate. The General Contractor shall ensure that the necessary number of copies of the returned set are prepared and distributed to the Owner, the Consultant, the General Contractor, the site, and to relevant Subcontractors and suppliers.
 - .1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by the Consultant,.
 - .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
 - .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
 - .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:
"This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."
- .3 Sleeving Drawings: Prepare and submit 4 copies of sleeving drawings to clearly and accurately indicate the exact location, elevation and size of any and all formed holes, recesses and sleeving required in the work of Divisions 21, 22 and 23. Obtain Consultant's approval in writing prior to sleeving, forming or cutting any such opening. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
- .4 Composite Wiring Diagrams: Prepare and submit three (3) copies of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.
- .5 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they

- conform to the requirements of those documents (e.g. NFPA-standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:
- .1 description of the system (description and type),
 - .2 description of the tests conducted and results observed, including re-testing, where necessary,
 - .3 description of any corrective measures undertaken,
 - .4 description of materials used (pipe and fittings),
 - .5 list of witnesses for each test conducted,
 - .6 date system left ready for service,
 - .7 signature of installing contractor.
- .6 Directories & Schematics
- .1 Submit five (5) copies of a neat typewritten directory indicating the valve number, related service, and location of each valve under this Division.
 - .2 Submit five (5) copies of system control schematics for each mechanical system indicating relative locations of equipment and control devices.
 - .3 Enclose one (1) copy of each directory/schematic under glass in a neat polished 18" x24" (460 mm x 610 mm) metal frame, complete with mounting clips.
- .7 Maintenance Data and Operating Instructions
- .1 Submit three (3) copies of Operation and Maintenance Manual individually bound in hard backed three-ring binders.
 - .2 Ensure the binder spines have typewritten lettering as follows:
OPERATION & MAINTENANCE MANUAL
for
[Insert name of project]
[Insert date of submission]
[Insert Division Title]
 - .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, the Contractor and the Consultant. Include special telephone numbers for service departments on normal and emergency call basis.
 - .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.
 - .5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.
 - .6 Ensure operating instructions include the following:
 - .1 General description of each mechanical system.
 - .2 Step by step procedure to follow in putting each piece of equipment into service.
 - .3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.
 - .4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches and relays.
 - .5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.
- .8 Ensure maintenance instructions include the following:
- .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.
 - .2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
 - .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
 - .4 Balancing and testing reports.

- .5 Copy of valve directory.
- .9 As-Built Records: Prepare and submit complete as-built records prior to Substantial Performance of the Work. Refer to paragraph 3.2.5 and to Division 1 for requirements.
- .10 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption from the Owner prior to disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 1 for additional requirements.
- .11 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

1.6 QUALITY ASSURANCE

- .1 Conform to minimum requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:
 - .1 AABC Associated Air Balance Council
 - .2 AMCA Air Moving and Conditioning Association
 - .3 ANSI American National Standards Institute
 - .4 ASA American Standards Association
 - .5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
 - .6 ASME American Society of Mechanical Engineers
 - .7 ASSE American Society of Sanitary Engineers
 - .8 ASPE American Society of Plumbing Engineers
 - .9 ASTM American Society of Testing and Materials
 - .10 AWWA American Water Works Association
 - .11 CAN2 National Standard of Canada (Published by CGSB)
 - .12 CAN3 National Standard of Canada (Published by CSA)
 - .13 CGSB Canadian General Standards Board
 - .14 CSA Canadian Standards Association
 - .15 EEMAC Electrical & Electronic Manufacturer's Association of Canada
 - .16 NBC National Building Code of Canada
 - .17 NEBB National Environmental Balancing Bureau
 - .18 NFPA National Fire Protection Association
 - .19 NEMA National Electrical Manufacturers Association
 - .20 OBC Ontario Building Code
 - .21 OFC Ontario Fire Code
 - .22 OFM Ontario Fire Marshall
 - .23 SMACNA Sheet Metal & Air Conditioning Contractors National Association
 - .24 TIAC Thermal Insulation Association of Canada
 - .25 ULC Underwriter's Laboratories of Canada Ltd
 - .26 UL Underwriter's Laboratories (including cUL)
- .3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.
- .4 Arrange and pay for permits and inspections by the Authorities Having Jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
- .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or the Owner when requested.
- .6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.
- .7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify the Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment

supplied under this Division that are received at the site by this Division.

1.8 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of this Division.
- .2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.
- .3 Notify the Consultant upon discovery of conditions which adversely affect work of this Division. No allowance will be made after award of the Contract for any expenses incurred through failure to do so.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications..

1.9 INTERRUPTIONS

- .1 Arrange execution of work to maintain present building operations, and to minimize the effect of work under this Division on existing operations.
- .2 Prior to interrupting any existing service notify the Owner and the Consultant, in writing, at least 7 days in advance, and obtain written authorization. Do not interrupt any existing service without the Consultant's specific authorization. Refer to Division 1 for requirements.
- .3 Arrange time and duration of interruption through the Owner Facilities Group in Property Services. Include in the Contract Price for all overtime or premium time hours necessary to minimize duration of service interruption.
- .4 Test and verify the proper operation of existing equipment and systems that are shut down due to work of this project, prior to returning to service.
- .5 Assume responsibility for consequential costs on failure to obtain permission to shut-down and/or start-up any item of equipment, system or service.

1.10 WARRANTY

- .1 Refer to Division 1 and to Section 23 01 01 General Requirements.
- .2 Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .3 Make submissions necessary to register product warranties to the benefit of the Owner.
- .4 Submit to the Consultant, prior to Substantial Performance of the Work, manufacturer's written warranties covering periods longer than two year or offering greater benefits than required in specifications and in the Owner's name.

1.11 EXTRAS AND CREDITS

- .1 Accompany all price submissions requested by the Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
 - .1 Materials, quantities and unit costs including any applicable contractors trade discount clearly identified.
 - .2 Labour hours and unit costs.
 - .3 Total materials and labour costs.
 - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under this Division bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.

- .3 Ensure manufacturers and suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site prior to doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 MOTOR STARTERS & CONTROLS

- .1 Mechanical Subcontractor shall provide all motor starters and associated controls required and as scheduled on drawings and noted for Mechanical equipment. Starters and controls shall be Canadian General Electric or equivalent. All starters, contactors, thermal overloads, etc. must be EEMAC rated. All starters shall be of one manufacturer except as specifically approved otherwise for integral pre-wired assemblies.
- .2 Starter and control units shall be equipped with necessary number of auxiliary contacts and relays to provide control sequences described in Mechanical Equipment Starter Schedule on the Drawings. Auxiliary contacts shall be interchangeable normally open or normally closed, by conversion in field without additional parts exterior to starter.
- .3 Manual starters may only be provided for single phase equipment operated by control device such as thermostat or limit control when such control device is rated for full electrical load of equipment.
- .4 Manual starters provided for single phase equipment actuated by electric timer or shall have H.O.A. feature. "Hand" position shall permit shunting of time switch. Where such units also have protective device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" positions and shall not be shunted.
- .5 Manual starters may only be provided for three phase equipment which is not actuated by pilot control device (pressure switch, float switch, safety limit devices, remote manual control device) unless otherwise noted in Starter Schedule.
- .6 Magnetic starters for manually operated equipment shall have "On/Off" selector switch or "Start-Stop" pushbutton in cover as scheduled.
- .7 Magnetic starters which are started automatically by electric time switch shall include "Hand-Off-Automatic" (H.O.A.) selector switch. "Hand" position shall permit shunting of time switch or E.M.S. Where such units also have protective pilot device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" position and shall not be shunted.
- .8 Magnetic starters which are started automatically by remote pilot device (or interlocked units) such as level controller, pressure switch, thermostat or flow switch shall include "Hand-off-Auto" (H.O.A.) selector switch, and, where scheduled, a "Test" pushbutton. "Hand" position shall permit shunting of remote pilot device and thereby permit operation of starter but only while depressing "Test" button.
- .9 Equip starter apparatus for prime plumbing, heating, air conditioning and ventilating equipment so that these units will automatically restart on resumption of power after power outage. Starters for these units shall have "On/Off" selector switch in cover if not fitted with H.O.A. selector feature or manual starter or otherwise noted.
- .10 Safety control device such as flow switches, pressure switches, high and low limited ("Fire" and "Freeze") shall not be shunted by "Hand" position of switch.
- .11 Manual motor starter shall be toggle operated with following general construction features:
 - Quick-Make, Quick-Break mechanism with double-break contacts.
 - Overload protection heaters, one per phase and speed.
 - Enclosure to suit application.
 - Pilot light, neon lamp.
 - Cover engraved with "On-Trip-Off".
- .12 Magnetic motor starters shall comprise electrically-operated motor starters combined with disconnect switch with following general construction features:
 - Quick-Make, Quick-Break mechanism with double-break contacts.
 - Fuse holders to accept specified fuses, one per phase.
 - Adjustable overload relays, one per phase.

- CEMA listed enclosure to suit application. Disconnect with mechanical cover interlocks, line side barriers and switch operated electrical interlocks to disconnect external control voltage unless starter includes suitable approved enclosed contacts and connections.
- "Reset" button.
- Pilot Lights of transformer type incandescent with amber safety lens cap.
- Control transformer with 120 volt fused secondary and sized to suit current rating of associated control devices.
- Scheduled cover mounted control devices with standard duty double break contact blocks.
- Minimum of two auxiliary contacts (unused "Seal-in" contact may be included).
- .13 Contactors for non-motor applications shall be built similar to combination magnetic starters, except less overload relays, and with Gould Shawmut AJT time delay HRC1-J fuses, rated for load, and with enclosed continuous current rating of at least 125% of connected full load.
- .14 "Double Voltage Relays" shall be CGE Model CR120 LXMC with general purpose enclosure, number of contacts required and "Mylar" shroud of enclosure of contacts, or equivalent.
- .15 Pilot devices such as "Start-Stop" pushbuttons, "Hand-Off-Auto" selector switches and indicating lights shall be of heavy-duty construction. Indicating lamps shall be transformer type incandescent with amber safety lens caps.
- .16 Each control unit shall be provided with engraved nameplates for designation of device controlled and duty.
- .17 Control wiring shall be 120 volt A.C. maximum. Provide control circuit transformers where these are not included in motor starters. Secondaries of control transformers shall be fused with one side grounded and controls, safety devices and interlocks shall be connected in ungrounded conductor, excepting only integral starter overload devices.
- .18 Single phase motors interlocked to start or operate with other equipment shall be provided with magnetic starters or suitable relays with necessary auxiliary contacts and double voltage relays or be otherwise electrically separated.
- .19 Overload relay heaters for starters shall be selected and field adjusted to trip at maximum value of 115% of actual nameplate full load amperes. Selection of heater elements shall be based on starter manufacturer's recommendations. Obtain data from Mechanical s 21, 22, and 23. Submit Motor Starter Schedule which shall list following for each motor:
 - Proposed equipment nameplate data
 - Actual full load amperes of motor
 - Speed of motor
 - Temperature Class in degrees Celsius rise and insulation class.
 - Circuit breaker or fuse type and proposed rating
 - Type of motor, duty and service factor.
- .20 Overload relay heaters shall trip in 20 seconds or less from cold or motor-locked rotar condition.
- .21 Where equipment is noted to be electrically interlocked, provide necessary interlocks, double voltage relays (Mylar shroud accepted) to provide specified operation.
- .22 Provide all fuses required to protect equipment. Fuses shall be proper size blade type time delay HRC1-J current limiting. Supply three spare fuses of each size and type and obtain duplicate receipt for same. Fuse clips shall reject standard NEC fuses. Fuses shall be rated in accordance with manufacturer's published data. Fuses to be of one manufacturer throughout.
- .23 Acceptable Alternate Manufacturers
 1. Furnas Electric Co.
 2. Westinghouse Corporation
 3. Allen Bradley Co.
 4. Square 'D' Co.
 5. Cutler Hammer Canada
 6. Klockner-Moeller Parts
 7. Commander
 8. Telemecanique Co.Or equivalent.

2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Please refer to Section 01 25 00 – Product Substitution Procedures.

- .2 The Contract Price shall be based on the product related requirements specified in the Contract Documents.
- .3 Where the Contractor, with the approval uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. The Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by The Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in the Contract Price.

2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by the Consultant.
- .2 Apply, in writing, to the Consultant for substitution of any products, indicating the following:
 - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
 - .2 Reason for substitution.
 - .3 Any revisions to the contract price made necessary by substitution.
 - .4 Any revisions to the contract time made necessary by substitution.
 - .5 Any revisions to layout, arrangement or services made necessary by substitution.
- .3 No substitutions will be permitted without written authorization from the Consultant.
- .4 Refer to Section 01 25 00 – Product Substitution Procedures for further requirements.

3 Execution

3.2 INSTALLATION REQUIREMENTS

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings prior to installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise in the Contract Documents, install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.
- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.
- .9 Do not use powder activated tools except as permitted by the Consultant and the Owner's workplace health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural Drawings or as directed by the Consultant.

3.3 CONTRACT DRAWINGS

- .1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.

- .2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain the Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 m) in any direction without a change to the contract price.
- .5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of this Division.
- .6 The drawings of this Division are intended for tender pricing. The quantities and quality to be included in the Contract Price shall be based on the layout and specifications as shown on the mechanical documents. If there is a difference in quantity between the architectural and drawings of this Division, base the Contract Price on the greater quantity.
- .7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.4 CONSTRUCTION DRAWINGS

- .1 Prepare fully dimensioned drawings showing devices, fixtures, equipment, outlets, sleeves and openings through structure. Indicate locations and weights on load points.
- .2 Prepare fully dimensioned construction drawings of products and services suitably interfaced with work of the sub-trades, in mechanical rooms, service and ceiling spaces, and other critical locations. Coordinate the work with other divisions. Base drawings on reviewed shop drawings and latest architectural drawings. Indicate details pertaining to the following: access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevation of pipes, ducts, conduits.
- .3 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.
- .4 Submit construction drawings to other Divisions. Provide one (1) transparency and four (4) print copies of construction drawings to the Consultant for record purposes.
- .5 Submit construction drawings prior to commencement of work.

3.5 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings. Obtain white prints from the Consultant for this purpose and pay printing costs. Identify each set as "Project Record Copy".
- .2 Record deviations from the Contract Documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of the Consultants documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a DVD in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.
- .6 Submit the "Project Record Copy" on one or more DVD with white prints of each drawing to the Consultant at the time of Substantial Performance of the Work.

3.6 USE OF EQUIPMENT

- .1 For the duration of this Contract, do not use any piece of equipment provided under this Contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the

Owner and the Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.

- .2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.7 SPECIAL TOOLS AND SPARE PARTS

- .1 Within 30 days of award of contract, prepare a complete itemized list of special tools and spare parts and submit to the Consultant for review. List will be used as a checklist and should include provision for sign off by the Owner on receipt.
- .2 On completion of the project furnish spare parts to the Owner as follows:
 1. One set of mechanical seals for each pump
 2. One casing joint gasket for each pump
 3. One head gasket for each heat exchanger
 4. One glass for each gauge glass installed
 5. One set of v-belts for each piece of machinery
 6. One set of new filters for each filter bank installed
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of special tools required to service equipment as recommended.
- .5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

3.8 INSTRUCTION

- .1 Instruct and familiarize the Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.
- .2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.
- .3 Ensure each instruction period includes, but is not limited to the following;
 - .1 a classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
 - .2 instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
 - .3 demonstration of the proper operating procedures for each item of equipment,
 - .4 explanation of the purpose and function of all safety devices provided,
 - .5 demonstration of all measures required for safe and proper access for operation and maintenance.
- .4 Provide a period of follow-up instruction (on two occasions) approximately one month after completing the Owner's instruction to clarify and reinforce earlier instructions.
- .5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to Substantial Performance of the Work.

3.9 START UP AND COMMISSIONING

- .1 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.
- .2 The Startup and Commissioning Team shall be comprised of;
 - .1 The individual, company or agency undertaking the work of each Section,
 - .2 Representatives of the Contractor and its Subcontractors as required,
 - .3 Representatives of equipment manufacturers,
 - .4 Representatives of the Consultants,
 - .5 Representatives of the Owner.
- .3 The Contractor and its Subcontractors shall each assign an individual representing each of the relevant trades to the startup and commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.

- .4 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.
- .5 Each Section shall prepare Check Sheets in accordance with the standards listed above and shall issue them to the commissioning team for use during the commissioning process.
- .6 Three (3) copies of commissioning manuals shall be provided, bound in hard cover D-ring binders with transparent cover on front and spine personalized to indicate;
 - .1 name and logo of Facility,
 - .2 name of the project,
 - .3 the Owner's project number,
 - .4 identification of the system commissioned,
 - .5 the date that the system was commissioned.
- .7 Commissioning manuals shall include machine printable index dividers to organize each manual by system and by commissioning stage.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 SECTION INCLUDES

- .1 Pipe and equipment hangers and supports.
- .2 Equipment bases and supports.
- .3 Sleeves and seals.
- .4 Flashing and sealing equipment and pipe stacks.

1.3 REFERENCES

- .1 ASME B31.1 - Power Piping.
- .2 ASME B31.2 - Fuel Gas Piping.
- .3 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .4 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .5 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .6 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .7 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- .8 NFPA 13 - Installation of Sprinkler Systems.
- .9 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.
- .10 UL 203 - Pipe Hanger Equipment for Fire protection Service.

1.4 SUBMITTALS

- .1 Section 23 01 01: Procedures for submittals.
- .2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- .3 Product Data: Provide manufacturers catalogue data including load capacity.
- .4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- .5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- .1 Conform to CSA B-51 for support of piping.

2 Products

2.1 PIPE HANGERS AND SUPPORTS

- .1 Manufacturers:
 - .1 Anvil International
 - .2 Myatt E & Co. Inc.
 - .3 Hunt ManufacturingOr equivalent.
- .2 Plumbing Piping:
 - .1 Conform to CSA B-51 and ASME B31.1
 - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 - .3 Hangers for Cold Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Hangers for Hot Pipe Sizes 2" to 4" (50 to 100 mm): Carbon steel, adjustable, clevis.
 - .5 Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - .6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .7 Multiple or Trapeze Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - .8 Wall Support for Pipe Sizes to 3" (76 mm): Cast iron hook.
 - .9 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - .10 Wall Support for Hot Pipe Sizes 6" (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

- .11 Vertical Support: Steel riser clamp.
- .12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .13 Floor Support for Hot Pipe Sizes to 4" (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .14 Floor Support for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- .15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .3 Refrigerant Piping:
 - .1 Conform to ASME B31.5.
 - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 - .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .5 Wall Support for Pipe Sizes to 3" (75 mm): Cast iron hook.
 - .6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - .7 Vertical Support: Steel riser clamp.
 - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- .1 Hanger Rods: galvanized, carbon steel continuous threaded.
- .2 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 EQUIPMENT ROOF CURBS

- .1 Fabrication: Welded 0.05" (1.2 mm) galvanized steel shell and base, mitred 3" (75 mm) cant, variable step to match roof insulation, factory installed wood nailer.

2.4 ROOFTOP PIPE/DUCT SUPPORTS

- .1 Acceptable manufacturers;
 - .1 Portable Pipe Hangers, Inc.
 - .2 Unistrut
- .2 Pre-engineered pipe/duct support system including;
 - 1. Bases: weather resistant and UV radiation resistant with seismic attachments
 - 2. Framing: 1-5/8" (41.3mm) strut or 1-7/8" (47.6mm) strut, fabricated of steel to ASTM A570, Grade 33., roll formed of 12-gauge (2.7mm thick) steel into 3-sided or tubular shape.
 - 3. Pipe Supports and Hangers: Conform to MSS SP-58 and MSS SP-69, fabricated of carbon steel. Single roller supports for piping subject to expansion and contraction.
 - 4. Finishes:
 - .1 Plastics as moulded with UV radiation protection.
 - .2 Metal surfaces hot dip galvanized free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets and other surface blemishes. Galvanizing shall conform to ASTM A123 for tubing and to ASTM A153 for hardware and accessories.
 - .5 Shop Drawings: Manufacturer to provide detailed shop drawings to indicate layout and supporting capacities of system components with installation and assembly instructions for each application. Shop drawings shall bear the signature and seal of a Professional Engineer.

3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's instructions and best trade practices.

3.2 INSERTS

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100 mm).
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 PIPE HANGERS AND SUPPORTS

- .1 Support horizontal piping in accordance to code requirements. Where there are no code requirements support as scheduled below.
- .2 Install hangers to provide minimum 1/2" (13 mm) space between finished covering and adjacent work.
- .3 Place hangers within 12" (300 mm) of each horizontal elbow.
- .4 Use hangers with 1-1/2" (38 mm) minimum vertical adjustment.
- .5 Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.
- .6 Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Support riser piping independently of connected horizontal piping.
- .9 Provide copper plated hangers and supports for copper piping.
- .10 Design hangers for pipe movement without disengagement of supported pipe.
- .11 Prime coat exposed steel hangers and supports. Refer to Section 09 91 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

- .1 Provide housekeeping pads of concrete, minimum 4" (100 mm) thick and extending 6" (150 mm) beyond supported equipment. **Refer to Section 03 30 53.**
- .2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- .3 Construct supports of steel members. Steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .4 Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 ROOFTOP PIPE/DUCT SUPPORT

- .1 Coordinate installation of supports and bases with roofing work. Ensure that roofing surfaces are smooth and flat and are ready to receive work.
- .2 Use care in installation of support systems not to damage roofing, flashing, equipment or related materials.
- .3 Install and secure support systems in strict accordance with manufacturer's written instruction.
- .4 Consult manufacturers of roofing system to determine if walk pads are required. Provide and fully adhere walk pads to roof system where required.
- .5 Bases and support framing shall be located as indicated on shop drawings provided by support system manufacturer and as specified herein. The support of all piping shall be complete and adequate, whether or not all required devices are shown.

- .6 The use of wood or wire for supporting piping will not be permitted.
- .7 Deflection of pipes shall not exceed 1/240th of the span.
- .8 Accurately locate and align bases. Where applicable, replace gravel around bases. Set framing posts into bases and assemble framing structure as indicated.
- .9 Use galvanized fasteners for galvanized framing, and use stainless steel fasteners for stainless steel framing.

3.6 FLASHING

- .1 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- .2 Flash vent and soil pipes projecting 3" (75 mm) minimum above finished roof surface with lead worked 1" (25 mm) minimum into hub, 8" (200 mm) minimum clear on sides with 24" x 24" (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
- .3 Flash floor drains in floors with topping over finished areas with lead, 10" (250 mm) clear on sides with minimum 36" x 36" (910 x 910 mm) sheet size. Fasten flashing to drain clamp device.
- .4 Seal roof, floor, shower and mop sink drains watertight to adjacent materials.
- .5 Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's instructions for sound control.
- .6 Provide curbs for mechanical roof installations 14" (350 mm) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- .7 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 SLEEVES

- .1 Set sleeves in position in formwork. Provide reinforcing around sleeves.
- .2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- .3 Extend sleeves through floors 1" (25 mm) above finished floor level. Caulk sleeves.
- .4 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk. air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- .5 Install chrome plated steel escutcheons at finished surfaces.

3.8 SCHEDULES

- .1 Imperial Measure (IP)

Pipe Size(in)	Rod Diameter (in)	Support Spacing (Ft)	
		Steel Pipe	Copper Tube
1/2	3/8	7	6
3/4	3/8	7	6
1	3/8	7	6
1-1/4	3/8	7	6
1-1/2	3/8	9	8
2	3/8	10	9
2-1/2	3/8	12	10
3	3/8	12	10
4	5/8	14	12
6	7/8	17	
8	7/8	19	
10	7/8	21	
12	7/8	23	
14	1	25	
16	1	27	
18	1	28	

- .2 Metric Measure (SI)

Pipe Size(mm)	Rod Diameter (mm)	Support Spacing (m)	
		Steel Pipe	Copper Tube
13	10	2.1	1.8
20	10	2.1	1.8
25	10	2.1	1.8
32	10	2.1	1.8
38	10	2.7	2.4
50	10	3	2.7
65	10	3.6	3
75	10	3.6	3
100	16	4.2	3.6
150	22	17	
200	22	5.7	
250	22	6.4	
300	22	7	

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 SECTION INCLUDES

- .1 Vibration control of piping, ductwork and equipment.
- .2 Inertia bases.

1.3 REFERENCES

- .1 Ontario Building Code.
- .2 SMACNA "HVAC Duct Construction Standards"

1.4 PERFORMANCE REQUIREMENTS

- .1 Provide vibration isolation on motor driven equipment over 0.35 kW, plus connected piping and ductwork.
- .2 Provide minimum static deflection of isolators for equipment as indicated.
 - .1 Upper Floors, Normal
 - .1 Under 400 rpm: 1-1/2" (40 mm)
 - .2 400 - 600 rpm: 3-1/2" (90 mm)
 - .3 600 - 800 rpm: 2" (50 mm)
 - .4 800 - 900 rpm: 1" (25 mm)
 - .5 1100 - 1500 rpm: 1/2" (12 mm)
 - .6 Over 1500 rpm: 1/4" (5 mm)
- .3 Use concrete inertia bases for fans having static pressure in excess of 3.4 IN. WG (0.85 kPa) or motors in excess of 40 HP (30 kW), and on base mounted pumps over 10 HP (7.5 kW).
- .4 Provide seismic restraints in accordance with Ontario Building Code requirements for Post Disaster Buildings. Seismic restraints shall be designed, installed and reviewed under the direct supervision of a Professional Engineer.

1.5 SUBMITTALS

- .1 Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
- .2 Product Data: Provide schedule of vibration isolator type with location and load on each.
- .3 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
- .4 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.6 PROJECT RECORD DOCUMENTS

- .1 Record actual locations of hangers including attachment points.

1.7 Copy of REFERENCES

- .1 AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- .2 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- .3 ASME B16.3 - Malleable Iron Threaded Fittings.
- .4 ASME B16.4 - Grey Iron Threaded Fittings.
- .5 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .6 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .7 ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- .8 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.
- .9 ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- .10 ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems.
- .11 ASME B31.1 - Power Piping.
- .12 ASME B31.2 - Fuel Gas Piping.
- .13 ASME B31.9 - Building Services Piping.
- .14 ASTM A47/A47M - Ferritic Malleable Iron Castings.
- .15 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .16 ASTM A74 - Cast Iron Soil Pipe and Fittings.

1.8 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.9 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform Work to applicable Codes including the Ontario Building Code. Maintain one copy on site.
- .3 Valves: Manufacturer's name and pressure rating marked on valve body.
- .4 Welding Materials and Procedures: Conform to ASME SEC IX and applicable provincial labour regulations.
- .5 Welder's Certification: To ASME SEC IX.
- .6 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.10 REGULATORY REQUIREMENTS

- .1 Perform Work to applicable Province of Ontario Plumbing code.
- .2 Conform to applicable code for installation of backflow prevention devices.
- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

2 Products

2.1 MANUFACTURERS

- .1 Manufacturer shall be a member of Vibration Isolation & Seismic Control Manufacturers Association.
- .2 Acceptable manufacturers:
 - .1 Vibron/Kinetics Noise Control
 - .2 VAW Systems Ltd.
 - .3 Korfund Dynamics
 - .4 Masdom Inc.Or equivalent.

2.2 INERTIA BASES

- .1 Structural Bases:
 - .1 Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 - .2 Construction: Welded structural steel with gusseted brackets, supporting equipment and motor with motor slide rails.
- .2 Concrete Inertia Bases:
 - .1 Mass: Minimum of 1.5 times weight of isolated equipment.
 - .2 Construction: Structured steel channel perimeter frame, with gusseted brackets and anchor bolts, adequately reinforced, concrete filled.
 - .3 Connecting Point: Reinforced to connect isolators and snubbers to base.
 - .4 Concrete: Reinforced 20 mPa concrete.

2.3 VIBRATION ISOLATORS

- .1 Open Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .3 Spring Mounts: Provide with levelling devices, minimum 1/4" (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.
 - .4 Sound Pads: Size for minimum deflection of 0.05" (1.2 mm); meet requirements for neoprene pad isolators.
- .2 Restrained Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and

- neoprene coated springs.
- .2 Code: Colour code springs for load carrying capacity.
- .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .3 Spring Mounts: Provide with levelling devices, minimum 1/4" (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.
- .4 Sound Pads: Size for minimum deflection of 0.05" (1.2 mm); meet requirements for neoprene pad isolators.
- .5 Restraint: Provide heavy mounting frame and limit stops.
- .3 Closed Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 1/4" (7 mm) clearance.
- .4 Restrained Closed Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 1/4" (7 mm) clearance and limit stops.
- .5 Spring Hanger:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .3 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 - .4 Misalignment: Capable of 20 degree hanger rod misalignment.
- .6 Neoprene Pad Isolators:
 - .1 Rubber or neoprene waffle pads.
 - .1 30 durometer.
 - .2 Minimum 1/2" (13 mm) thick.
 - .3 Maximum loading 275 kPa.
 - .4 Height of ribs: maximum 0.7 times width.
 - .2 Configuration: Single layer.
- .7 Rubber Mount or Hanger: Moulded rubber designed for 1/2" (13 mm) deflection with threaded insert.
- .8 Glass Fibre Pads: Neoprene jacketed pre-compressed moulded glass fibre.
- .9 Seismic Snubbers:
 - .1 Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
 - .2 Neoprene Elements: Replaceable, minimum of 3/4" (18 mm) thick.
 - .3 Capacity: 4 times load assigned to mount groupings at 3/8" (10 mm) deflection.

- .4 Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Install isolation for motor driven equipment.
- .3 Bases:
 - .1 Set steel bases for 1" (25 mm) clearance between housekeeping pad and base.
 - .2 Set concrete inertia bases for 2" (50 mm) clearance between housekeeping pad and base.
 - .3 Adjust equipment level.
- .4 Install spring hangers without binding.
- .5 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- .6 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- .7 Provide pairs of horizontal limit springs on fans with more than 1.5 kPa static pressure, and on hanger supported, horizontally mounted axial fans.
- .8 Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.06" (1.5 mm) maximum clearance. Provide other snubbers with clearance between 1/8" and 1/4" (4 mm and 7 mm).
- .9 Support piping connections to isolated equipment resiliently as follows:
 - .1 Up to 4" (100 mm) Diameter: First three points of support.
 - .2 5" to 8" (125 to 200 mm) Diameter: First four points of support.
 - .3 10" (250 mm) Diameter and Over: First six points of support.
 - .4 Select three hangers closest to vibration source for minimum 1" (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1" (25 mm) static deflection or 1/2 static deflection of isolated equipment.
- .10 Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

- .1 Inspect isolated equipment after installation and submit report. Include static deflections.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 SECTION INCLUDES

- .1 The Contractor shall ensure that its mechanical Subcontractor will be responsible for the work of Testing, Adjusting and Balancing of HVAC systems as follows;
 - .1 Testing, adjustment, and balancing of air systems.
 - .2 Testing, adjustment, and balancing of plumbing systems.
 - .3 Measurement of final operating condition of HVAC systems.
- .2 This Section shall verify correct operation of;
 - .1 piping systems,
 - .2 air systems,
 - .3 equipment

1.3 REFERENCES

- .1 Ontario Building Code.
- .2 Ontario Fire Code.
- .3 AABC - National Standards for Total System Balance.
- .4 ACG - AABC Commissioning Guideline.
- .5 ADC - Test Code for Grilles, Registers, and Diffusers.
- .6 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- .7 ASHRAE Guideline 0 The Commissioning Process,
- .8 ASHRAE Guideline 1 The HVAC Commissioning Process,
- .9 ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Commissioning Process,
- .10 ASTM E779 Determining Air Leakage Rate by Fan Pressurization.
- .11 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- .12 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.
- .13 SMACNA HVAC Systems Commissioning Manual,

1.4 SUBMITTALS

- .1 Submit name of adjusting and balancing agency for approval within 30 days after award of the Contract.
- .2 Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- .3 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
- .4 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for the Consultant and for inclusion in operating and maintenance manuals.
- .5 Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side.
- .6 Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- .7 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in S.I. Metric units.
- .8 All reports shall be prepared in electronic (computer) format using MS Word software and all tabulations shall be prepared in electronic (computer) format using MS Excel spreadsheet software. Submittals shall include three (3) copies each of hard copy printout and two (2) copies with text in ".pdf" and tabulations in ".xls" or ".xlsx" formats on CD, DVD, or USB flash drive.

1.5 PROJECT RECORD DOCUMENTS

- .1 Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- .2 Record actual locations of flow measuring stations.

1.6 QUALITY ASSURANCE

- .1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.
- .2 Maintain one copy of each document on site.

1.7 INDEPENDENT AGENCY

- .1 All work of Mechanical Testing, Adjusting and Balancing shall be undertaken by a single agency, employed under Mechanical Division 21, 22 and 23
- .2 The work of the agency consists of the furnishing of all labour, materials, equipment and accessories necessary in the testing, verification and documentation of the operational performance of all equipment and systems installed under the Sections of Mechanical Division 21, 22 and 23

1.8 QUALIFICATIONS

- .1 Agency: Company specializing in the testing, adjusting, and balancing of systems under this Section with minimum five years documented experience certified by AABC or prequalified as listed below.
- .2 Work shall be performed under the supervision of an AABC certified Test and Balance Engineer, an NEBB Certified Testing, Adjusting and Balancing Supervisor or a Professional Engineer experienced in the performance of this work
- .3 Acceptable agencies include;
 - .1 National Air Balance Inc.
 - .2 Clark Balancing Ltd.
 - .3 Dynamic Flow Balancing Ltd.Or equivalent.

1.9 PRE-BALANCING CONFERENCE

- .1 Convene one week prior to commencing work of this Section.

1.10 SEQUENCING

- .1 Sequence work to commence after completion of systems and schedule completion of work before Substantial Performance of the Work.

1.11 SCHEDULING

- .1 Schedule and provide assistance in final adjustment and test of life safety system with Fire Prevention Office at the Town of Markham

1.12 CO-OPERATION

- .1 Co-operate with installing contractor(s) in advising them of specific scheduling requirements for systems verification.
- .2 Provide advice to installing contractors regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.
- .3 Coordinate verification of smoke control and automatic sprinkler systems with verification of fire alarm system under Division 26.

2 Products

2.1 REFERENCE STANDARDS

- .1 All equipment required for the verification of equipment and systems shall be furnished by the agency employed to conduct the Mechanical Systems Verification.
- .2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall reconduct its verifications.
- .3 All equipment used by the agency in its verification of mechanical systems remains the property/responsibility of the agency and is not included in the supply to the project.

3 Execution

3.1 EXAMINATION

- .1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - .1 Systems are started and operating in a safe and normal condition.
 - .2 Temperature control systems are installed complete and operable.
 - .3 Proper thermal overload protection is in place for electrical equipment.
 - .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - .5 Duct systems are clean of debris.
 - .6 Fans are rotating correctly.
 - .7 Fire and volume dampers are in place and open.
 - .8 Air coil fins are cleaned and combed.
 - .9 Access doors are closed and duct end caps are in place.
 - .10 Air outlets are installed and connected.
 - .11 Duct system leakage is minimized.
- .2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- .3 Beginning of work represents acceptance of existing conditions in the areas served.

3.2 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Consultant to facilitate spot checks during testing.
- .2 Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

- .1 Roof Top Unit: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
- .2 Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.

3.4 ADJUSTING

- .1 Ensure recorded data represents actual measured or observed conditions.
- .2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- .3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- .4 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- .5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- .6 Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- .1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- .2 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- .3 Measure air quantities at air inlets and outlets.
- .4 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- .5 Use branch volume control dampers and splitters to regulate air quantities. Devices at air outlets may be used only to the extent that adjustments do not create objectionable air motion or sound levels.
- .6 Vary total system air quantities by adjustment of fan speeds. Adjust airflow to design quantity. Provide drive changes as required.
- .7 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- .8 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan.
- .9 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- .10 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- .11 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- .12 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 in.wg. (12.5 Pa) positive static pressure near the building entries.
- .13 For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

- .1 Adjust water systems to provide required or design quantities.
- .2 Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- .3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .4 Effect system balance with automatic control valves fully open to heat transfer elements.
- .5 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- .6 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 VERIFICATION CHECKLIST

- .1 Prepare a series of checklists to record the verification of each item of equipment and each system. Submit a draft of each checklist to the Consultant and the Owner for review and approval. Discuss comments offered the Consultant and the Owner and include improvements as directed.
- .2 Checklists shall include the following as a minimum;
 - .1 date(s) of observations and/or tests,
 - .2 a record of the nameplate data for each equipment item and each associated motor,
 - .3 a list of observations appropriate to the equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,
 - .4 appropriate space for recording comments and/or instructions given during observations.

3.8 EQUIPMENT VERIFICATION

- .1 Test the operation of all equipment installed under Division 21, 22 and 23 according to instructions in appropriate articles of this Division. Advise installing contractor of any required adjustments or replacements to ensure that equipment is operating as intended. Retest equipment after adjustment or replacement.
- .2 Ensure that the installing contractor has given proper advance notification to all persons required to be present as tests are conducted.
- .3 Instrumentation: verify installation of air filter gauges, pitot traverse stations, and flow-measuring devices ensuring that:
 - .1 Location of points for readings is appropriate to measure what it is intended to measure;
 - .2 The scale range is appropriate to place the normal reading near mid-range of the scale;
 - .3 Proper positioning of instrumentation to allow reading from a convenient location, and for easy access.
- .4 Filters Inspection: visually inspect each filter installation. Verify adjustment of latching devices, installation of end spacers in filter boxes, and proper latching and sealing of access doors. Verify the installation of new (clean) filter media after the installing contractor's start-up procedures.
- .5 Pre-start-up Inspection:
 - .1 Verify proper equipment mounting and setting.
 - .2 Verify that control, interlock, and power wiring are complete.
 - .3 Verify proper alignment of motors and drives.
 - .4 Verify proper piping connections and accessories.
 - .5 Verify that lubrication is complete.
- .6 First Run Observation:
 - .1 Verify direction of rotation.
 - .2 Verify setting of safety controls.
 - .3 Monitor heat build-up in bearings.
 - .4 Check motor loads against nameplate ratings.
- .7 Equipment Checkout:
 - .1 Verify the proper overload heater sizes.
 - .2 Verify function of safety and operating controls.
 - .3 Verify proper operation of equipment.
 - .4 Report on inspection, observation, and checkout procedures.
- .8 Motor Rotation: visually inspect and verify the direction of motor rotation. It is possible for motor rotation to have been checked by the electrician when power connections were made on temporary electric power, then when final connections were made to the permanent transformer bank, crossed phasing may reverse the rotation of all three-phase motors on the system.
- .9 Overload Heaters: verify supply voltage to all equipment. If the applied voltage is different from the motor nameplate, determine whether the applied voltage is within the range allowed under the motor guarantee. If not, take the necessary action to have the installing contractor change the motor or the applied voltage. When the voltage is off the nameplate value, but within the allowable range, compute the equivalent amperage at nameplate voltage and compare to the overload heater amperage rating range. Then, consider whether the ambient temperature of the starter is above, below, or the same as the ambient temperature are not the same. Advise the installing contractor to use overload heaters of higher range for "hot area" starters or ones of lower range for "cold area" starters to compensate the heater trip point for heat gains or losses with the environment.
- .10 Alignment of Drives: verify the alignment of drives, belt and direct coupled, and the adjustment of belt tension.
- .11 Control Diagrams and Sequences: provide for coordination with work under the automatic control systems to have the control diagrams and sequences of operation corrected to "as installed", reflecting changes brought about in response to contract modifications and to the more pragmatic changes in diagrams and sequences to make the installed system control the building systems as intended by the designer.
- .12 Safety and Operating Control Setpoints: systematically verify the safety and operating controls of equipment, including an operational check of associated control sequences.
- .13 Fin Straightening: inspect finned surface heat transfer coils for damages fins and advise

- the installing contractor of repairs required.
- .14 Verify that manufacturer's start-up procedures have been performed and that equipment is installed in accordance with the manufacturers written installation recommendations.
- .16 Where work is noted to be done in stages a complete air balance and verification report will be required at the end of each stage.

3.9 AIR SYSTEM VERIFICATION

- .1 Review drawings, specifications and installed work to ensure that systems may be properly balanced in accordance with drawings. Advise installing contractor of any additional requirements for effective balancing.
- .2 In air handling systems which include supply fans with variable speed drives, airflows shall be verified to design with all filters clean and with all filters loaded to filter manufacturer's recommended final (change-out) resistance. Motor and drive capacity to accommodate full range of filter loadings shall be verified.
- .3 In air handling systems which include supply fans without variable speed drives, air filters shall be verified to design airflows with air filters loaded so that the air pressure drop through each filter is equal to the average of the manufacturers listed initial resistance and recommended final (change-out) resistance.
- .4 Test and record blower rpm for each fan and air handling unit.
- .5 Test and record motor full load amperes.
- .6 Make Pitot tube traverse of main supply and obtain operating air quantities at fans.
- .7 Test and record system static pressures, suction and discharge.
- .8 Test and record system operating recirculated air quantities.
- .9 Test and record system operating outside air quantities.
- .10 Test and record entering drybulb air temperatures (heating and cooling coils).
- .11 Test and record entering wet bulb air temperatures (heating and cooling coils).
- .12 Test and record leaving dry bulb air temperatures (heating and cooling coils).
- .13 Test and record leaving wet bulb air temperatures (cooling coils only).
- .14 Measure airflow in all main and zone branch supply and return air ducts.
- .15 Test and record airflow at each diffuser, grille, and register.
- .16 Witness and verify results of duct leakage tests conducted under section 15810.
- .17 Tabulate and certify test results on suitable forms and submit to the Consultant for approval and record. Identify each diffuser, grille, and register as to location and area. Identify and list size, type, and manufacturer of diffusers, grilles, registers, and all testing equipment. Use manufacturer's rating on all equipment to make required calculations.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 SECTION INCLUDES

- .1 Duct work insulation.
- .2 Insulation jackets.

1.3 REFERENCES

- .1 Section 23 01 01: Requirements for references and standards.
- .2 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .4 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .5 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
- .6 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .7 ASTM C1071 - Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).
- .8 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .9 ASTM E96 - Water Vapour Transmission of Materials.
- .10 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- .11 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .12 NAIMA National Insulation Standards.
- .13 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- .14 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .15 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- .16 CGSB-Canadian General Standards Board.
- .17 CAN/CGSB-51.9 Mineral Fiber Thermal Insulation for Piping and Round Ducting.
- .18 CAN/CGSB-51.10 Mineral Fiber Board Thermal Insulation
- .19 CAN/CGSB-51.11 Mineral Fiber Thermal Insulation Blanket.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 23 01 01: Procedures for submittals.
- .2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 SUBMITTALS FOR INFORMATION

- .1 Section 23 01 01: Procedures for submittals.
- .2 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Applicator Qualifications: Company specializing in performing the work of this section with minimum 6 years documented experience.

1.7 REGULATORY REQUIREMENTS

- .1 Materials: Flame spread/smoke developed rating of 25/50 to the requirements of the Ontario Building Code.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 23 01 01: Transport, handle, store, and protect products.
- .2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Section 23 01 01: Environmental conditions affecting products on site.
- .2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .3 Maintain temperature during and after installation for minimum period of 24 hours.

2 Products

2.1 GLASS FIBRE, FLEXIBLE

- .1 Manufacturer: Owens Corning Fiberglas
- .2 Other acceptable manufacturers offering equivalent products:
 - .1 Manson Insulation
 - .2 Knauf Insulation
 - .3 Schuller International Inc.Or equivalent.
- 3 Insulation: ASTM C553; flexible, noncombustible blanket.
 - .1 'ksi' value : ASTM C518,0.045 at 75.2 °F (24 °C).
 - .2 Maximum service temperature: 250 °F (121 °C).
 - .3 Maximum moisture absorption: 0.20 percent by volume.
- .4 Vapour Barrier Jacket:
 - .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
 - .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
 - .3 Secure with pressure sensitive tape.
- .5 Vapour Barrier Tape:
 - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .6 Outdoor Vapour Barrier Mastic:
 - .1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.
- .7 Tie Wire: Annealed steel, 1/16" (1.5 mm).

2.2 GLASS FIBRE, RIGID

- .1 Manufacturer: Owens Corning Fiberglas Model Vapour-Seal.
- .2 Other acceptable manufacturers offering equivalent products:
 - .1 Manson
 - .2 Knauf Fiber Glass
 - .3 Schuller
 - .4 Substitutions: Refer to Section 01 25 00.
- .3 Insulation: ASTM C612; rigid, noncombustible blanket.
 - .1 'ksi' value : ASTM C518,0.036 at 75.2 °F (24 °C).
 - .2 Maximum service temperature: 250 °F (121 °C).
 - .3 Maximum moisture absorption: 0.20 percent by volume.
 - .4 Density: 48 kg/cu m.
- .4 Vapour Barrier Jacket:
 - .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
 - .2 Moisture vapour transmission: ASTM E96; 0.04 perm.
 - .3 Secure with pressure sensitive tape.

2.3 JACKETS

- .1 Canvas Jacket: UL listed.
 - .1 Fabric: ASTM C921, 220 g/sq m, plain weave cotton treated with dilute fire retardant lagging adhesive.
 - .2 Lagging Adhesive: Compatible with insulation.
- .2 Mineral Fibre (Outdoor) Jacket: Asphalt impregnated and coated sheet, 2.45 kg/sq m.
- .3 PVC Jacket (Indoor):
 - .1 Jacket: ASTM C921, One piece sheet material.
 - .1 Minimum Service Temperature: -31 °F (-35 °C).
 - .2 Maximum Service Temperature: 150 °F (66 °C).
 - .3 Moisture Vapour Transmission: ASTM E96; 0.03 perm inches.
 - .4 Maximum Flame Spread: ASTM E84; 25 or less.
 - .5 Maximum Smoke Developed: ASTM E84; 50 or less.
 - .6 Thickness: 20 mil (0.4 mm) minimum.
 - .2 Colour: standard off-white **OR coloured to suit duct identification**
 - .3 Covering Adhesive Mastic
 - .1 Compatible with insulation, maximum VOC content of 50 g/L.
 - .4 Manufacturer;
 - .1 Ceel-Co 300 series
 - .2 Speedline *Smoke Safe*
- .4 Aluminum Jacket: ASTM B209M.
 - .1 Thickness: 0.40 mm sheet.
 - .2 Finish: Smooth.
 - .3 Joining: Longitudinal slip joints and 2" (50 mm) laps.
 - .4 Fittings: 0.4 mm thick die shaped fitting covers with factory attached protective liner.
 - .5 Metal Jacket Bands: 3/8" (10 mm) wide; 0.015" (0.38 mm) thick aluminum.

2.4 ACCESSORIES

- .1 Adhesives and finishes shall be as recommended by the insulation manufacturer. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.
- .2 Vapor retarder lap adhesive shall be water based, fire retardant
- .3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50 mm) width.
- .4 Tie wire shall be of 1/16" (1.5 mm) Ø stainless steel.
- .5 Fasteners shall be of 1/8" (4 mm) Ø pins, with 35 mm square clips. Clip length to suit insulation thickness.
- .6 Bands shall be 1/2" (12 mm) wide 1/4" (6mm) thick galvanized steel.
- .7 Facing shall be of 1" (25 mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

3 Execution

3.1 EXAMINATION

- .1 Verify that ductwork has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- .1 Install duct insulations to Technical Identification and Analysis Centre National Installation Standards.
- .2 Apply insulation materials, accessories, jackets and finishes in accordance with manufacturer' written instructions and as specified.
- .3 Insulated ductwork conveying air below ambient temperature:
 - .1 Provide insulation with vapour barrier jackets.
 - .2 Finish with tape and vapour barrier jacket.

- .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- .4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- .4 Insulated ductwork conveying air above ambient temperature:
 - .1 Provide with or without standard vapour barrier jacket.
 - .2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- .5 Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces below 3 metres above finished floor: Finish with canvas jacket sized for finish painting.
- .6 Exterior Applications: Provide insulation with vapour barrier jacket. Cover with outdoor jacket finished as specified.
- .7 External Duct Insulation Application:
 - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
 - .2 Secure insulation without vapour barrier with staples, tape, or wires.
 - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
 - .4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.
 - .5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- .8 Duct and Plenum Liner Application:
 - .1 Adhere insulation with adhesive for 90 percent coverage.
 - .2 Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
 - .3 Seal and smooth joints. Seal and coat transverse joints.
 - .4 Seal liner surface penetrations with adhesive.
 - .5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 DUCT INSULATION

- .1 Insulate new or altered ductwork and re-insulate existing ductwork where insulation has been removed or damaged as follows:

<u>Service</u>	<u>Type</u>	<u>Thickness</u>
Air supply rectangular	rigid	1" (25mm)
Air supply round	flexible	1" (25mm)
Exhaust 6' (2m) from outside) rectangular	rigid	3" (75mm)
Exhaust 6' (2m) from outside) round	flexible 3"	(75mm)
Fresh air intake rectangular	rigid	3" (75mm)
Exhaust air plenums	rigid	3" (75mm)
Ductwork outdoors	rigid	3" (75mm)
Rectangular air supply runouts to terminal units <10' (3m) in length	rigid	1" (25mm)
Round air supply runouts to terminal units <10' (3m) in length	flexible 1"	(25mm)
Duct mounted cooling coils	rigid	1 1/2" (40mm)

- .2 Inline duct silencers shall be insulated in the *same manner* as ductwork.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 SECTION INCLUDES

- .1 Piping insulation.
- .2 Jackets and accessories.

1.3 REFERENCES

- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .4 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .5 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .6 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .7 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .8 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .9 ASTM C547 - Mineral Fibre Pipe Insulation.
- .10 ASTM C552 - Cellular Glass Thermal Insulation.
- .11 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .12 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .13 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .14 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

1.4 SUBMITTALS

- .1 Product Data: Provide product description, list of materials and thickness for each service, and locations.
- .2 Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

- .1 Materials: Flame spread/smoke developed rating of 25/50 or less to ULC S102 and ASTM E84.

1.6 QUALIFICATIONS

- .1 Applicator: Company specializing in performing the work of this section with a minimum of three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Transport, handle, store, and protect products.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Store insulation in original wrapping and protect from weather and construction traffic.
- .4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of 24 hours.

2 Products

2.1 GLASS FIBRE

- .1 Manufacturers:
 - .1 Manufacturer: Owens Corning Fiberglas
- .2 Other acceptable manufacturers offering equivalent products:
 - .1 Manson Insulation
 - .2 Knauf Insulation
 - .3 Schuller International Inc.Or equivalent.
- .2 Insulation: ASTM C547; rigid moulded, noncombustible.
 - .1 'ksi' value : ASTM C335, 0.035 at 75°F (24°C).
 - .2 Minimum Service Temperature: -20°F (-28.9°C).
 - .3 Maximum Service Temperature: 302°F (150°C).
 - .4 Maximum Moisture Absorption: 0.2 percent by volume.
- .3 Vapour Barrier Jacket
 - .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
 - .2 Moisture Vapour Transmission: ASTM E96; 0.02 perm.
 - .3 Secure with self sealing longitudinal laps and butt strips.
 - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Tie Wire: 1.3 mm stainless steel with twisted ends on maximum 12" (300 mm) centres.
- .5 Vapour Barrier Lap Adhesive
 - .1 Compatible with insulation.
- .6 Insulating Cement/Mastic
 - .1 ASTM C195; hydraulic setting on mineral wool, VOC content not to exceed 80 g/L.
- .7 Fibrous Glass Fabric
 - .1 Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - .3 Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
- .8 Indoor Vapour Barrier Finish
 - .1 Vinyl emulsion type acrylic, compatible with insulation, white colour, VOC content not to exceed 250 g/L.
- .9 Outdoor Vapour Barrier Mastic
 - .1 Vinyl emulsion type acrylic, compatible with insulation, white colour.
- .10 Insulating Cement
 - .1 ASTM C449, VOC content not to exceed 80 g/L.

2.2 PHENOLIC INSULATION

- .1 Manufacturers:
 - .1 Manufacturer: Resolco International bv "Insul-Phen"
 - .2 Other Manufacturers: in accordance with 01 25 00
- .2 Insulation: ASTM C-1126 Phenolic Foam Thermal Insulation, Chlorofluorocarbons and hydrochlorofluorocarbons free, rigid moulded, noncombustible insulation fabricated in required shapes by Resolco International approved fabricators to ASTM C-450 and C-585.
 - .1 Density: 2.5-lb/ft³ (40-kg/m³)
 - .2 Temperature range: -290°F to +250°F (-129°C to +107°C)
 - .3 Closed cell content: 92%
 - .4 Compressive strength: 29 psi (2 bar)
 - .5 Thermal conductivity: 0.13 BTU-in/hr-ft²-°F (18.72 W-mm/m²-°C)
 - .6 Fire resistance rating: 25/50 to ASTM E84 on plain and faced product up to 3" (75mm) Thick
- .3 Joint Sealer:
 - .1 vapour barrier type, moisture and water resistant, 97% solids by weight, non-hardening, flexible in temperature range from -5°F to +200°F (-20.5°C to +93.3°C), Daxcel 161D, Fosters 30-45, Childers CP-76.
- .4 Vapour Barrier Mastic / Reinforcing:
 - .1 Vimasco Vapor-Block, Fosters 30-80, #749 or Childers' Chil-Perm #SP-35, or equivalent with the following minimum requirements:
 - .1 Wet Fammability: No flash to boiling

- .2 Water Vapor Permeance: Maximum 0.08 US perms
- .3 Average Non Volatile: 58% by volume
- .4 Service Temperature Range: -20°F to +190°F (29°C to 88°C)
- .5 Application: Two Coats
- .2 The membrane for reinforcement of vapor retardant mastic shall be 6 X 6 or 10 X 10 glass fiber reinforcing mesh, Chil Glas #5 made by Chilers or PC-79 Fabric, 5 X 6 mesh, by Pittsburgh Corning, or equivalent.
- .5 Vapour Barrier (Indoor Service)
 - .1 Vapor barrier for indoor service shall be ASJ All Service Jacket as manufactured by Compac Corp or Lamtec Corp as per the Resolco UL E84 test reports, constructed from 0.009 mm thick aluminum foil laminated to 30lb. Kraft paper by flame retardant adhesive (VOC content not to exceed 650 g/L for clear or 350 g/L for pigmented) or equivalent. The laminated product shall be reinforced with tri directional fiberglass yarn with yarn spacing of 5 per inch.
 - .2 Venture 1555U factory applied zero perm jacket system shall be used in areas of high humidity or where there is a risk of mould/mildew growth.
 - .3 In areas of heavy mechanical abuse or high pressure wash down areas use product for Outdoor Service.
- .6 Vapour Barrier (Outdoor Service)
 - .1 The vapor barrier used to seal any plain pipe insulation for outdoor service prior to application of cladding shall be Polyguard Insulrap 30 rubberized bitumen adhesive laminated to a 4 mil polyethylene film. Total thickness shall be 30 mils (0.76mm), permeance; 0.015 max, or equivalent.
 - .2 Polyguard 650 LT Liquid Adhesive is required at application temperatures below 50°F (10°C) or with dusty insulation surfaces. As an alternative to the use of Liquid Adhesive, a light pass may be made with a heat gun over the face of the adhesive mass, just prior to application.
 - .3 Peel & Seal, self-stick, aluminum embossed finish; by Polyguard Products may be considered as an alternative, outdoors. It eliminates the need for metal cladding, however, it is recommended for installation above +60°F (+16°C) and in no case, below +40°F (4°C).
 - .4 All outdoor jacket systems shall be banded using 1/2" (12 mm) aluminum banding with wing seals at 12" (300 mm) centers.
- .7 Fabrication Adhesive
 - .1 Fabrication adhesive for Insul-Phen shall be H.B. Fuller's SC-1454, a contact adhesive or H.B. Fuller's HL-2278, hot melt adhesive, or equivalent.
- .8 Pipe and Hanger Supports
 - .1 Pipe support load bearing insulation shall be fabricated by a Resolco or equivalent. Approved fabricator from Resolco CFC & HCFC free heavy density Insul-Phen in 3.75lb/ft³ density., or equivalent The upper 1870° section of the support can be fabricated from standard 2.5lb./ft³ density Insul-Phen and 2.5lb./ft³ can be used at the support point up to a certain pipe diameter (contact your local Resolco fabricator or technical rep) with a 12" (300 mm) long saddle.
 - .2 The pipe support insulation shall be supported by a saddle. Stainless steel saddles shall be used where edible food or open product is exposed. For all other applications it is acceptable to use painted, galvanized or carbon steel.
- .9 PVC Cladding (Indoor Use only)
 - .1 The jacketing to provide protection to insulation and vapor barrier shall be 0.030" (0.8 mm) thick Ceel-Co 300 Series UVR PVC Jacketing or Proto LoSmoke 25/50 UVR PVC. Jacketing shall be tough all purpose, UV resistant capable of enduring frequent washing with hot water or other cleaning agents. All joints of PVC jacket shall be solvent welded with Ceeltite or Proto PVC Adhesive. As an alternative a high density (3.75lb) phenolic along with 0.020 PVC jacket can be used.
 - .2 Ceel-Co 300 Series or Proto LoSmoke UVR PVC Jacket .040" (1 mm), or a double wrap of .030" (0.8 mm) thick shall be used where protection from mechanical abuse or high pressure washing is required.
 - .3 A stainless steel diamond-mesh expanded metal lath cage shall be installed with spacers a minimum of 1" (25 mm) away from and over top of the pipe and insulation sealed with PVC Jacket in areas where it is possible for knives, etc. to damage jacket system.
 - .4 In food preparation/hygenic areas cladding must withstand scalding water washdowns; wherever a higher temperature material is required: Proto EXOD (R), a Chlorinated

- polyvinyl chloridematerial, light grey and is rated to +225°F (107°C). EXOD (R) shall be ordered "cut and precurled" for pipe insulation jacket.
- .10 Aluminum Cladding (Outdoor Use only)
- .1 The metal cladding weather barrier to provide protection from weather, mechanical wear or other damage shall be aluminum alloys 3003, 1100 or 3105 meeting ASTM B209 with H-14 temper, 0.016" (0.4 mm) thick with Polysurlyn moisture barrier on the back side. The metal jacketing shall be RPR Incul-mate, Childers Products or equivalent.
- .2 .016 inch thick aluminum is acceptable for all piping except where excessive abuse is anticipated; use .024" (6 mm) thick. .024" (6 mm) thick shall be used on all equipment as minimum, however .032" (8 mm) thick is preferred.
- .3 The metal cladding where frequent washing is anticipated, shall be smooth for all piping and horizontal equipment and 1-1/4" (30 mm) corrugated for all vertical equipment above 30" (762 mm) insulation OD. Stucco embossed finish may be used for other areas.
- .4 Where foot traffic is likely and increased strength of jacket is necessary use rolls of pipe jacketing; Childers Corrolon or RPR Rib-Cor, 3/16" (0.2 mm) corrugated in the circumferential direction or equivalent.
- .11 Fastening Accessories
- .1 Tape for fastening plain pipe covering insulation shall be 3/4" (20 mm) Fiberglass reinforced strapping tape made by National Tape Co. or equivalent.
- .2 Stainless steel type T304/T316 or .020 aluminum strapping for fastening aluminum jacketing outdoors and outer layer of vessel and/or large diameter (above 16 inches O.D.) pipe insulation shall be 1/2" x .020" (15 mm x .5 mm) thick with stainless steel or aluminum wing seals made by RPR Products, Childers Products or equivalent. RPR no. 7 or breather spring 4 inches long made from stainless steel type T305 shall be used for securing large diameter vessels metal jacketing.
- .3 Polypropylene 1/2" (15 mm) wide, 1/2" (15 mm) thick banding and clips, Q-Band/Q-Clip made by Band-It Inc. shall be used for securing PVC jacketing indoors. The banding shall not be used in food processing areas where bacterial growth is anticipated. Banding may be used for temporary securement until PVC joint adhesive cures. The PVC Jacketing must be complete sealed at all joints to prevent entry of water or moisture. In nonfood processing areas PVC jacketing should be glued using manufacturers adhesive (VOC content not to exceed 510g/L).
- .12 Inspection Plugs
- .1 NDT Inspection plugs made from EPDM and aluminum metal cap as manufactured by Parker Special Products shall be installed on pipe and equipment requiring frequent inspections. Use 1-1/2" (40 mm) NDT plug for pipe and equipment insulation jacket OD of less than 9" (225 mm). Use 2-1/2" (65 mm) and 3" (75 mm) NDT plug for pipe and equipment between 9" (225 mm) and 24" (600 mm) insulation jacket OD. Use 5" (125 mm) NDT plug for pipe and equipment insulation jacket OD above 24" (600 mm).
- .13 Expansion/Contraction Joints
- .1 Expansion/contraction joint material shall be 1lb/ft³ density fiberglass blanket.

2.3 JACKETS

- .1 PVC Plastic
- .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material.
- .1 Minimum Service Temperature: -31°F (-35°C).
- .2 Maximum Service Temperature: 151°F (66°C).
- .3 Moisture Vapour Transmission: ASTM E96; 0.03 perm inches.
- .4 Maximum Flame Spread: ASTM E84; 25 or less.
- .5 Maximum Smoke Developed: ASTM E84; 50 or less.
- .6 Thickness: 20 mil (0.4 mm) minimum.
- .2 Colour: standard off-white **OR** coloured to suit pipe identification.
- .3 Covering Adhesive Mastic
- .1 Compatible with insulation, maximum VOC content of 50 g/L.
- .4 Manufacturer;
- .1 Ceel-Co 300 series
- .2 Speedline *Smoke Safe*
- Or equivalent.

- .2 Aluminum Jacket: ASTM B209.
 - .1 Thickness: 0.02" (0.40 mm) sheet.
 - .2 Finish: Smooth.
 - .3 Joining: Longitudinal slip joints and 2" (50 mm) laps.
 - .4 Fittings: 0.02" (0.40 mm) thick die shaped fitting covers with factory attached protective liner.
 - .5 Metal Jacket Bands: 3/8" (10 mm) wide; 0.01" (0.38 mm) thick aluminum.

2.4 REMOVABLE / REUSABLE INSULATION COVERS

- .1 Material: Teflon coated, woven fiberglass fabric
- .2 Weight: 16.5 oz/sq.yd. (± 10%)
- .3 Thickness: 0.015" (± 10%)
- .4 Colour: Gray
- .5 Tensile Strength: 400 x 330 lb. (W x F)
- .6 Tarp Tear strength: 60 x 40 lb. (W x F)
- .7 Mullen Burst Pressure: 650 psi
- .8 Insulation thickness: Match connecting piping
- .9 Temperature Range: -67°F to 500°F
- .10 Lacing Hooks: Stainless Steel
- .11 Tie Wire: 16-ga stainless steel

2.5 ACCESSORIES

- .1 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 21 01 01. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.
- .2 Vapor retarder lap adhesive shall be water based, fire retardant
- .3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50 mm) width.
- .4 Tie wire shall be of 1/16" (1.5 mm) ø stainless steel.
- .5 Fasteners shall be of 1/8" (4 mm) Ø pins, with 35 mm square clips. Clip length to suit insulation thickness.
- .6 Bands shall be 1/2" (12 mm) wide 1/4" (6mm) thick galvanized steel.
- .7 Facing shall be of 1" (25 mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

2.6 CELLULAR GLASS

- .1 Manufacturer: Pittsburgh Corning FOAMGLAS or equivalent.
- .2 Insulation: ASTM C552 "Standard Specification for Cellular Glass Thermal Insulation",
 - .1 'k' Value: 0.039 at 24 degrees C.
 - .2 Maximum Service Temperature: 482 degrees C.
 - .3 Maximum Water Vapour Transmission: 0.1 perm.
 - .4 Maximum Moisture Absorption: ASTM C240, 0.2% by volume.
 - .5 Density: 128 kg/cu m.
- .3 FOAMGLAS® pipe insulation shall be fabricated according to the requirements of ASTM C1639 "Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation".

3 Execution

3.1 EXAMINATION

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- .1 Install piping insulations to TIAC National Installation Standards.
- .2 Apply insulation materials, accessories, jackets and finishes in accordance with manufacturer' written instructions and as specified.

- .3 On exposed piping, locate insulation and cover seams in least visible locations.
- .4 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 - .1 Provide vapour barrier jackets, factory applied or field applied.
 - .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
 - .3 Finish with glass cloth and vapour barrier adhesive.
 - .4 PVC fitting covers may be used.
 - .5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- .5 For insulated pipes conveying fluids above ambient temperature:
 - .1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.
 - .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - .3 Finish with glass cloth and adhesive.
 - .4 PVC fitting covers may be used.
 - .5 For hot piping conveying fluids 140°F (60°C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - .6 For hot piping conveying fluids over 140°F (60°C), insulate flanges and unions at equipment.
- .6 Inserts and Shields:
 - .1 Application: Piping 1-1/2" (40 mm) diameter or larger.
 - .2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - .3 Insert Location: Between support shield and piping and under the finish jacket.
 - .4 Insert Configuration: Minimum 6" (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - .5 Insert Material: hydrous calcium silicate insulation.
- .7 Finish insulation at supports, protrusions, and interruptions.
- .8 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement.
- .9 Provide integral vapour barrier jacket on insulation on pipe and fittings for exterior applications.
- .10 Provide PVC jacket and fitting covers for pipe in mechanical equipment rooms and where exposed in finished spaces.
- .12 Provide aluminum jacket and fitting covers with seams located on bottom side of horizontal piping for exterior applications, in boiler rooms and where subject to temperatures > 200°F (93°C).
- .11 For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- .12 For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 TOLERANCE

- .1 Substituted insulation materials: Thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 PIPE INSULATION

- .1 Insulate new or altered piping with rigid pipe insulation and re-insulate existing piping where insulation has been removed or damaged as follows:

Service	Operating Temperature Range °F (°C)	Pipe Diameter in. (mm)	Insulation Thickness in. (mm)
Cold water (outside building)	0 to 850 (-18 to 454)	All sizes	2 (50)
Condensate (cold)	0 to 850 (-18 to 454)	All sizes	1/2 (13)
Domestic cold water	0 to 850 (-18 to 454)	All sizes	1 (25)
Domestic hot water & hot water recirculation	105 (41) and higher	2 (50) and smaller 2-1/2 (65) and larger	1 (25) 1-1/2 (40)
Sanitary drainage	40 to 55 (4 to 13)	All sizes	1 (25)
Storm drainage	40 to 55 (4 to 13)	All sizes	1 (25)
Hydronic heating (hot water gn glycol/water)	105 to 140 (41 to 60)	4 (100) and smaller	1 (25)
	105 to 140 (41 to 60)	5 (125) and larger	1-1/2 (40)
	141 to 200 (61 to 93)	All sizes	1-1/2 (40)

Note: Phenolic insulation may be used in place of rigid fibreglass pipe insulation, thickness to provide equivalent thermal resistance.

- .2 Insulate with flexible insulation as follows:

Service	Thickness
Horizontal storm and sanitary drainage	1" (25 mm)

- .3 Insulate valves, flanges and pipe connections with removable / reusable insulation covers.
 .4 Wrap butt joints with a 4" (100 mm) strip of fire resistant vapour barrier jacket cemented with lagging adhesive.
 .5 Where the pipe hanger is around the insulation, provide an insulation protection shield within the pipe saddle. Coordinate with installation of hangers.
 .6 Insulate all fittings, flanges and valves on pipes to provide equivalent insulation to that on adjoining pipe.
 .7 Continue insulation through sleeves including specified finish.
 .8 Cut back covering on strainers and finish off to expose removable head insulation.
 .9 Cover expansion joints first with 24 gauge (0.7 mm) galvanized metal sleeve and then insulate to provide equivalent thickness to that on adjoining pipe.
 .10 Protect insulation with protection saddles where insulated pipe is supported by rollers.
 .11 Insulate pipe hangers supporting new piping carrying water at 70°F (21°C) or less to prevent condensation. Extend insulating material along hanger rod to height 4 times thickness of insulation. Seal insulation with vapourproof sealant.
 .12 Extend pipe insulation and covering through walls, floors, ceilings, and concrete beams, unless indicated otherwise on drawings. protect exposed insulation extending through floors with 4" (100 mm) wide strip of 18 gauge (1.3 mm) galvanized iron.
 .13 Pack annular space between pipe sleeves and piping or pipe covering with glass fibre insulation or rockwool insulation. In fire rated assemblies use Dow Silicon RTV or other ULC listed materials. Seal exposed insulation with mastic.
 .14 Recover exposed surfaces of insulated piping installed in exposed areas, mechanical rooms, and equipment rooms with PVC jacketing and PVC fitting covers installed in accordance with manufacturers instructions.

- .15 Insulate and cover exposed surfaces of waste connections, traps, hot and cold supply risers and valves at each lavatory and sink designated for "handicapped" or "barrier free" use with: PVC insulated fitting covers specifically designed for this application. Vinyl material is not to exceed flame spread rating of 150, and if intended to be used in high buildings, its smoke developed classification does not exceed 300. Zeston or other equivalent material. or foamed plastic type insulation finished with two coats of Armstrong Armflex or other equivalent material.
- .16 Provide aluminum metal cladding over the insulation on the following services;
 - .1 All exposed piping located outdoors.
- .17 Insulate sprinkler and standpipe main from take-off from domestic water to a point approximately 6 feet (1800 mm) after electrically supervised valve.
- .18 Oversize insulation of Domestic hot water piping complete with heating cable for pipe sizes 1-1/4" (35 mm) dia. and smaller by 1/4" (6 mm) in inside diameter to allow for installation over heating cable.

3.6 REFRIGERATION PIPE INSULATION

- .1 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be as follows: 1/2" (13 mm) thick for pipe 1" (25 mm) O.D. and smaller; 3/4" (20 mm) thick for pipe 1-1/8" (28 mm) to 2" (50 mm) O.D.; 1" (25 mm) thick for pipes 2-1/8" (54 mm) O.D. and larger.
- .2 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a very minimum. Seal all joints in the insulation with Armaflex 520 BLV or equivalent. Insulate flexible pipe connectors.
- .3 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and provide two coats of grey Armaflex finish. Extend insulation through pipe support clamps. Provide a 6" (150 mm) long, 20 gauge (1.1 mm) galvanized steel sleeve around pipe insulation at each support.

End of Section

1. GENERAL

1.1 Scope / Summary

- .1 Provide all metering equipment required to measure and trend natural gas consumption by end use.

1.2 Related Sections

- .1 22 09 00 Instrumentation and Control for Plumbing
- .2 26 09 13 – Electrical Power Monitoring

2. Design Requirements / Products

2.1 End Uses to be Monitored

- .1 Provide gas meters for each separate end use, including but not limited to:
 - .1 Facility incoming gas
- .2 Metering Equipment
 - .1 Meters
 - .1 Provide gas meters complete with bypass piping arrangement or other means to remove or isolate for service without interruption to gas flow.
 - .2 Materials shall be compatible with the systems in which they are installed at all potential operating temperatures and pressures.
 - .3 Meters shall provide a pulse output scaled to an appropriate volume. In general, provide a scaled pulse output of 0.01 m³ per pulse unless high consumption would result in pulses too frequent to be reliably captured by the pulse counting equipment.
 - .4 Meters requiring power shall be hard-wired to an emergency power circuit. Battery powered units are not acceptable.
 - .5 Provide meters with readout of totalized volume.
 - .6 Accuracy +/- 1.5% in expected operating flow range.
 - .2 Data logging Equipment
 - .1 Internet Protocol (IP) based data logger complete with:
 - .1 Built-in web server.
 - .2 Capable of operating with a dedicated IP address (to be provided by the Region).
 - .3 Communications Protocols:
 - .1 HTTP/Post capable of pushing data to 3rd party applications/databases.
 - .2 Modbus TCP
 - .4 Built-in real-time and historic graphics accessible with any HTML 5 internet browser (computer, tablet, phone) on the Region's network. Data to be displayed in local time, adjusted for daylight savings time.
 - .5 Real-time clock with battery backup and email alert for battery end of life.
 - .6 Time-Stamp:
 - .1 Represent date and time
 - .2 In UTC time or offset from a specified UTC time
 - .3 Resolution: Minimum 1 second
 - .7 Ability to export all stored trend data to comma separated value (.csv) or Microsoft Excel format for importing into spreadsheets. Time-stamps to be exported as a single field with a numeric (non-text) value in local time.
 - .8 Published application programming interface (API) allowing data to be retrieved from the pulse counter via non-proprietary means, such as JavaScript Object Notation (JSON).
 - .9 Provide minimum 2 spare inputs for future additional meters.
 - .10 Location of spare inputs to be determined by the Region.

- .11 Built-in trending and data storage:
 - .1 3 years of consumption data (m³) at 5 minute intervals for each input with time-stamp.
 - .2 Stored in non-volatile memory.
- .12 Battery/power backup (for pulse counting):
 - .1 Lasting a minimum of 72 hours.
 - .2 Rechargeable.
 - .3 Email alert for battery end of life.
- .13 No special software required to set up data logger or access data.
- .14 Security:
 - .1 Unrestricted access to data and graphics over the Region's network.
 - .2 Password protection for access to setup, changing settings/parameters and deleting data.
- .15 Ability to measure, store and trend the following data complete with timestamp:
 - .1 Totalized consumption (m³)
 - .2 Acceptable product: z3 Controls Inc. NetMeter OMNI or equivalent.
- .3 DATA CABLING
 - .1 Cat 5e or Cat 6 Unshielded Twisted Pair (UTP)
 - .2 Colour: Green

3. Execution

3.1 Provide gas meters for each separate end use, including but not limited to:

- .1 Installation Requirements
 - .2 Meters to be supplied and installed by the mechanical contractor. Meters to be supplied with complete pulse output. Sub Meters by American Meter Co., Itron or Norgas Controls or equivalent are acceptable. Pulse output should be complete with wiring harness. BAS contractor to supply intrinsically safe barrier as required. Manufacturer's technician to be on site for the startup, to be included with the meter supply.
 - .3 Install data logger in a painted, hinged NEMA 1 (or better) enclosure complete with power supply. Label front of enclosure with data logger name, IP address, meter name(s) and load(s) measured.
 - .4 Provide optical isolation/safety devices as required by the local gas utility or other authorities having jurisdiction.
 - .5 All communication and signal cables to be continuous. No splicing is allowed.
 - .6 Affix York Region Property Services Branch Asset ID tag (to be provided by the Region) to data logging unit prior to installation.
 - .7 Data logger and network configuration to be done in consultation with the Region's Property Services Branch.
 - .8 Connect data logging equipment to the Region's IT network.
 - .9 Commission data logger:
 - .1 Ensure latest available firmware version is installed in data logger.
 - .2 Obtain Network information from York Region project manager and program into data logger, including IP address, subnet mask, default gateway, primary and secondary DNS addresses.
 - .3 Set data logger clock to current local time.
 - .4 Set up email alerts as specified and/or requested by the Region's project manager.
 - .5 Set up trend logging as specified and/or requested by the Region's project manager. At minimum, set up trend logging per 2.2.2.1.10 and 2.2.2.1.14 above.
 - .6 Set default homepage to display real-time demand graphs and consumption statistics.
 - .7 Confirm data logger readings correspond to physical meter reading.
 - .8 Calibrate any analog sensors connected to the data logger.
 - .9 Verify data logger information is viewable through a web browser on a device on the Region's network.
 - .10 Complete and submit Gas Meter Installation/Startup Verification Form (23 09 13.01).

- .11 Provide training on data logger software use to Region staff including Facilities Operations and Maintenance and Corporate Energy Services.
- .12 Provide meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals (for meter(s) and data logger) and recommended meter recalibration interval(s).

End of Section

1. Furnace & Condensing Unit

1.1 Model Number

.1 Furnace: Carrier 59MN7A100V21-22 and cased coil CNPVP6024ALA with vent kit KGAVT0801CVT and thermostatic expansion valve KSATX0501PUR. Thermostat: SYSTXCCITN01-A or equivalent.

.2 Condensing Unit: Carrier 24ANB160A003 or equivalent

Basis of design is Carrier, alternate products meeting the specifications and efficiency by York & Trane or equivalent are acceptable.

2. Product Data

The 59TP6A Multipoise Variable- Speed Condensing Gas Furnace shall be a two-stage Performance™ System.

2.1 Standard Features

- .1 All sizes meet ENERGY STAR® Version 4.0 criteria for gas furnaces: 95+ AFUE; AMACF electrical rating; 2% or less cabinet airflow leakage.
- .2 Quiet operation.
- .3 Height 35" (889mm) cabinet
- .4 Silicon Nitride Perfect Light™ Hot Surface Igniter.
- .5 ComfortFan™ technology allows control of continuous fan speed from a compatible thermostat.
- .6 4-way multipoise design for upflow, downflow or horizontal installations, with unique vent elbow and optional through-the-cabinet downflow venting capability.
- .7 Full-featured variable-speed blower motor, two-speed inducer motor, and two-stage gas valve.
- .8 Self-diagnostics.
- .9 Adjustable blower speed for cooling, continuous fan, and dehumidification.
- .10 Aluminized-steel primary heat exchanger.
- .11 Stainless-steel condensing secondary heat exchanger.
- .12 Factory-configured ready for upflow applications.
- .13 Fully-insulated casing including blower section.
- .14 Direct-vent/sealed combustion, single-pipe venting or ventilated combustion air.
- .15 Installation flexibility: sidewall or vertical vent.
- .16 Certified to leak 2% or less of nominal air conditioning CFM delivered when pressurized to 1-in. Water column with all present air inlets, air outlets, and condensate drain port(s) sealed.

2.2 Features and Benefits

.1 Comfort Heat Technology®

This feature with Adaptive Control is proprietary function that promotes homeowner comfort through two stages of heating. This Carrier furnace offers a patented algorithm that continually monitors and adjusts

furnace operation by looking at both current and past conditions to determine the most effective stage of heating and the amount of time to run each stage, every cycle.

.2 SmartEvap™ Technology

When paired with a compatible thermostat, this dehumidification feature overrides the cooling blower off-delay when there is a call for dehumidification. By deactivating the blower off-delay, SmartEvap technology prevents condensate that remains on the coil after a dehumidification cycle from re-humidifying throughout the home. This results in reduced humidity and a more comfortable indoor environment for the homeowner.

Unlike competitive systems, SmartEvap technology only overrides the cooling blower off delay when humidity control is needed. Once humidity is back in control, Smart Evap re-enables the energy-saving cooling blower off-delay.

.3 ComfortFan™ Technology

Sometimes the constant fan setting on a standard furnace system can actually reduce homeowner comfort by providing too much or too little air! Fan On Plus technology improves comfort all year long by allowing the homeowner to select the continuous fan speed of their choice using a compatible thermostat.

.4 Power Heat™ Igniter

Carrier's unique SiN igniter is not only physically robust but it is also electrically robust. It is capable of running at line voltage and does not require complex voltage regulators as do other brands. This unique feature further enhances the gas furnace reliability and continues Carrier's tradition of technology leadership and innovation in providing a reliable and durable product.

.5 Full-Featured, Variable Speed Motors

Our variable-speed ECM (Electronically Commutated Motor) optimizes comfort levels in the home year round; features such as passive/active dehumidification, ramping profiles, and quiet operation. They can provide cooling match enhancements to increase the effective SEER of select Carrier air conditioner or heat pump system. This motor does not report back RPM and static pressure to enable static pressure reporting to the UI or zoning system, which is required for zoning, active filter monitoring and system static pressure reporting.

.6 Reliable Heat Exchanger Design

The aluminized steel, clam shell primary heat exchanger was re-engineered to achieve greater efficiency out of a smaller size. The first two passes of the heat exchanger are based on the current 80% product, a design with more than ten years of field-proven performance and success. These innovations, paired with the continuation of a crimped, no-weld seam create an efficient, robust design for this essential component.

The condensing heat exchanger, a stainless steel fin and tube design, is positioned in the furnace to extract additional heat. Stainless steel coupling box componentry between heat exchangers has exceptional corrosion resistance in both natural gas and propane applications.

.7 Optional Media Filter Cabinet

Enhanced indoor air quality in the home is made easier with our media filter cabinet. When installed as a part of the system, this cabinet allows for easy and convenient addition of Carrier high efficiency air filter.

.8 4-Way Multipoise Design

One model for all applications – there is no need to stock special downflow or horizontal models when one unit will do it all. The new heat exchanger design allows these units to achieve the certified AFUE in all positions.

.9 Direct or Single-pipe Venting, or Optional Ventilated Combustion Air

This furnace can be installed as a 2-pipe (Direct Vent) furnace, in an optional ventilated combustion air application, or in single-pipe, non-direct vent applications. This provides added flexibility to meet diverse installation needs.

.10 Sealed Combustion System

This furnace brings in combustion air from outside the furnace, which results in especially quiet operation. By sealing the entire combustion vestibule, the entire furnace can be made quieter, not just the burners.

.11 Insulated Casing

Foil-faced insulation in heat exchanger section of the casing minimizes heat loss. The acoustical insulation in the blower compartment reduces air and motor noise for quiet operation.

.12 Monoport burners

The burners are specially designed and finely tuned for smooth, quiet combustion and economical operation.

.13 Bottom Closure

Factory-installed for side return; easily removable for bottom return. The multi-use bottom closure can also serve for roll-out protection in horizontal applications, and act as the bottom closure for the optional return air base accessory.

.14 Certifications

This furnace is CSA (AGA and CGA) design certified for use with natural and propane gases. The furnace is factory-shipped for use with natural gas. A CSA listed gas conversion kit is required to convert furnace for use with propane gas. The efficiency is AHRI efficiency rating certified. This furnace meets California Air Quality Management District emission requirements.

3. GUIDE SPECIFICATIONS GENERAL 24ABB

3.1 System Description

Outdoor-mounted, air-cooled, split-system air conditioner unit suitable for ground or rooftop installation. Unit consists of a hermetic compressor, an air-cooled coil, propeller-type condenser fan, and a control box. Unit will discharge supply air upward as shown on the Contract Drawings. Unit shall be used in a refrigeration circuit to match up to a packaged fan coil or coil unit.

3.2 Quality Assurance

1. Unit shall be rated in accordance with the latest edition of ARI Standard 210.
2. Unit shall be certified for capacity and efficiency, and listed in the latest ARI directory.
3. Unit construction shall comply with latest edition of ANSI/ ASHRAE and with NEC.
4. Unit shall be constructed in accordance with UL standards and shall carry the UL label of approval. Unit shall have c-UL approval.
5. Unit cabinet shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500-hr salt spray test.
6. Air-cooled condenser coils shall be leak tested at 150 psig and pressure tested at 450 psig.
7. Unit constructed in ISO9001 approved facility.

3.3 Delivery, Storage, and Handling

1. Unit shall be shipped as single package only and is stored and handled per unit manufacturer's recommendations.

4. PRODUCTS

AIR-COOLED, SPLIT-SYSTEM AIR CONDITIONER 24ABB 1-1/2 TO 5 NOMINAL TONS or equivalent

4.1 Equipment

1. Factory assembled, single piece, air-cooled air conditioner unit. Contained within the unit enclosure is all factory wiring, piping, controls, compressor, refrigerant charge Puron (R-410A), and special features required prior to field start-up.

4.2 Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, bonderized, and coated with a powder coat paint.

4.3 Fans

1. Condenser fan shall be direct-drive propeller type, discharging air upward.
2. Condenser fan motors shall be totally enclosed, 1-phase type with class B insulation and permanently lubricated bearings. Shafts shall be corrosion resistant.
3. Fan blades shall be statically and dynamically balanced.
4. Condenser fan openings will be equipped with coated steel wire safety guards.

4.4 Compressor

1. Compressor shall be hermetically sealed.
2. Compressor shall be mounted on rubber vibration isolators.

4.5 Condenser Coil

1. Condenser coil shall be air cooled.
2. Coil shall be constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed.

4.6 Refrigeration Components

1. Refrigeration circuit components shall include liquid-line shutoff valve with sweat connections, vapor-line shutoff valve with sweat connections, system charge of Puron (R-410A) refrigerant, and compressor oil.
2. Unit shall be equipped with filter drier for Puron refrigerant.

End of Section

1. PRODUCTS

1.1 MANUFACTURERS

- .1 The following manufacturers are approved for use:
 - 1. Base Bid Tempeff, supplied in Ontario by HTS (905-643-7719) or equivalent. Refer to Section 01 25 00 for Product substitution procedures. All additional costs for any product substitution for all trades associated with any change shall be the responsibility of the Contractor.

1.2 GENERAL DESCRIPTION

- .1 Configuration: Fabricate as detailed on drawings.
- .2 Performance: As shown on schedules.

1.3 UNIT CONSTRUCTION

- .1 Fabricate unit with double wall galvanized panels secured with mechanical fasteners. All access doors shall be sealed with permanently applied bulb-type gasket.
 - 1. Panels and access doors shall be constructed as a 1-inch (25-mm) nominal thick; with injected polyurethane foam insulation. R value shall be 6.5 per inch of wall thickness. The outer panel shall be constructed of G90 galvanized steel. The inner liner shall be constructed of G90 galvanized steel. Manufacturer shall supply test data demonstrating less than L/240 deflection for an unsupported 48x48 panel under 30" W.C pressure. Units that cannot demonstrate this deflection are unacceptable. Outer casing shall be finished with a powder coated industrial paint.
 - 2. Access Doors shall be flush mounted to cabinetry, with minimum of two hinges, locking latch and full size handle assembly.

1.4 SUPPLY / RETURN FANS

- .1 Provide direct-drive plenum fan(s) with ECM motors. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.
- .2 Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on rubber-in-shear vibration type isolators inside cabinetry.

1.5 ELECTRICAL

- .1 All electrical components shall bear a UL and CSA safety listing.
- .2 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.
- .3 Air handler manufacturer shall provide and mount a damper controls for standalone operation of the ERV.

1.6 PARTICULATE FILTERS

- .1 Filter section with filter racks and guides with hinged access doors for side loading and removal of filters

- .2 Filter media shall be UL 900 listed, Class I or Class II.
- .3 Flat arrangement with 2", 50mm pleated MERV 8 panel filters.

1.7 ENERGY RECOVERY

- .1 Dual Core™ Energy Recovery
 - .1 Unit shall be equipped with Dual Core™ energy recovery technology. The unit shall be 90% efficient (sensible +-5%) at equal airflow in winter and up to 80% sensible in summer. It shall also provide up to 70% latent recovery in winter mode. Unit shall accomplish this recovery without a defrost cycle that will reduce the effectiveness of the device. Devices employing defrost cycles that bypass the energy recovery device, or reduce the effectiveness are not acceptable. Energy recovery device shall not require frost protection in applications down to -40 degrees. Cores shall be Generation 3, comprised of precisely corrugated high grade aluminum.
 - 2. Switchover damper section shall be comprised of low leakage dampers operated by fast acting electric actuators having damper switching times of 0.75 seconds. Dampers that do not switch within the specified times without objectionable noise are not acceptable.
 - 3. Recovery cycles shall be controlled by internal programmed thermostats measuring both supply and exhaust air, and optimizing performance of both heat recovery and free cooling modes.

3. EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's Installation & Maintenance instructions.

3.2 ENVIRONMENTAL REQUIREMENTS

- .1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 REFERENCES

- .1 ASHRAE HANDBOOK, HVAC SYSTEMS & EQUIPMENT, Duct Construction Recommendations
- .2 Sheet Metal And Air Conditioning Contractors' National Association (SMACNA)
 - .1 HVAC Duct Construction Standards - Metal and Flexible
 - .2 HVAC Duct Systems Design
 - .3 Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
 - .4 Accepted Industry Practice for Industrial Duct Design
 - .5 HVAC Systems - Testing, Adjusting and Balancing
 - .6 Round Industrial Duct Construction Standards
 - .7 Rectangular Industrial Duct Construction Standards
 - .8 HVAC Air Duct Leakage Test Manual.
 - .9 Guide for Steel Stack Construction
- .3 National Fire Protection Association (NFPA)
 - .1 80 Standard for Fire Doors and Windows
 - .2 90A Standard for Installation of AC and Ventilation Systems
 - .3 90B Standard for Installation of Warm Air Heating and AC Systems
 - .4 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - .5 255 Building Materials, Test of Burning Characteristics (same as ASTM E84)

1.3 PERFORMANCE REQUIREMENTS

- .1 No variation of duct configuration or sizes permitted except by written permission.
- .2 Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.
- .3 Sizes indicated on the Drawings are clear inside dimensions and do not include for duct linings.

1.4 SUBMITTALS

- .1 Division 1: Procedures for submittals.
- .2 Product Data: Provide data for duct materials.
- .3 Shop Drawings:
 - 1. Plenums and plenum related items showing physical dimensions, joints, sealants, door construction and hardware.
 - 2. Factory fabricated ducts, fittings and joining systems.
 - 3. Firewall duct penetrations; fire and smoke dampers; louvers and access doors.
 - 4. Duct fitting particulars such as gauges, sizes, welds, reinforcements and configuration for 4" wg. (1000 kPa) pressure class and higher systems.
- .4 Submit changes or alterations in ductwork layout, with supporting calculations showing that the modified design will not increase total pressure, before work commences. Submittals for proposed changes shall be stamped for acceptance prior to commencement of work.
- .5 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.
- .6 Material Safety Data Sheets (MSDS) for sealants, adhesives and coatings.

1.5 PROJECT RECORD DOCUMENTS

- .1 Division 1: Submittals for project closeout.
- .2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .2 Perform Duct Leakage Testing to SMACNA "HVAC Air Duct Leakage Testing Manual"
- .3 Maintain one copy of document on site.
- .4 Asbestos Free: Insulating and sealing materials must be certified to be free of asbestos.
- .5 Brazing: Certify brazing procedures, brazers, and operators in accordance with AWS B2.2 Brazing Procedures and Performance Qualifications
- .6 Welding: Certify welding procedures, welding equipment and welders in accordance with AWS D9.1 Sheet Metal Welding Code.

1.7 REGULATORY REQUIREMENTS

- .1 Ontario Building Code (OBC)
- .2 Ontario Fire Code (OFC)
- .3 Construct ductwork to NFPA 90A standards.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- .2 Maintain temperatures during and after installation of duct sealants.

2 Products

2.1 MATERIALS

- .1 Table of Materials

APPLICATIONS	MATERIALS
Rigid HVAC ducts, casings and fittings	ASTM A653 galvanized steel sheet, lock form quality, G90 zinc coating (0.90 oz/ft ²) to ASTM A90. Sheets free of pits, blisters, sliyers, and ungalvanized spot
Rigid HVAC ducts, casings and fittings installed underground (below slabs on grade). Rigid HVAC ducts, casings and fittings installed in swimming pools (natatorium).	PVC coated, galvanized steel sheets, lock form quality to ASTM A653, G90 zinc coating (0.90 oz/ft ² both sides) and factory applied 4-mil PVC coating. Ductwork shall be UL-181, Class 1 listed.

- .2 Hanger Rod: continuously threaded, ASTM A36 galvanized steel.
- .3 Sealant: Non-hardening, water resistant, fire resistive, low VOC (VOC content not to exceed 250 g/L), compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- .4 Supports: Angle iron, channels, rods and related supporting materials shall be galvanized or red oxide coated.
- .5 Fasteners: Use galvanized rivets, screws and bolts throughout, except on stainless steel ductwork, use SS fasteners.
- .6 Reinforcements: Provide galvanized steel or stainless steel reinforcement shapes and plates to match ductwork.
- .7 Tie Rods: Use galvanized steel, 1/4 inch minimum diameter fasteners for ductwork 36 inch or less in length; use 3/8 inch minimum diameter for lengths longer than 36 in.

2.2 DUCT CONSTRUCTION

.1 Duct Construction Schedule

Duct Application	Duct Pressure	Pressure Class (in.wg.)	Seal Class	Leakage Class
Rectangular HVAC Supply from terminal unit to air outlet	Positive	2	A	6
Round HVAC Supply from terminal unit to air outlet	Positive	2	A	3
Rectangular HVAC Single zone supply from AC Unit to air outlet	Positive	2	A	6
Round HVAC Single zone supply from AC Unit to air outlet	Positive	2	A	3
Rectangular HVAC Return from air outlet to	Negative	2	A	6
Rectangular HVAC Return from air outlet to	Negative	2	A	3
Rectangular Sanitary exhaust ductwork	Negative	2	A	6
Round Sanitary exhaust ductwork	Negative	2	A	3
Rectangular General HVAC exhaust ductwork	Negative	2	A	6
Round General HVAC exhaust ductwork	Negative	2	A	3

2.3 DUCT SEALING

.1 Duct Sealing Requirements

SEAL CLASS	SEALING REQUIREMENTS
A	All transverse joints, longitudinal seams and duct wall penetrations.
B	All transverse joints, longitudinal seams a
C	All transverse joints

2.4 DUCT LEAKAGE

.1 Leakage Class is defined as

$$C_L = F / (P)^{0.65}$$

where: C_L = Leakage Class

F = Leakage Factor (cfm/100-ft² of duct surface)
 P = Static pressure in the duct (in.wg.)

.2 Table

LEAKAGE FACTOR (F) CFM / 100-SQ.FT. of DUCT SURFACE					
LEAK CLASS	PRESSURE CLASS (in.wg.) (+ve or -ve)				
C_L	1	2	4	6	10
48	48	75	118	154	214
24	24	38	59	77	107
12	12	19	30	38	54
6	6	9	15	19	27
3	3	5	7	10	13
0	0	0	0	0	0

2.5 DUCTWORK FABRICATION

- .1 All Ductwork shall be constructed to withstand 1-1/2 times fan pressure at shut-off and 2" (500 Pa) minimum.
- .2 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated in accordance with recommendations of ASHRAE and SMACNA.
- .3 Joints and reinforcements:
 1. to SMACNA and ASHRAE
 2. may be made with the Ductmate System or Nexus System. System components shall be made of standard catalogue manufacture as supplied by Ductmate Industries, Inc. or Nexus Inc. or equivalent.
- .4 Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.
- .5 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- .6 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm cemented slip joint, brazed or electric welded. Prime coat welded joints.
- .7 Provide standard 45-degree lateral wye takeoffs. Alternative 90-degree conical tee connections may be used only where specifically indicated in the Contract Documents.

2.6 ROUND SPIRAL LOCK SEAM DUCTWORK

- .1 Spiral ducts and elbows shall not be used for watertight exhaust systems.
- .2 Ducts and fittings shall be manufactured from minimum G90 galvanized steel meeting ASTM A527/A527M-85.
- .3 Ductwork shall be "Uni-Seal" single wall, round spiral lock-seam type duct in wall thicknesses listed below.
- .4 Fittings shall be "Uni-Form" single wall, round fittings suitable for use with "Uni-Seal" ductwork in wall thicknesses as follows:

Diameter In.(mm)	Duct Metal Thickness		Fitting Metal Thickness	
	In. (GA)	(mm)	In. (GA)	(mm)
3 (75) to 14 (356)	0.022 (26 ga.)	(0.56)	0.028 (24 ga.)	(0.70)
15 (380) to 26 (660)	0.028 (24 ga.)	(0.71)	0.034 (22 ga.)	(0.86)
27 (686) to 36 (914)	0.034 (22 ga.)	(0.86)	0.040 (20 ga.)	(1.0)
37 (939) to 50 (1270)	0.040 (20 ga.)	(1.0)	0.052 (18 ga.)	(1.32)
52 (1321) to 60 (1524)	0.052 (18 ga.)	(1.32)	0.064 (16 ga.)	(1.62)

- .5 Acceptable Manufacturer: "Uni-Seal" spiral lock-seam duct and "Uni-Form" fittings as manufactured by United Sheet Metal. Other manufacturers refer to Section 15010.2.3.

2.7 FLEXIBLE DUCTWORK

- .1 Flexible ducts shall be factory fabricated to CAN/ULC S110, factory fabricated assembly with a laminated inner liner of aluminum foil, fiberglass and polyester, a galvanized steel helix coil formed to the inner liner, a fiberglass insulation blanket, and a polyethylene outer jacket. Flexible duct shall have a flame resistant rating of 25 or less and a smoke developed rating of 50 or less

Pressure Rating	Low & Medium	High Pressure
Max. positive pressure	6"wg (3 kPa)	12"wg (6 kPa)
Max. negative pressure	4"wg (2 kPa)	5"wg (2.5 kPa)
Maximum velocity	4000 fpm (20m/s)	5500 fpm (28m/s)
Permeance	0.1 perm	0.1 perm
Operating temperature	-20 to 250 deg. F	-20 to 250 deg. F
Max. thermal conductance	0.23 BTU/Hr-F°	0.23 BTU/Hr-F°
Listed & Labelled	Class 0 /Class 1	Class 0 /Class 1
Flexmaster Type	5	3

- .3 Lab Exhaust Systems: Ductwork to be a factory fabricated assembly of neoprene-coated polyester with galvanized steel helix reinforcement. Flexible duct shall be rated for a minimum of 6.0" w.g. positive pressure, 4.0" w.g. negative pressure, 5500 FPM velocity, -65 to 250 degrees F. Flexible duct shall have a flame resistant rating of 25 or less and a smoke developed rating of 50 or less. Uni-flex Model U-LOK 200.
- .4 Accessories: conical spin-in collars with butterfly volume dampers for connections to ductwork, round rigid galvanized steel fittings fabricated to SMACNA Standards and ASHRAE recommendations, bridge and gear clamps.
- .5 Acceptable Manufacturers:
 - .1 Flexmaster
 - .2 Others refer to Section 15010.2.3.
- .4 Acceptable Manufacturers:
 - .1 Uni-Coat as manufactured by United Sheet Metal.
 - .2 Other manufacturers refer to Section 15010.2.3.

2.8 DESIGN REQUIREMENTS

Ductwork System:

- .1 Primary supply air ductwork (between discharge side of fan and terminal boxes) shall be medium pressure class as a minimum.
- .2 Secondary supply air ductwork (eg downstream of terminal boxes) shall be low pressure class as a minimum.
- .3 Use round or oval ducts instead of rectangular ducts to reduce leakage and drum effect from vibration.
- .4 Ductwork shall be as direct as possible to minimize the number of elbows, abrupt contractions and expansions and transitions.
- .5 Long radius elbows and 45 degree lateral take-offs should be used wherever possible.
- .6 Provide sufficient straight duct run before diffusers to minimize turbulence induced noise.
- .7 Flexible ductwork may be used but shall be limited to connections between duct branches and diffusers or VAV terminal units and shall be limited to 6' long. Flexible ductwork shall be installed fully extended with bend radius greater than the duct diameter to avoid kinking.
- .8 Ductwork outside the building should be avoided to minimize heat gain to or heat loss from the ductwork.
- .9 Duct-mounted access doors shall be provided in ductwork wherever there are manual dampers, fire dampers, turning vanes, coils to allow inspection.
- .10 All exhaust ductwork within the building shall be under negative pressure.

.2 Ductwork Protection and Cleaning:

- .1 Refer to Section 01 73 33 *Indoor Air Quality Management*.
- .2 During manufacture and storage, cap off ends of ducts until ready for installation.
- .3 During installation cap off ends of unfinished ducts while plastering, drywall and other operations are in progress.
- .4 Cover open ends or registers of exhaust/return ducts with 1" thick filter media secured with tape. Filter media to remain until all dust producing operations are completed.
- .5 If after inspection by the Consultant and/or Region Project Manager the ductwork systems is deemed to be unacceptable, the Contractor shall prior to operation or test and balance, clean systems and equipment including but not limited to ductwork (supply/return/exhaust), air handling equipment, plenums, terminal units, fans, dampers, grilles/registers/diffusers with high power vacuum machines. Cleaning shall be performed in accordance with National Duct Cleaners Association (NADCA) standards, and by agent specializing in this field of work, and a member in good standing with NADCA. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Submit report, verified by Testing, Adjusting and Balancing agent ("TAB Agent"), identifying the extent of duct system cleaning and certifying that NADCA standards have been met.
- .6 Provide adequate access into ductwork for cleaning purposes.

.3 Ductwork Sealing and Leak Testing:

- .1 Ductwork seams and joints shall be sealed for a Seal Class B including all traverse joints, longitudinal seams, and connections. Connections include spin-ins, taps, branch connections, access doors, and connections to equipment.
- .2 Ductwork shall be leak tested at the rated pressure in accordance with SMACNA HVAC Duct Leakage Test Manual. A leak test report shall be provided to the Region.
- .3 Duct sealing and leak testing shall be conducted before ductwork is insulated or concealed by drywall or T bar ceiling to allow for re-sealing or repairing duct sections.
- .4 The leakage shall not exceed the allowable cfm/100ft² of duct area for the seal and leakage class apportioned to each section tested.
- .5 **Ductwork leak testing shall be witnessed by the Commissioning Authority or a Regional Municipality of York representative.**

.4 Duct Insulation:

- .1 All supply air ductwork shall be insulated.
- .2 All return air ductwork located above the ceiling and below the building roof shall be insulated.
- .3 All outdoor supply or return ductwork shall be insulated.
- .4 Insulate the first 3m of all exhaust ductwork from an exterior wall.
- .5 All exhaust or relief air ductwork between motor operated dampers and building exterior penetration point shall be insulated.

.5 Air Plenums:

- .1 Return air plenums that are formed by exterior walls, and roof slabs shall be sealed air-tight to prevent untreated outdoor air from being drawn into the return air stream.

.6 Air Terminal Units:

- .1 Variable-Air-Volume (VAV) terminals shall be certified under ARI 880 Standard for Air Terminals.
- .2 VAV terminals shall be pressure-independent type and capable of operating satisfactorily throughout their range from minimum to maximum air flow.
- .3 VAV terminals to be volume control calibrated to identify air volume in increments of percent of maximum air flow.
- .4 Damper controls to be accessible from outside the unit. Damper position to be visible from outside the unit.
- .5 Re-heat coils shall have access for cleaning.
- .6 VAV terminal units shall have BACnet controls.
- .7 Fan-powered VAV terminals located in the ceiling should be avoided to reduce maintenance, and noise concerns.
- .8 Hot water re-heat coils may be used in the VAV boxes particularly for perimeter zones and if required for zone temperature control. If used in conjunction with hot water perimeter radiators, the radiators should be the first stage of heating and the re-heat coils the second stage.

3 Execution

3.1 INSTALLATION

- .1 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .2 Install ductwork parallel to building lines.
- .3 Support all ductwork from structural members. Where structural bearings do not exist, suspend strapping or hangers from steel channels or angles. Provide supplementary structural members. Do not suspend from metal deck.
- .4 Do not break continuity of insulation vapour barrier by hangers or rods.
- .5 Hangers shall be steel angles with supporting rods, locking nuts and washers to following table;

[Except for Fire Rated Ventilation Ductwork or Fire Rated Kitchen Exhaust Grease Duct which shall comply with ULC Listing and manufacturers instructions]

Duct Sizes	Angle Size	Rod Size	Spacing
up to 30"	1" x 1" x 1/8"	1/4"	10 feet
31" to 42"	1-1/2"x1-1/2"x1/8"	1/4"	10 feet
43" to 60"	1-1/2"x1-1/2"x1/8"	3/8"	10 feet
61" to 84"	2" x 2" x 1/8"	3/8"	8 feet
Duct Sizes	Angle Size	Rod Size	Spacing
Up to 750 mm	25 x 25 x 3 mm	6 mm	3 metres
775 to 1050 mm	40 x 40 x 3 mm	6 mm	3 metres
1075 to 1500 mm	40 x 40 x 3 mm	10 mm	3 metres
1525 to 2100 mm	50 x 50 x 3 mm	10 mm	2.5 metres

- .6 Anchor all risers at bottom and support from building structure at each floor level.
- .7 Vertical ducts passing through floors shall be supported on angles secured to duct bearing on the floor.
- .8 Where ducts pass through walls, floors, openings required to have a fire resistance rating the opening in the construction around the duct shall be filled with an approved fire stop material as per NFPA 90A and fire damper shall also be installed with access doors as per the code.
- .9 Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- .10 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

- .11 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- .12 Use crimp joints with or without bead for joining round duct sizes 8" (200 mm) and smaller with crimp in direction of air flow.
- .13 Use double nuts and lock washers on threaded rod supports.
- .14 Connect terminal units to supply ducts directly or with 12" (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.
- .15 Connect diffusers or light troffer boots to low pressure ducts directly or with 60" (1.5 m) maximum length of flexible duct held in place with strap or clamp.
- .16 Connect flexible ducts to metal ducts with adhesive and metal or nylon straps.
- .17 Ground across flexible connector with No. 2/0 braided copper strap.
- .18 Set plenum doors 6" to 12" (150 to 300 mm) above floor. Arrange door swings so that fan static pressure holds door in closed position.
- .19 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
- .20 Install High Transmission Loss ductwork between duct silencer and mechanical room wall.
- .21 Balancing dampers shall be installed on branches as per locations shown on the drawings and as per the requirements of NEBB and AABC listing/measuring standards.
- .22 Perform duct leakage testing for all ductwork installed under this contract.

3.10 FLEXIBLE DUCTWORK

- .1 Flexible ductwork may be installed for final connections to air outlets provided that not more than 5 ft. (1.5 m) in length is used for each connection, and where specifically indicated on drawings.
- .2 All fittings used with flexible ductwork shall be rigid round duct.
- .3 Use pre-insulated flexible ductwork where application is to be insulated.

3.11 DUCT LEAKAGE TESTING

- .1 Ductwork shall be leak tested in accordance with the SMACNA "HVAC Air Duct Leakage Test Manual". The maximum permitted duct leakage shall be determined by multiplying the leakage factor from paragraph 2.4 above by the surface area of the ductwork in the test zone.
- .2 Ductwork that exceeds the maximum permitted leakage shall be re-sealed and re-tested.
- .3 Duct leakage test shall be witnessed and certified by the Systems Verification Agency of Section 23 05 93.
- .4 Record and submit three (3) copies of test results to the Consultant for review prior to application of duct insulation or concealment of ductwork.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

1.2 SECTION INCLUDES

- .1 Diffusers.
- .2 Registers/grilles.

1.3 REFERENCES

- .1 ADC 1062 - Air Distribution and Control Device Test Code.
- .2 AMCA 500 - Method of Testing Louvres for Ratings.
- .3 AMCA 5000 - Method of Testing Dampers for Ratings.
- .4 ARI 650 - Air Outlets and Inlets.
- .5 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.
- .6 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- .7 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

- .1 Section 23 01 01: Procedures for submittals.
- .2 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- .3 Samples: Submit two of each required air outlet and inlet type.

1.5 PROJECT RECORD DOCUMENTS

- .1 Section 23 01 01: Submittals for project closeout.
- .2 Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- .1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.
- .2 Test and rate louvre performance to AMCA 500.

1.7 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

2 Products

REFER TO DIFFUSERS & GRILLES SCHEDULE ON DRAWINGS

2.1 MANUFACTURERS

- .1 E. H. Price model indicated or equivalent products by;
 - .1 Titus
 - .2 Kreuger
 - .3 Metalaire
 - .4 NailorOr equivalent.

2.2 SQUARE CONE DIFFUSERS, FIXED PATTERN

- .1 Manufacturer's Reference: E. H. Price Model SCD or equivalent.
- .2 Type: Square, fixed pattern, stamped, multi-core diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated in the Contract Documents.
- .3 Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- .4 Fabrication: Steel with baked enamel off-white finish.
- .5 Accessories: Radial opposed blade damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

2.3 CEILING GRID CORE EXHAUST AND RETURN GRILLES

- .1 Manufacturer's reference: E. H. Price 80D or equivalent.
- .2 Type: Fixed grilles of 1/2" z 1/2" x 1/2" (13 x 13 x 13 mm) louvres.
- .3 Frame: 1-1/4" (32 mm) margin with concealed mounting. Channel lay-in frame for suspended grid ceilings.
- .4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from Face.

3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- .3 Install diffusers and grilles and connect to ductwork with air tight connections.
- .4 Provide balancing dampers in duct take-off to diffusers, grilles and registers, whether or not dampers are included as part of the diffuser, grille or register assembly.
- .5 Paint visible ductwork behind air outlets and inlets matte black.
- .6 Install filters in diffusers, grilles and registers after final cleaning of rooms and ductwork has been completed and accepted and when environmental conditions are suitable. Ensure that air tight seal is achieved.
- .7 Provide balancing dampers in duct take-off to diffusers, return grilles etc whether or not dampers are shown on the drawings. The Contractor is fully responsible to provide dampers required for proper balancing of the system.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 23 01 01.

2 Products

2.1 MANUFACTURERS

- .1 Manufacturer: Schwank Model (UHE –90 -30). Ultra High Efficiency, or equivalent.
- .2 Other manufacturers offering equivalent products with equal or better efficiencies will only be accepted as equivalent (Roberts Gordon LCC & Superior).

2.2 TUBULAR INFRARED HEATERS

- .1 Units: Packaged, partially factory assembled, pre-wired unit consisting of cabinet, burner, heat exchanger, radiant tube, reflector, controls; for natural gas.
- .4 Heat Exchanger: Aluminized tubular steel combustion chamber with aluminized steel tube with aluminum reflector.
- .5 Gas Burner:
 - .1 Gas Burner: Forced draft type with adjustable combustion air supply.
 - .2 Gas valve provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - .3 Electronic pilot ignition, with electric spark igniter.
 - .4 Non-corrosive burner air blower with permanently lubricated motor.
- .6 Gas Burner Safety Controls: Thermo-couple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.
- .7 Operating Controls: Line voltage thermostat cycles burner to maintain room temperature setting.
- .8 Each Radiant Tube heater to be controlled by a Schwank Trutemp mean radiant temperature thermostat. Thermostat to be provided by mechanical trade, installed and wired by electrical trade.
- .9 All Radiant Tube Heaters shall be of Ultra High Efficiency.

End of Section

1 General

1.1 GENERAL REQUIREMENTS

- .1 Read and conform to:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended,
 - .2 Division 1 requirements and documents referred to therein.
- .2 Section 25 01 01 applies to and governs the work of all Sections of Mechanical Divisions 21, 22 and 23.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among Subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the Work.
- .4 The specifications are integral with the Drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the Contract Documents on the most costly arrangement.

1.2 DEFINITIONS

- .1 The following are definitions of words found in this specification and on associated drawings under this Division:
 - .1 "Concealed" - locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
 - .2 "Exposed" - mechanical work normally visible to building occupants.
 - .3 "Furnish" - (and its derivatives) has the same meaning as the term "Supply".
 - .4 "Install" - (and its derivatives) - receive, store and handle at the site, mount and support and connect all required services. Includes adjustment and calibration, testing, commissioning, inspection by authorities having jurisdiction and documentation.
 - .5 "Provide" - (and its derivatives) - supply, install in place, connect the associated required services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.
 - .6 "Supply" - (and its derivatives) purchase and deliver to the site for installation. Includes submittals, manufacturer's field inspection and warranty.
 - .7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.

1.3 WORK INCLUDED

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Cutting and patching of new or existing work
- .3 Excavating and backfilling
- .4 Identification of equipment, piping, ductwork, and valves and controllers
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches.
- .6 Motors required for equipment supplied under this Division.
- .7 Variable frequency drives for motors and equipment supplied under this Division.
- .8 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under this Division.
- .9 Disconnect switches for exhaust fans located on the roof complete with;
 - .1 EEMAC 1 enclosure if housed within a weatherproof cabinet,
 - .2 EEMAC 3 enclosure if exposed to weather
- .10 Take such measures and include in the Contract Price for the proper protection of the existing building and its finishes at all times during alterations and construction of the new addition. Coordinate this protective work with all trades.

- .11 Refer to Mechanical/Electrical Equipment Schedule in the Contract Documents for extent of wiring and electrical characteristics.
- .12 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.

1.4 RELATED WORK

- .1 Power wiring, conduit and connections for motors under this Division will be by Division 26.
- .2 Power wiring, conduit and connections to variable frequency drives for motors under this Division will be by Division 26. Wiring and connections from VFD to motors under this Division will be by Division 26.
- .3 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under this Division.
- .4 Painting of exposed piping and ductwork other than for identification will be supplied under Division 9.
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches will be provided under Division 3.

1.5 SUBMITTALS

- .1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction, and obtain two (2) copies of approved drawings for retention by Consultant prior to commencement of work under this Division.
- .2 Shop Drawings: Prepare and submit two (2) copies of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return one copy, marked with comments and his review stamp as he deems appropriate. The General Contractor shall ensure that the necessary number of copies of the returned set are prepared and distributed to the Owner, the Consultant, the General Contractor, the Site, and to relevant Subcontractors and suppliers.
 - .1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by the Consultant.
 - .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
 - .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
 - .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:
"This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."
- .3 Sleeving Drawings: Prepare and submit 4 copies of sleeving drawings to clearly and accurately indicate the exact location, elevation and size of any and all formed holes, recesses and sleeving required in the work of Mechanical Divisions 21, 22 and 23. Obtain the Consultant's approval in writing prior to sleeving, forming or cutting any such opening. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
- .4 Composite Wiring Diagrams: Prepare and submit three (3) copies of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.
- .5 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they conform to the requirements of those documents (e.g. NFPA-standards). Include a copy of each

- certificate in the Operation and Maintenance manual. Certificates shall include the following:
- .1 description of the system (description and type),
 - .2 description of the tests conducted and results observed, including re-testing, where necessary,
 - .3 description of any corrective measures undertaken,
 - .4 description of materials used (pipe and fittings),
 - .5 list of witnesses for each test conducted,
 - .6 date system left ready for service,
 - .7 signature of installing contractor.
- .6 Directories & Schematics
- .1 Submit five (5) copies of a neat typewritten directory indicating the valve number, related service, and location of each valve under this Division.
 - .2 Submit five (5) copies of system control schematics for each mechanical system indicating relative locations of equipment and control devices.
 - .3 Enclose one (1) copy of each directory/schematic under glass in a neat polished 18" x24" (460 mm x 610 mm) metal frame, complete with mounting clips.
- .7 Maintenance Data and Operating Instructions
- .1 Submit three (3) copies of Operation and Maintenance Manual individually bound in hard backed three-ring binders.
 - .2 Ensure the binder spines have typewritten lettering as follows:
OPERATION & MAINTENANCE MANUAL for
[Insert name of project]
[Insert date of submission]
[Insert Division Title]
 - .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, the Contractors, and the Consultant. Include special telephone numbers for service departments on normal and emergency call basis.
 - .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.
 - .5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.
 - .6 Ensure operating instructions include the following:
 - .1 General description of each mechanical system.
 - .2 Step by step procedure to follow in putting each piece of equipment into service.
 - .3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.
 - .4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches and relays.
 - .5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.
 - .7 Ensure maintenance instructions include the following:
 - .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.
 - .2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
 - .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
 - .4 Balancing and testing reports.
 - .5 Copy of valve directory.
- .8 As-Built Records: Prepare and submit complete as-built records prior to Substantial Performance of the Work. Refer to paragraph 3.2.5 and to Division 1 for requirements.

- .9 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption from the Owner prior to disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 1 for additional requirements.
- .10 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

1.6 QUALITY ASSURANCE

- .1 Conform to minimum requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:
 - .1 AABC Associated Air Balance Council
 - .2 AMCA Air Moving and Conditioning Association
 - .3 ANSI American National Standards Institute
 - .4 ASA American Standards Association
 - .5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
 - .6 ASME American Society of Mechanical Engineers
 - .7 ASSE American Society of Sanitary Engineers
 - .8 ASPE American Society of Plumbing Engineers
 - .9 ASTM American Society of Testing and Materials
 - .10 AWWA American Water Works Association
 - .11 CAN2 National Standard of Canada (Published by CGSB)
 - .12 CAN3 National Standard of Canada (Published by CSA)
 - .13 CGSB Canadian General Standards Board
 - .14 CSA Canadian Standards Association
 - .15 EEMAC Electrical & Electronic Manufacturer's Association of Canada
 - .16 NBC National Building Code of Canada
 - .17 NEBB National Environmental Balancing Bureau
 - .18 NFPA National Fire Protection Association
 - .19 NEMA National Electrical Manufacturers Association
 - .20 OBC Ontario Building Code
 - .21 OFC Ontario Fire Code
 - .22 OFM Ontario Fire Marshall
 - .23 SMACNA Sheet Metal & Air Conditioning Contractors National Association
 - .24 TIAC Thermal Insulation Association of Canada
 - .25 ULC Underwriter's Laboratories of Canada Ltd
 - .26 UL Underwriter's Laboratories (including cUL)
- .3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.
- .4 Arrange and pay for permits and inspections by the Authorities Having Jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
- .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or the Owner when requested.
- .6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.
- .7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify the Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.8 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of this Division.
- .2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.
- .3 Notify the Consultant upon discovery of conditions which adversely affect work of this Division. No allowance will be made after the award of the Contract for any expenses incurred through failure to do so.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications.

1.9 INTERRUPTIONS

- .1 Arrange execution of work to maintain present building operations, and to minimize the effect of work under this Division on existing operations.
- .2 Prior to interrupting any existing service notify the Owner and the Consultant, in writing, at least 7 days in advance, and obtain written authorization. Do not interrupt any existing service without the Consultant's specific authorization. Refer to Division 1 for requirements.
- .3 Arrange time and duration of interruption through the Owner Facilities Group in Property Services. Include in the Contract Price for all overtime or premium time hours necessary to minimize duration of service interruption.
- .4 Test and verify the proper operation of existing equipment and systems that are shut down due to work of this project, prior to returning to service.
- .5 Assume responsibility for consequential costs on failure to obtain permission to shut-down and/or start-up any item of equipment, system or service.

1.10 WARRANTY

- .1 Refer to Division 1 and to Section 25 01 01 General Requirements.
- .2 Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .3 Make submissions necessary to register product warranties to the benefit of the Owner.
- .4 Submit to the Consultant, prior to Substantial Performance of the Work, manufacturer's written warranties covering periods longer than two years or offering greater benefits than required in specifications and in the Owner's name.

1.11 EXTRAS AND CREDITS

- .1 Accompany all price submissions requested by the Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
 - .1 Materials, quantities and unit costs including any applicable contractors trade discount clearly identified.
 - .2 Labour hours and unit costs.
 - .3 Total materials and labour costs.
 - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under this Division bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.
- .3 Ensure manufacturers and suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring

- hazardous materials onto the site prior to doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 MOTOR STARTERS & CONTROLS

- .1 Mechanical Division shall provide all motor starters and associated controls required and as scheduled on drawings and noted for Mechanical Divisions 21, 22 and 23 equipment. Starters and controls shall be Canadian General Electric or equivalent. All starters, contactors, thermal overloads, etc. must be EEMAC rated. All starters shall be of one manufacturer except as specifically approved otherwise for integral pre-wired assemblies.
- .2 Starter and control units shall be equipped with necessary number of auxiliary contacts and relays to provide control sequences described in Mechanical Equipment Starter Schedule on Drawings. Auxiliary contacts shall be interchangeable normally open or normally closed, by conversion in field without additional parts exterior to starter.
- .3 Manual starters may only be provided for single phase equipment operated by control device such as thermostat or limit control when such control device is rated for full electrical load of equipment.
- .4 Manual starters provided for single phase equipment actuated by electric timer or shall have H.O.A. feature. "Hand" position shall permit shunting of time switch. Where such units also have protective device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" positions and shall not be shunted.
- .5 Manual starters may only be provided for three phase equipment which is not actuated by pilot control device (pressure switch, float switch, safety limit devices, remote manual control device) unless otherwise noted in Starter Schedule.
- .6 Magnetic starters for manually operated equipment shall have "On/Off" selector switch or "Start-Stop" pushbutton in cover as scheduled.
- .7 Magnetic starters which are started automatically by electric time switch shall include "Hand-Off-Automatic" (H.O.A.) selector switch. "Hand" position shall permit shunting of time switch or E.M.S. Where such units also have protective pilot device (e.g. firestat) such device shall be wired into both "Hand" and "Auto" position and shall not be shunted.
- .8 Magnetic starters which are started automatically by remote pilot device (or interlocked units) such as level controller, pressure switch, thermostat or flow switch shall include "Hand-off-Auto" (H.O.A.) selector switch, and, where scheduled, a "Test" pushbutton. "Hand" position shall permit shunting of remote pilot device and thereby permit operation of starter but only while depressing "Test" button.
- .9 Equip starter apparatus for prime plumbing, heating, air conditioning and ventilating equipment so that these units will automatically restart on resumption of power after power outage. Starters for these units shall have "On/Off" selector switch in cover if not fitted with H.O.A. selector feature or manual starter or otherwise noted.
- .10 Safety control device such as flow switches, pressure switches, high and low limited ("Fire" and "Freeze") shall not be shunted by "Hand" position of switch.
- .11 Manual motor starter shall be toggle operated with following general construction features:
- Quick-Make, Quick-Break mechanism with double-break contacts.
 - Overload protection heaters, one per phase and speed.
 - Enclosure to suit application.
 - Pilot light, neon lamp.
 - Cover engraved with "On-Trip-Off".
- .12 Magnetic motor starters shall comprise electrically-operated motor starters combined with disconnect switch with following general construction features:
- Quick-Make, Quick-Break mechanism with double-break contacts.
 - Fuse holders to accept specified fuses, one per phase.
 - Adjustable overload relays, one per phase.
 - CEMA listed enclosure to suit application. Disconnect with mechanical cover interlocks, line side barriers and switch operated electrical interlocks to disconnect external control voltage unless starter includes suitable approved enclosed contacts and connections.
 - "Reset" button.
 - Pilot Lights of transformer type incandescent with amber safety lens cap.

- Control transformer with 120 volt fused secondary and sized to suit current rating of associated control devices.
- Scheduled cover mounted control devices with standard duty double break contact blocks.
- Minimum of two auxiliary contacts (unused "Seal-in" contact may be included).
- .13 Contactors for non-motor applications shall be built similar to combination magnetic starters, except less overload relays, and with Gould Shawmut AJT time delay HRC1-J fuses, rated for load, and with enclosed continuous current rating of at least 125% of connected full load.
- .14 "Double Voltage Relays" shall be CGE Model CR120 LXMC with general purpose enclosure, number of contacts required and "Mylar" shroud of enclosure of contacts, or equivalent.
- .15 Pilot devices such as "Start-Stop" pushbuttons, "Hand-Off-Auto" selector switches and indicating lights shall be of heavy-duty construction. Indicating lamps shall be transformer type incandescent with amber safety lens caps.
- .16 Each control unit shall be provided with engraved nameplates for designation of device controlled and duty.
- .17 Control wiring shall be 120 volt A.C. maximum. Provide control circuit transformers where these are not included in motor starters. Secondaries of control transformers shall be fused with one side grounded and controls, safety devices and interlocks shall be connected in ungrounded conductor, excepting only integral starter overload devices.
- .18 Single phase motors interlocked to start or operate with other equipment shall be provided with magnetic starters or suitable relays with necessary auxiliary contacts and double voltage relays or be otherwise electrically separated.
- .19 Overload relay heaters for starters shall be selected and field adjusted to trip at maximum value of 115% of actual nameplate full load amperes. Selection of heater elements shall be based on starter manufacturer's recommendations. Obtain data from Mechanical Divisions 21, 22 and 23. Submit Motor Starter Schedule which shall list following for each motor:
 - Proposed equipment nameplate data
 - Actual full load amperes of motor
 - Speed of motor
 - Temperature Class in degrees Celsius rise and insulation class.
 - Circuit breaker or fuse type and proposed rating
 - Type of motor, duty and service factor.
- .20 Overload relay heaters shall trip in 20 seconds or less from cold or motor-locked rotar condition.
- .21 Where equipment is noted to be electrically interlocked, provide necessary interlocks, double voltage relays (Mylar shroud accepted) to provide specified operation.
- .22 Provide all fuses required to protect equipment. Fuses shall be proper size blade type time delay HRC1-J current limiting. Supply three spare fuses of each size and type and obtain duplicate receipt for same. Fuse clips shall reject standard NEC fuses. Fuses shall be rated in accordance with manufacturer's published data. Fuses to be of one manufacturer throughout.
- .23 Acceptable Alternate Manufacturers
 1. Furnas Electric
 2. Westinghouse
 3. Allen Bradley
 4. Square 'D'
 5. Cutler Hammer
 6. Klockner-Moeller.
 7. Commander
 8. TelemecaniqueOr equivalent.

2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Please refer to Section 01 25 00 – Product Substitution Procedures.
- .2 The Contract Price shall be based on the product related requirements specified in the Contract Documents.
- .3 Where the Contractor, with the Consultant's approval, uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by the Contractor to provide such

drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in the Contract Price.

2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by the Consultant.
- .2 Apply, in writing, to the Consultant for substitution of any products, indicating the following:
 - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
 - .2 Reason for substitution.
 - .3 Any revisions to the contract price made necessary by substitution.
 - .4 Any revisions to the contract time made necessary by substitution.
 - .5 Any revisions to layout, arrangement or services made necessary by substitution.
- .3 No substitutions will be permitted without written authorization from the Consultant.
- .4 Refer to Section 01 25 00 – Product Substitution Procedures for further requirements.

3 Execution

3.1 INSTALLATION REQUIREMENTS

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings prior to installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise in the Contract Documents install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.
- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.
- .9 Do not use powder activated tools except as permitted by the Consultant and the Owner's workplace health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural Drawings or as directed by the Consultant.

3.2 CONTRACT DRAWINGS

- .1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.
- .2 Obtain accurate dimensions from the architectural and structural Drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain the Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 m) in any direction without a change to the Contract Price.
- .5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling

drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of this Division.

- .6 The drawings of this Division are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as shown on the mechanical documents. If there is a difference in quantity between the architectural and drawings of this Division, base the Contract Price on the greater quantity.
- .7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.3 CONSTRUCTION DRAWINGS

- .1 Prepare fully dimensioned drawings showing devices, fixtures, equipment, outlets, sleeves and openings through structure. Indicate locations and weights on load points.
- .2 Prepare fully dimensioned construction drawings of products and services suitably interfaced with work of the sub-trades, in mechanical rooms, service and ceiling spaces, and other critical locations. Coordinate the work with other divisions. Base drawings on reviewed shop drawings and latest architectural drawings. Indicate details pertaining to the following: access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevation of pipes, ducts, conduits.
- .3 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.
- .4 Submit construction drawings to other Divisions. Provide one (1) transparency and four (4) print copies of construction drawings to the Consultant for record purposes.
- .5 Submit construction drawings prior to commencement of work.

3.4 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings. Obtain white prints from the Consultant for this purpose and pay printing costs. Identify each set as "Project Record Copy".
- .2 Record deviations from the Contract Documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of Consultants documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a DVD in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.
- .6 Submit the "Project Record Copy" on one or more DVD with white prints of each drawing to the Consultant at the time of Substantial Performance of the Work.

3.5 USE OF EQUIPMENT

- .1 For the duration of this Contract, do not use any piece of equipment provided under this Contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the Owner and the Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.
- .2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.6 SPECIAL TOOLS AND SPARE PARTS

- .1 Within 30 days of award of contract, prepare a complete itemized list of special tools and spare parts and submit to the Consultant for review. List will be used as a checklist and should include provision for sign off by the Owner on receipt.
- .2 On completion of the project furnish spare parts to the Owner as follows:
 - .1 One set of mechanical seals for each pump.
 - .2 One casing joint gasket for each pump.
 - .3 One head gasket for each heat exchanger.
 - .4 One glass for each gauge glass installed.
 - .5 One set of v-belts for each piece of machinery.
 - .6 One set of new filters for each filter bank installed.
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

3.7 INSTRUCTION

- .1 Instruct and familiarize the Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.
- .2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.
- .3 Ensure each instruction period includes, but is not limited to the following;
 - .1 a classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
 - .2 instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
 - .3 demonstration of the proper operating procedures for each item of equipment,
 - .4 explanation of the purpose and function of all safety devices provided,
 - .5 demonstration of all measures required for safe and proper access for operation and maintenance.
- .4 Provide a period of follow-up instruction (on two occasions) approximately one month after completing the Owner's instruction to clarify and reinforce earlier instructions.
- .5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to Substantial Performance of the Work.

3.8 START UP AND COMMISSIONING

- .1 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.
- .2 The Startup and Commissioning Team shall be comprised of;
 - .1 The individual, company or agency undertaking the work of each Section,
 - .2 Representatives of the Contractor and its Subcontractors as required,
 - .3 Representatives of equipment manufacturers,
 - .4 Representatives of the Consultants,
 - .5 Representatives of the Owner.
- .4 The Contractor and its Subcontractors shall each assign an individual representing each of the relevant trades to the startup and commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.
- .5 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.
- .6 Each Section shall prepare Check Sheets in accordance with the standards listed above and shall issue them to the commissioning team for use during the commissioning process.
- .7 Three (3) copies of commissioning manuals shall be provided, bound in hard cover D-ring binders with transparent cover on front and spine personalized to indicate;
 - .1 name and logo of Facility,
 - .2 name of the project,
 - .3 the Owner's project number,

- .4 identification of the system commissioned,
- .5 the date that the system was commissioned.
- .8 Commissioning manuals shall include machine printable index dividers to organize each manual by system and by commissioning stage.

End of Section

1. GENERAL

1.1 CONDITIONS

- .1 Read and conform to:
 - .1 The General Conditions of the Contract as amended
 - .2 The General Requirements of Division 25 01 01

1.2 BUILDING MANAGEMENT SYSTEM SUBCONTRACTOR

- .1 All work of this Section shall be coordinated and provided by a single BMS Subcontractor.
- .2 The work of this Section shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Mechanical Divisions 21, 22 and 23 Sections for details.
- .3 The work of this Section shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, warranties, services, and items which are required for the complete, fully functional and commissioned BMS, even if these are not specifically mentioned or fully described under this Section.
- .4 Contractor shall ensure that if BAS Subcontractor believes there are conflicts or missing information in the project documents, BAS Subcontractor promptly requests clarification and instruction from the Consultant.

1.3 GENERAL DESCRIPTION

- .1 This document outlines the minimum equipment and performance standards for a completely interoperable Building Automation System (BAS).
- .2 The work shall include design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following Sections.
- .3 The BAS shall be capable of total integration of facility infrastructure systems with user access to all system data, either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.
- .4 The entire BAS shall be peer-to-peer networked, stand-alone, distributed control in accordance with American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers (ANSI/ASHRAE) Standard 135-2004, BACnet – A Data Communication Protocol for Building Automation and Control Networks.
- .5 All labour, material, equipment and software not specifically referred to herein or on the plans, but is required to meet the functional intent, shall be provided without additional cost to the Owner.
- .6 Contractors shall be manufacturers or licensed factory representatives and installers of the manufacturers, specified for the local area in which the Site is located.
- .7 The Contractor shall ensure that BAS Subcontractor provides the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The Contractor shall provide as many trips to the Site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the Consultant and/or project supervisor.
- .8 The Contractor shall ensure that the controls Subcontractor specifically reads all mechanical and electrical drawings, specifications, and addenda and determine the controls work provided by the mechanical Subcontractor, and the electrical Subcontractor. The controls Subcontractor is expected to have the expertise to coordinate the work of other contractors and to make a completely coordinated Building Automation Control System (BAS) for the mechanical systems.
- .9 The BAS shall be compatible with future control Products for 10 years or more.
- .10 Ensure compliance with all applicable codes and authorities having jurisdiction.
- .11 The system shall be installed by trade certified electricians regularly employed by the controls contractor. The system shall be tested and calibrated by factory certified technicians qualified for this type of work and in the regular employment of the BAS manufacturer or its exclusive factory authorized installing contracting field office representative. The installing Subcontractor shall have a minimum of five years of installation experience with the manufacturer. Supervision, calibration and commissioning of the system shall be by the employees of the factory authorized BAS branch or representative.

2. ACCEPTABLE BMS SUBCONTRACTORS

- .1 The Building Automation System shall be one of the following:
 - .1 Automated Logic
 - .2 Delta Controls Inc.
 - .3 Reliable Controls Corporation.
 - .4 or equivalent.

3. SCOPE

The scope of work under this Section shall include, but not be limited to, the following work:

- .1 Preparation of control shop drawings for review and approval. *See Submittals.*
- .2 Supply and install a network of Building Automation Control System (BAS) panels and field devices. *See Hardware, Software and Field Devices.*
- .3 Supply and install customized graphics software as specified. *See Software.*
- .4 Install, wire and label all BAS control system components. *See Installation.*
- .5 Calibrate and commission the installed control system. *See Commissioning.*
- .6 Provide maintenance manuals and as-built drawings. *See As-Built Documentation.*
- .7 Provide customized training for operations, maintenance and technical staff. *See Training*

4. DRAWINGS AND SUBMISSIONS

Submit four (4) copies of following information to the consultant and/or the project manager for review and approval:

- .1 Control Schematics.
- .2 Detailed sequence of operation for each control schematic or controlled system.
- .3 System Architecture indicating the proposed interconnection and location of all BAS panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etc.)
- .4 BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e, AO/DO/AI/DI), end device fail position, end device manufacture and model number, and wire tag ID). Terminal identification for all control wiring shall be shown on the shop drawings.
- .5 Wiring diagrams including complete power system, interlocks, control and data communications.
- .6 Hard copy graphical depiction of the application control programs.
- .7 Manufacturers' data / specification sheets for all material supplied.

5. Materials

- .1 All points shall be available to BACnet.
- .2 Points shall be field reconfigurable. No set points shall be hard coded in the programs.
- .3 All controllers shall be loaded to a maximum of 80%. 20% of each of the inputs, outputs and variables shall remain unused to allow for future growth and expandability.
- .4 The system shall consist of all operator interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.
- .5 All equipment, points, etc. shall have common labelling.
- .6 Software shall be completely programmable and capable of all control and mathematical functions.
- .7 All temperature units for BAS and controlled equipment shall be in °C (degrees celcius).
- .8 Operator Activity Tracking - An audit trail report to track system changes, accounting for operator initiated actions, changes made by a particular person or changes made to a specific piece of equipment

- designated time frame, shall be printable and archived for future use. The operator activity tracking shall be in a tamper-proof buffer file.
- .9 Operator workstation interface software shall optimize operator understanding through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality:
 - a. Real-time graphical viewing and control of environment
 - b. Scheduling and override of building operations
 - c. Collection and analysis of historical data and dynamic data (trend plot)
 - d. Definition and construction of dynamic color graphic displays
 - e. Editing, programming, storage and downloading of global controller databases
 - f. Alarm reporting, routing, messaging, and acknowledgment
 - .10 Provide a graphical user interface, which shall minimize the use of the keyboard through the use of a mouse or a similar pointing device and a "point and click" approach to menu selection.
 - .11 Battery backup: Automatic restart after power failure: Upon restoration of power after an outage, the BAS shall automatically, and without human intervention, update all monitored functions, resume operation based on current synchronized time and status and implement special start-up strategies as required.
 - .12 Refresh rate – The maximum permissible refresh rate is ONE (1) second. The refresh rate is defined as the time it takes the controller central processing unit (CPU) to sample all inputs, calculate all variables, update all timers and proportional integral derivative (PID) controllers, check all schedules, update all trend logs and runtime logs, execute all programs and assign values to all outputs.
 - .13 The HVAC equipment shall be supplied as "Thermostat-Ready". The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.
 - .14 Reports shall be generated on demand or via a pre-defined schedule and directed to video displays, printers or hard drive. As a minimum, the system shall allow the user to easily obtain the following types of reports:
 - a. A general listing of all or selected points in the network
 - b. List of all points currently in alarm
 - c. List of all points currently in override status
 - d. List of all disabled points
 - e. List of all points currently locked out
 - f. List of user accounts and access levels
 - g. List all weekly schedules
 - h. List of limits and dead-bands
 - i. Excel reports
 - j. System diagnostic reports including a list of BAS panels on line and communicating, and the status of all BAS terminal unit device points
 - k. List of programs
 - .15 Provide a means for the operator to view the communication status of all controllers connected to the system. The status should show whether the controller is communicating or not.
 - .16 Provide a means for the operator to reset the error count for all controllers to zero.
 - .17 Provide a means for the operator to display and change the system configuration. This shall include, but not be limited to, system time, day of the week, date of day light savings set forward/ set back, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.
 - .18 Provide a security system that prevents unauthorized use unless the operator is logged on. Access shall be limited to the operator's terminal functions unless the user is logged on.
 - .19 Where possible, utilize Optimized Start features on equipment to reduce hydro demand charges.
 - .20 During the initial design The Region shall supply the controls contractor a range of BACnet addresses the

BAS will run on. The BAS network will run either BACnet over IP or BACnet over MSTP. All BAS points will be network visible so that other BACnet systems can auto discover them. The Contractor shall consult with York Region Project Manager during the development of addresses.

6. Operator's Workstation

- .1 Supply and install all operating software and dynamic system graphics on the Operator's Workstation. Workstation to be supplied by BAS contractor unless stated otherwise by The Region Project Manager.
- .2 Supply licenses for all software required to monitor, configure system, edit graphics, trend storage, (data exchange including Open Database Connectivity (ODBC) if applicable)) without limitations to points.
- .3 Reliable Controls shall include licensing for the following: Mach-Proweb (MPW) controllers which allows any web enabled device to access graphics and adjust set points. Server not required. Built-in controller trend logs are acceptable, server is not required. One MPW is required for the EMS Station located in the mech/elect room. Remote access to the vendor is only possible through a pre-arranged GOTO meeting with operation and maintenance department. Integration of lighting controls into BAS is not required.
- .4 Delta Controls shall include licensing for the following: ORCAweb-Large, Illustrator, ORCAweb, OWS, ODBC, DDE, Historian Large.
- .5 Automated Logic shall include licensing for the following: WEB CTRL, Advanced reports.
- .6 The operator workstation interface software shall be designed to operate on the Windows 7 Professional platform.

7. WAN Access

- .1 Provide necessary interface and cabling to connect the BAS to the YR WAN. Obtain the particular WAN system details from the Consultant or Project Supervisor.
- .2 The Region shall supply the WAN IP address, Gateway and Subnet mask for the BACnet/IP Broadcast Management Device (BBMD) router in the network. The controls contractor will facilitate integration into the Region's existing BAS BACNET network.
- .3 On the network a BACnet IP device that is capable of BBMD will route information from other sites and the operator work station. In addition there shall be a CAT5 wire that is run to the Region's IT switch with a 4' pigtail and connector.

8. Trend Data

- .1 Provide trend logs for every hardware input and output.
- .2 All trends should be accessible via the graphical interface.
- .3 Trends should contain all related variables of a control loop (i.e. setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph. Field Devices Individual trends should provide an appropriate "snapshot" of the variable. Trends should contain a minimum of 5 days worth of trend data.
- .4 Provide trending capabilities at 5 minute intervals that allow the user to easily monitor and preserve records of system activity over a one year period. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard drive for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
- .5 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.
- .6 Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual point or predefined groups of at least six points. Provide sufficient capacity to allow for trending a minimum of 100 points at 2000 samples each. Reports should be easily transferable on-line to Microsoft Excel. The Contractor shall provide custom designed spreadsheet reports for use by the Owner to track energy usage and cost, equipment run-times, equipment efficiency, and/or building environmental conditions.
- .7 The operator shall be able to change trend log setup information. This includes information to be trend logged as well as the interval at which the information is to be logged. All points in the system may be

logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics where the point is displayed.

- .8 Trending shall include the ability to track energy management aspects including, but not limited to, the following:
 - a. Daily use
 - b. Monthly use
 - c. Daily Hi and Low
 - d. Monthly Hi and Low
 - e. Demand Limiting and Load Shedding Program
 - f. Run time accumulation for any specified equipment
 - g. After hour use log
- .9 The primary input sensor for all control loops must connect to the same panel containing the control loop output.
- .10 Trend data storage must be in the same panel as the hardware or logical points being trended.

9. Alarms

- .1 The BAS will be configured to provide for remote alarm capabilities.
- .2 Alarms shall be capable of being routed to The Region's IT server so that they can be sent to Operator's email addresses.
- .3 The operator workstation shall provide audible, visual and printed means of alarm indication. The Alarm Dialog box shall always become the Top Dialog box regardless of the application(s) being run at the time (such as a word processor). A printout of all alarms shall be sent to the assigned terminal and port.
- .4 Provide a log of alarm messages. The alarm log shall be archived to the hard drive of the operator workstation. Each entry shall include a point descriptor and address, time and date of alarm occurrence, point value at the time of alarm, time and date of point return to normal condition and time and date of alarm acknowledge.
- .5 The controls Subcontractor shall work with the Region to determine the alarms unless specified otherwise.
- .6 Alarm messages shall be in plain English and shall be user definable on site or via remote communication.

10. Field Devices

- .1 Automatic Control Valves
 - a) Valves used for throttling applications shall have a linear percentage-to-flow characteristic.
 - b) Ball valves are the preferred valve type for zone and HVAC control valves. Globe and butterfly valves shall be used where required to provide the desired pressure drop and CV.
 - c) Automatic Control valves shall be manufactured by Belimo or equivalent.
- .2 Control Valve Actuators
 - a) Size control valve actuators to provide a tight close off against system head pressures and pressure differentials.
 - b) Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.
 - c) Floating point control of valves is not acceptable under any circumstances.
 - d) Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.
- .3 Damper Actuators
 - a) Actuators shall be direct coupled for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Provide 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two position applications.

- b) Damper actuators are to be manufactured by Belimo.
- .4 Automatic Control Dampers
 - a) All automatic control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor (except for VAV Boxes which shall be supplied by the mechanical Subcontractor). All dampers in a mixing application shall be opposed blade. Parallel blade shall be permitted in other applications. Dampers shall be a tight closing, low leakage type with replaceable extruded vinyl seals on all outdoor and exhaust applications.
- .5 Room Sensors/Thermostats
 - a) Office: Temp Display, Set point Display, Set point Adjust, Schedule Override, High and Low Limit on set points.
 - b) All areas except offices: Set point Adjust, Schedule Override, High and Low Limit on set points.
 - c) Mount sensors at a height of 5'-6" unless otherwise indicated.
 - d) Mount thermostats and space sensors as noted on the drawing. Do not mount on outside walls without permission of consultant.
- .6 Current Switches (Digital)
 - a) Provide BAS status for fan and pump motors using a mosfet type digital switch. Acceptable manufactures are ACI Instrumentation, Enercorp Instruments Ltd., Greystone, Veris and Elkor Technologies Inc. or equivalent.
- .7 Pressure Transmitters
 - a) Technical Performance - Solid State design, operating on capacitance principle, with non-interactive fine resolution, zero and span adjustments. End-to-end accuracy +/- 2% of full scale pressure range, including temperature compensation. 4-20mA or 0-5 VDC output.
 - b) Standard of Acceptance – ACI, Enercorp, Greystone, Modus. or equivalent.
- .8 Duct Temperature Sensor
 - a) Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe. Operating range 0-60 degrees C. End-to-end accuracy +/- 0.3 degC. Assembly complete with wiring housing and mounting flange.
 - b) Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature from all individual sensors. End-to-end accuracy +/- 0.3oC. Assembly complete with wiring housing and mounting flange. Mount in a zig-zag manner to provide continuous coverage of the entire duct cross-sectional area.
- .9 Outdoor Air Temperature Sensor
 - a) Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy. In the event of sensor failure the sensor deemed to be accurate shall be used to control the systems. The outdoor air sensors shall be located on a north wall if possible and a minimum of three (3) feet from any opening in the building envelope which could affect the sensor readings. The back face of the sensor enclosure shall be insulated to prevent temperature pick up from the building wall.
 - b) Technical Performance, 10 k ohm thermistor -50°C to 50°C in a weatherproof enclosure mounted on north exposure. End accuracy of +/- 0.3 °C over the entire operating range.
- .10 Pipe Temperature Sensor
 - a) Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 - +100 oC. End-to-end accuracy +/- 0.3 oC over the entire operating range. Complete with brass thermowell. Use heat transfer paste when mounting the sensor in thermowell. No surface mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the Consultant.

.11 CO₂ Detector

- a) Technical Performance – Infrared CO₂ monitor c/w 4-20mA or 0-5 VDC output, accuracy of +/- 40 ppm +3% reading.
- b) Standard of Acceptance – ACI-CO₂-D or Telaire duct mount or equivalent..

11. Security System Monitoring to BAS

- .1 Provide digital input from security system.
- .2 When building security armed all outside lighting control shuts off 20 minutes after alarm system armed.
- .3 When building security armed all Air Handling Units's, Exhaust Fans and heating systems shall be changed to unoccupied mode immediately when armed regardless of scheduled times.
- .4 All critical alarms as determined by York Region.

12. Enclosure

The BAS control and power supply cabinets shall conform with the following:

- .1 Panel enclosures shall be a locking type, metal cabinet, with common keying.
- .2 CSA certified 150359 and UL listed E109310.
- .3 16 or 14 gauge steel.
- .4 Slip hinges enabling door removal for easier access and mounting. Door shall be lockable.
- .5 1/4 turn keyed latch standardized to G549 keyset.
- .6 14 or 12 gauge galvanized steel panel on collar studs natural finish.
- .7 Grounding stud on inner cover surface.
- .8 Grounding hole on mounting panel with grounding screw.
- .9 ANSI/ASA61 grey polyester - epoxy textured powder coating inside out.
- .10 3" deep wire duct shall be installed to neatly conceal controller wiring.
- .11 Power supply cabinets shall be provided with a ESA Field Evaluation approval.
- .12 2-100VA 120/24 Transformers Class II UL5085-3.
- .13 Over Current Protection by Circuit Breaker.
- .14 Outlet Receptacle for Service Laptop Power.

13. BAS Database Naming Conventions & Programs

- .1 All BAS programs shall be created in each panel in logical order as determined by the equipment being controlled by each panel on the network.
- .2 All programs and program code is to follow proper coding practices including internal comments to describe the function of the statements and also ensure the source code is formatted in a consistent and logical manner. Programming coding should be kept as simple as possible.
- .3 System Schedules shall be submitted for approval and will include global and local scheduling.
- .4 The Outdoor Air Temperature Program shall be in its own program named OAT PG.
- .5 Network Status Panel Naming Conventions should indicate the building, panel location and panel number. The building name can be abbreviated as necessary to fit in the space.

14. Graphic Display Screens

- .1 All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for Site Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system.
- .2 All operator accessible points shall be yellow text and all information points shall be blue.
- .3 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.

- .4 Appendix A at the end of this document shows examples of typical graphic screens. These are examples only. Graphics shall comply with the following specific screen content. Not all equipment and systems are listed below but the format will be the same for other equipment:
- .5 Graphic Screens General All Screens
 - a) Navigation buttons to each major system in the building which indicate current screen display by a change in button colour
 - b) Background colour shall be black
 - c) Outdoor air temperature shall be displayed on every graphic screen
- .6 Site Graphic
 - a) The York Region Logo on the site or opening graphic screen
 - b) Artist concept or scanned in picture of the front of the building
 - c) Access links to all global schedules or specific screens affecting entire building operation
 - d) Access buttons links to Set Time, Holiday Schedule, Schedule, Alarms, Points on Manual
- .7 System Architecture
 - a) Control panel layout and network architecture
 - b) Indicating BAS panels and panel type(model)
 - c) Panel locations room number text on screen
 - d) Systems controlled by each panel
 - e) Links to points list accessible from each panel
- .8 Architecture Panel Layout (Locations on Floor Plans)
 - a) Locations of each panel on each floor plan level
 - b) Panel types indicated by different icon
 - c) Controls transformers locations
 - d) Main network wiring and sub-network wiring layout
- .9 Floor Plans graphics
 - a) Room numbers accurate as per room signage
 - b) Mechanical rooms locations & signage tags
 - c) Space temperatures for every temperature on each floor in appropriate room
 - d) Space focus pick area for individual room control where applicable shall be yellow text
 - e) Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour
 - f) Status of Air Handler by colour change Red for off status, or text indication
 - g) Supply air temperature for each air handler
- .10 Air Handler (AHU) graphic
 - a) Accurate representation of the AHU design
 - b) All associated control points to be displayed
 - c) All points to be monitored for automatic mode and shall be displayed when in Manual mode
 - d) A calculated percentage of fresh air shall be indicated on the AHU graphic
 - e) Operator offset adjustment of the supply air setpoint, adjustable directly from the graphic
 - f) AHU physical location shall be indicated on the graphic
 - g) Weekly occupied time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon
 - h) Weekly student time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon
 - i) Trend logs shall be accessible directly from the graphic by selecting an icon
- .11 Boiler graphic
 - a) Boiler graphic piping layout shall be accurate as per piping layout

- b) All associated control points for the boiler system to be displayed
- c) Operator offset adjustment of the scheduled water setpoint, adjustable directly from the graphic
- d) Lead boiler and boiler stages shall be indicated
- e) Lead pump shall be indicated
- f) Boiler status shall be indicated graphically
- g) Pump status shall be indicated graphically
- h) Calculated scheduled water setpoints to be displayed
- i) Operator offset editable directly from the graphic screen
- j) Weekly time of day schedule for the building occupied schedule shall be accessible directly from the graphic by selecting an icon
- k) Trend logs shall be accessible directly from the graphic by selecting an icon

.12 Exhaust fans graphic

- a) Exhaust fans control shall be editable directly from the graphic
- b) Exhaust fan status shall be indicated in text and a change in the exhaust fan icon
- c) Exhaust fan physical location shall be indicated on the graphic
- d) Area of the building being exhausted shall be indicated on the graphic

15. Installation

- .1 All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise.
- .2 All wiring shall be in accordance with the Ontario Electrical Code and any applicable local codes. All BAS wiring shall be installed in conduit unless otherwise allowed by the Ontario Electrical Code or applicable local codes. Where BAS plenum-rated cable wiring is allowed, it shall be run parallel to, or at right angles to, the structure, properly supported and installed in a neat and workmanlike manner. BAS wiring that runs in exposed ceiling spaces (eg garages, mechanical rooms) shall be installed in conduit.
- .3 In accessible ceilings, wiring from BAS controllers to sensors and actuators, control system network and low voltage wiring only may be installed with yellow jacket Low Voltage Thermostat cable. Where the ceiling is used as a return air plenum install plenum rated yellow jacket cable instead of LVT.
- .4 BX or flex conduit may only be used for the final (approximately one meter) run to controls devices, where the controls equipment is mounted on vibrating machinery.
- .5 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in all electrical Specifications Sections..
- .6 No wire smaller than 18 gauge is to be used on the project except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.
- .7 All field wiring including sensor wiring and wiring from panels to devices shall be continuous. The use of wire connectors, wire nuts or splicing is not allowed.
- .8 Provide wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of the Consultant for the use of strap-on sensors.
- .9 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.
- .10 Mount transformers and other peripheral equipment in panels located in serviceable areas. Provide line side breakers/fuses for all transformers.
- .11 All 120 VAC power for any controls equipment shall be from dedicated circuits. Provide a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.
- .12 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status.
- .13 All BAS control wiring shall be yellow jacket for identification purpose.

- .14 The breaker or power isolation location shall be clearly marked on the inside door of each BAS panel enclosure.
- .15 Wiring in ceiling spaces to be installed clear of ceiling tiles and lights to allow access and removal of tiles and lights.
- .16 The Contractor shall prepare a wiring mock-up of a typical system/device/main panel to demonstrate quality and workmanship for approval by the Region. This approved mock-up quality shall be maintained throughout the entire installation. System requiring mock-up to be discussed with the Region's Project Manager.
- .17 All wiring shall be routed orthogonally and drops shall have additional wiring coiled in ceilings to facilitate future sensor relocation.
- .18 Wiring in ceiling spaces to be secured/tied every 48" minimum.
- .19 Surge suppression shall comply, as a minimum, with the manufacturer's requirements.
- .20 All equipment including controllers shall be grounded.
- .21 All end-of-wire connectors shall be certified.
- .22 All components shall be labelled and detailed in manuals.
- .23 All wiring systems shall be colour coded to simplify maintenance.
- .24 All equipment shall be located for ease of service access.
- .25 Contractor shall maintain a list of deficiencies when close to completion, and shall update this list on a regular basis for review by the Owner's representative.
- .26 If the project is a retrofit of an existing system:
 - a) Contractor shall remove all old redundant wiring following system verification
 - b) Re-use of existing wiring is not allowed. Run continuous new wiring
 - c) Re-use of components (eg enclosures, transformers) is not allowed unless approved by the Region's Project Manager

16. Equipment Location

- .1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated BAS controllers, shall have locally mounted controllers, in accessible locations within the building envelope. All locally mounted controllers shall be installed in enclosures suitable for that location. BAS controllers for mechanical equipment other than those listed above shall be mounted in mechanical rooms as noted below, unless specifically approved by the Consultant for this project.
- .2 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.
- .3 No BAS panel shall be located inside the rooftop fan enclosure under any circumstances. All BAS panels shall be located within the building envelope, and shall be enclosed in a metal locking enclosure, as specified in 16.4.
- .4 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers.
- .5 Transformers or power supplies shall not be located in ceiling spaces unless approved by the engineer for terminal control valves, actuators or zone controllers. When transformers are installed above ceilings, transformers shall be installed in metal enclosures, and the location shall be clearly labeled on the t-bar ceiling to indicate power transformer location.
- .6 A 120 VAC duplex receptacle for laptop power shall be provided if the cabinet is located further than 5' laterally from the nearest outlet.

17. Identification and Labelling Equipment

- .1 All panels must have a lamacoid tag (min. 3"x1") affixed to the front face indicating panel designation and function (i.e. "BAS Panel 1" or "Relay Panel 3").
- .2 All field sensors or devices must have a lamacoid tag (min. 3"x1") attached with tie-wrap or adhesive indicating the point software name and hardware address (i.e. AHU1_MAT, 2.IP4).

- .3 Room sensors and other sensors in finished areas will require a device tag.
- .4 All devices within a field enclosure will be identified via a label or tag.
- .5 All BAS panel power sources must be identified by an adhesive label indicating the source power panel designation and circuit number on the outside of the enclosure door (i.e. "120vac fed from LP-2A cct #1).
- .6 All field equipment panels fed from more than one power source must have a warning label on the front cover.
- .7 All wires will be identified with self-adhesive wire labels or clip-on plastic wire markers at both ends.
- .8 All rotating equipment controlled by the BAS will have a tag or label affixed indicating that the equipment may start without warning.
- .9 All BAS panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (i.e. AI or DO), device fail position, device manufacturer and model number or reference and wire tag reference.
- .10 Where required, field panels will have wiring diagrams attached to the inside door.
- .11 Provide new or modify existing equipment wiring diagrams (i.e. boilers, chillers, etc.) wherever the BAS interfaces to other equipment.

18. Commissioning

- .1 Perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning.
- .2 Upon completion of the performance tests, repeat these tests, point-by-point in the presence of the Owner's representative, as required. Properly schedule these tests so that testing is completed by the time directed by the Owner's representative.
- .3 Confirm and demonstrate to the Consultant and the Owner's agent that all systems are programmed and operating correctly. When project is complete the contract shall allow sufficient programming time in order to customize the sequences to meet operational needs, fine tuning of the system and other duties as required. York Region will determine the schedule.
- .4 Submit a four (4) copies of the system commissioning report to the Consultant for review and approval.
- .5 Each analogue inputs (i.e. temperatures, pressure, etc.) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1C of the readings observed at the workstation.
- .6 Each analogue output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100% range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100% range from a minimum control range of 10-90%.
- .7 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.
- .8 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.
- .9 Record all out-of-season or unverified points in the commissioning report as "uncommissioned".
- .10 The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.
- .11 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.
- .12 Control loop tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a "reasonable" period of time without excessive cycling or hunting of the controlled device.

19. Training

- .1 Once 5 consecutive Days of alarm-free operation are complete and documented, operator training may begin.
- .2 Provide 1 day of instruction to the Owner's designated personnel on the operation of the BAS and describe its intended use with respect to the programmed functions. Operator orientation of the BAS shall include,

but not be limited to, the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the system's operation.

20. Warranty

- .1 Warranty all components supplied under this contract for a period of two years in accordance with Article A-15 of the Agreement Between Owner and Contractor. Replace all controls equipment that fails during this period without cost to the owner.
- .2 All controllers shall have a 5 year manufacturer's warranty.

21. As-Built Documentation

- .1 Within two weeks following substantial completion of the project, update the original submittal documents to reflect the "As Built" conditions of the project and submit four copies as required by the consultant and/or the Project Manager.
- .2 Provide a separate laminated copy of the control drawings for mounting in the mechanical room or in the controls panels.
- .3 Provide final point lists, shop drawings and all installed equipment data and operations sheets.
- .4 Submit diskettes/CD's (including back-up diskettes/CD's) containing up to date copies of the programs in each controller. Provide original program disks and documentation proving registration for all software programs provided as a part of this contract including: the BAS operator interface software, and the BAS graphics (bitmap files). Provide one set of original disks for every computer supplied under this Contract or that the software has been loaded onto.
- .5 Submit (4) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

22. Control Points and Points List

- .1 A typical points list for system control and monitoring is shown in Appendix B and shall be used as a guide for system design.
- .2 This points list is not intended to be complete. It is intended to be a typical list to capture all foreseeable equipment types. Project specific points list must be created on a project-by-project basis by the BAS contractor and shall be reviewed by York Region.
- .3 York Region staff shall be consulted to develop the sequence of operations. York Region will provide the BACnet address range for each building.
- .4 All control points shall have built in time delays to prevent short cycling.
- .5 Point Naming conventions shall be submitted for review by York Region Project team. Names may be changed to comply with the Regions naming conventions.

End of Section

1 General

1.1 GENERAL

- .1 Read and conform to:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended.
 - .2 Division 25 01 01 General Requirements.

1.2 SECTION INCLUDES

- .1 Sequence of operation:
 - .1 Furnace & DX Condensing unit
 - .2 ERV
 - .3 Exhaust Fan IT Room
 - .4 DE stratification Fans
 - .5 Domestic Hot Water Recirculation Pump
 - .6 CO/NOX Ventilation System for Truck Bay & Ambulance Bay.

.1 Furnace & Condensing Unit

.1 Modes of Operation

- .1 The occupied and unoccupied modes of operation are determined by a time clock. System can be set to run continuously in the occupied mode.
- .2 The furnace will operated by BAS to maintain room temperature at set point. During the summer season the DX condensing unit will be energized to provide cooling to meet the room temperature set point. During winter season BAS enable/ disable stage 1 and stage 2 heating to maintain room temperature at set point. BAS to operate the supply fan at low speed or high speed determined by outdoor temperature, room temperature and room temperature set point.
- .3 BAS will enable/disable the furnace and will monitor the status to generate an alarm if the furnace fails to operate when commanded on.

.2 ERV

- .1 ERV will be operated through BAS based on time of day schedule. BAS to map all the occupancy sensor status from lighting control system through BACnet. Building occupancy will be determined by the occupancy sensor status from lighting control system.
- .2 When building is unoccupied, ERV to be off and furnace to be on to maintain unoccupied set point.
- .3 When building is occupied, ERV to be on with furnace to maintain room temperature set point. ERV to run at low speed when the furnace is run at low speed. When CO₂ concentration is above set point then ERV to run at high speed. When furnace is running at high speed, ERV to be run at high speed to maintain negative room pressure in Washrooms and locker room.
- .4 Normally the unit will operate on low speed and upon sensing higher CO₂ concentrations (CO₂ set point to be determined). It will run on high speed.
- .5 The Contractor shall ensure that the BAS Subcontractor to install insulated parallel blade dampers in the intake and exhaust duct of the ERV, BAS to operate both these dampers with the enabling and disabling of the ERV. These dampers are to be in closed position during the time the ERV is not in operation. BAS to generate an alarm if the ERV fails to operate when commanded on.

.3 AC unit IT Room (AC-1)

The AC unit will be standalone control by AC unit Manufacturer. BAS to monitor the room temperature and status of AC-1 through current sensor. BAS to generate alarm if the AC-1 does not operate when commanded on.

.4 De-stratification Fans in Apparatus Bay

These fan will be operated through local speed controller installed in the apparatus bay.

.5 Domestic Hot Water re-circulation pump

BAS will operate the pump based on occupancy determined by security system. Aquastat at the pump will operate the pump to maintain the water temperature at set point. BAS will monitor the pump status through current sensor. BAS will generate an alarm if the pump falls when commanded on.

.6 CO/NOX Ventilation

The exhaust fan of the apparatus bay will operate with the outdoor air damper to maintain the CO/NOX set point as read by the CO/NOX sensor. If the set point is not reached upon activation of the System for a pre-determined time then the system to generate an audible and visible alarm. The CO/NOX Set point will be determined during system start up.

End of Section

1. GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Conform to General Requirements, Division 1 and Instructions to Bidders.

1.2 REFERENCES

- .1 Refer to and be governed by the conditions and requirements of the "GENERAL CONDITIONS OF STIPULATED PRICE CONTRACT", Instructions to Bidders and "Division 1 General Requirements" of the specifications.

1.3 APPLICATION

- .1 This Section applies to and is an integral part of all succeeding Sections of this Division of the specification.

1.4 DEFINITIONS

- .1 The following are definitions of words found in Sections of this Specification and on associated drawings:
- .2 "Concealed" - hidden from normal sight in furred spaces, shafts, crawl spaces, ceiling spaces, walls and partitions;
- .3 "Exposed" - all work normally visible to building occupants;
- .4 "Provide" (and tenses of "Provide") - supply, install and connect complete.
- .5 "Install" (and tenses of "install") - install, and connect complete;
- .6 "Supply" - Supply only.
- .7 "Work" - all equipment, permits, materials and labour to provide a complete electrical installation as required and detailed in Drawings and Specification.
- .8 "Authorities" or "Authorities Having Jurisdiction" - any and all current laws and/or by-laws of any federal, provincial or local authorized agencies having jurisdiction over the sum total or parts of the work including, but not restricted to the Municipal Planning and Building Department, Municipal Fire Department, Labour Canada, The Provincial Fire Marshall, The Local Hydro Supply Authority, The Ontario Building Code, The Workplace Safety and Insurance Act, Municipal Public Works Department, the Canadian Electrical Code with Ontario Supplement, hereinafter referred to as the "Code", the Electrical Safety Authority and all Inspection Bulletins.
- .9 "Drawings and Specifications" - "the Contract Drawings and Specifications".
- .10 "Consultant" shall mean the firm of REGAL ENGINEERING, or other person authorized to act on their behalf.

1.5 WORK INCLUDED

- .1 The work shall include all labour, materials, equipment, permits, inspections and tools required for a complete and working installation as described but not necessarily limited to items, in the following sections:

SECTION 26 00 00	Electrical General Requirements
SECTION 26 05 53	Receptacle and Circuit Labelling
SECTION 26 09 13	Electrical Power Monitoring
SECTION 26 10 00	Electrical Basic Materials and Methods
SECTION 26 30 00	Electrical Service and Distribution
SECTION 26 30 10	Power Generators
SECTION 26 30 20	Low voltage Bypass / Isolation - ATS
SECTION 26 50 00	Lighting System

SECTION 26 60 00	Digital Occupancy Sensors and Lighting Control System
SECTION 26 70 00	Fire Alarm System
SECTION 27 00 00	Telecommunication Raceway System
SECTION 28 00 00	Security System
SECTION 29 00 00	EMS Shore Cord Assembly Details

1.6 SEISMIC RESTRAINTS

- .1 Include all costs related to provisions of seismic restraints and equipment necessary for electrical systems and equipment in the Contract Price. Costs shall include for the design of structural elements (by a Professional Engineer) of the seismic restraints for all electrical equipment included in this Contract.

1.7 SCHEDULING OF PRODUCT DELIVERY

- .1 Every effort must be made to ensure delivery of all materials and products in the Contract Documents on time. At commencement of Contract, prepare schedule of order dates for items requiring long delivery periods.

1.8 EXAMINATION OF SITE

- .1 Prior to submitting a tender carefully examine conditions at the Site, which may or will affect the work. Refer to and examine all Contract Documents, including room finish schedules to determine finished, partially finished and unfinished areas of the building.
- .2 Ensure that materials and equipment are delivered to the Site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into the spaces where they are to be located without difficulty. Be responsible for any cutting and patching involved in getting assemblies into place.

1.9 QUALITY ASSURANCE:

- .1 General Codes and Standards:
 1. Comply with the Ontario Building Code and Canada Labour Code, Part 4.
 2. Where provisions of pertinent codes or local by-laws conflict with these Specifications and Drawings or each other, comply with the most stringent provisions.
 3. Operating voltages shall comply with CAN3-C235-83.
 4. Ground system shall comply with CSA Standard C22.1.
 5. Abbreviations for electrical terms: to CSA Z85-1983
- .2 Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.
 1. Equipment must bear, on manufacturer's label, certification mark or label acceptable under Electrical Safety Authority.
- .3 Provide units from the same manufacturer where two or more units of same class or type of equipment are required.
- .4 Manufacturer's names are stated in this Specification to establish a definite basis for tender submission and to clearly describe the quality of product that is desired for the work.
- .5 Standard Specifications
 - .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with latest issue of applicable Standard Specifications issued by authorities having jurisdiction, but such Standard Specifications shall not be applied to decrease the quality of workmanship, products and services required by the Contract Documents
- .6 Electrical Codes and Permits:
 - .1 The work shall be tendered on and shall be carried out in accordance with

- these Drawings and Specifications and shall comply with the essential requirements of the latest editions of the Canadian Electrical Code C. 22.1 and the Electrical Safety Code (together with applicable bulletins issued by the Inspection Department of Electrical Safety Authority). In no instance, however, shall the standards established by the Drawings and Specifications be reduced by any of the codes referred to above. In the event of conflicting requirements, the codes shall take precedence over these Contract Documents and the Consultant's decision shall be final.
- .2 Arrange for and obtain all necessary permits, inspection and approvals from authorities having jurisdiction, and also pay all applicable fees. The Contractor shall conform to all Municipal Codes and By-laws which affect the work.
 - .3 Applicable Codes
 - .1 Ontario Electrical Safety Code
 - .2 Canadian Electrical Code with applicable regional amendments
 - .3 Ontario Building Code
 - .4 National Building Code
 - .5 Ontario Fire Code
 - .6 National Fire Code and Fire Commissioner Canada requirements
 - .7 Canadian Standards Association
 - .8 Underwriter's Laboratories of Canada.
 - .9 Canadian Underwriters Association
 - .10 Electrical Inspection Department of Ontario Hydro.
 - .4 Before starting any work, submit the required number of copies of Drawings and Specifications to the Electrical Safety Authority and the local authority for approval and comments. Comply with any changes requested as part of the Contract, but notify the Consultant immediately of such changes for proper processing of these requirements. Prepare and furnish any additional Drawings, details or information as may be required by the Engineer.
 - .5 On or before the completion of this Contract, obtain at Contractor's own expense, the necessary certificate of inspection from the Inspection Branch of the Electrical Safety Authority of Ontario and forward same to the Consultant. Furnish necessary certificates as evidence that work installed conforms to laws and regulations of authorities having jurisdiction.
 - .6 Equipment and material must be acceptable to Electrical Safety Authority.
 - .7 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.
 - .8 Supply and install warning signs, nameplates and glass covered Single Line Diagrams as required by Electrical Safety Authority.
 - .9 Submit required documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.

1.10 REQUIREMENTS OF DRAWINGS:

- .1 Contract:
 - .1 The Drawings for electrical work are essentially performance drawings, partly schematic, intended to convey the scope of work and extent of work. They only indicate general arrangement and approximate location of apparatus, fixtures and general typical sizes and locations of equipment and connections. The Drawings do not intend to show architectural, structural or mechanical details.
 - .2 Do not scale Drawings, but obtain information involving accurate dimensions to structure from those shown on Architectural and Structural Drawings, or by site measurements of existing areas. Follow the Electrical Drawings in laying out the work but consult general Construction Drawings as well as detail Drawings to become familiar with all conditions affecting the work, and verify spaces in which the

- work will be installed and structures to which it will be attached.
- .3 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.). Alter, at no additional cost, the location of materials and/or equipment up to 3m, or as directed by the Consultant, provided that the changes are made before installation and do not necessitate additional material or labour.
 - .4 Leave space clear and install work to accommodate future materials and/or equipment as indicated in the Contract Documents and to accommodate equipment and/or material supplied by other trades. Verify all equipment sizes in relation to space allowed and check all clearances.
 - .5 Confirm on the Site, the exact location and mounting elevation of equipment and fixtures as related to Architectural or Structural details. Confirm location of outlets and/or connection points for equipment supplied by other trades.

1.11 SHOP DRAWINGS:

- .1 Pay careful attention to all shop drawings and review comments and ensure that all requirements are fully complied with.
- .2 Submit for review, manufacturer's or vendor's drawings for all products being furnished except cable (up to 1000V), wire and conduit. Include rating, performance, specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly.
- .3 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
- .4 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.
- .5 Identify the equipment by system name and number, e.g. Fire Alarm Control Panel, Emergency Lighting Fixture "type I", etc.
- .6 Obtain and comply with the manufacturer's installation instructions.
- .7 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with name of Contractor, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.
- .8 The Consultant will stamp shop drawings as follows:
 - .1 Drawing: Reviewed ()
 - .2 Reviewed as Modified ()
 - .3 Revise and Resubmit ()
 - .4 Not Reviewed ()
- .9 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.
- .10 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work as well as compliance with

- codes and inspection authorities such as C.S.A., etc.
- .11 Coordinate work of this Division such that items will properly interface with work of other Divisions.
 - .12 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.
 - .13 Coordinate work of this Division with Division 7 to ensure that damage does not occur to the fireproofing work of Division 7.

1.12 SUBSTITUTIONS

- .1 Refer to 01 25 00.t.

1.13 DIMENSIONS AND QUANTITIES

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.
- .2 Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.
- .3 Make necessary changes or additions to routing of conduit, cables, cable trays, and similar items to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.

1.14 EQUIPMENT LOCATIONS

- .1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m without adjustment to Contract price.
- .2 Switch, control device and outlet locations are shown diagrammatically.

1.15 WORKING DRAWINGS AND DOCUMENTS

- .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract. Execute such Work only after verification of dimensions and materials and obtaining Consultant's written permission to proceed.
- .2 Contractor may be required to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one (1) trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.
- .3 Carry out all alterations in the arrangement of work which has been installed without proper study and approval by the Consultant, even if in accordance with the Contract Documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.16 INSTALLATION DRAWINGS

- .1 Prepare installation drawings for equipment, based upon approved Vendor drawings, to check required Code clearances, raceway, busway and cable entries, sizing of housekeeping pads and structure openings. Submit installation drawings to the Consultant for review.

1.17 "AS BUILT" RECORD DRAWINGS

- .1 (Refer to and comply with the requirements of Division 1) Maintain a set of Contract Drawings on site and record all deviations from the Contract Documents. As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.
- .2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.
- .3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
- .4 Record deviations from branch circuit numbers shown on Drawings.
- .5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification Sections.
- .6 Upon completion of Contract Work, prior to Substantial Performance inspection and after final review with Consultants, Contractor shall neatly transfer recorded information and make final As-Built submission to the Consultant in the following form:
 - One (1) set of clean, legible prints.
 - Updated ACAD R2012 drawings.The submission will be reviewed by the Consultant. Any comments shall be addressed and resubmitted until the submission is in a form acceptable to the Consultant.

1.18 TEST REPORTS

- .1 For each check and test performed, prepare and submit a Test Report, signed by the Test engineer, and where witnessed, by the Consultant.
- .2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.
- .3 Include calibration record, percentage error and applicable correction factors.
- .4 Submit a Certified Test Report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

1.19 OPERATING AND MAINTENANCE MANUALS

- .1 Refer to and comply with Division 1 and related Sections.

1.12 FIRE BARRIERS

- .1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.
- .2 Prior to installation, submit for review to the Consultant, proposed fire barrier seal materials, method of installation and ULC system number.
- .3 Acceptable Manufacturers:
 - .1 A/D Fire Protection Systems
 - .2 Dow Corning
 - .3 Fire Stop Systems
 - .4 IPC Flamesafe Firestop
 - .5 Nelson Electric
 - .6 3M
 - .7 Tremco
 - .8 or equivalent

1.21 MISCELLANEOUS METAL FABRICATIONS

- .1 Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical equipment in accordance with Section 05 50 00. All supports, platforms, brackets and channel struts shall be made of steel material.

1.22 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

- .1 Prepare and submit to the Consultant for review and forwarding to the appropriate sub-trade, drawings indicating all required sleeves. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses, and formed openings to suitable grid lines and elevation datum. Begin to prepare such drawings immediately upon notification of acceptance of tender and award of contract. Make all modifications to locations as directed by Consultant at no extra cost to contract.

1.23 METALS

- .1 Steel construction required solely for the work of electrical trades and not shown on architectural or structural Drawings shall be provided by the Contractor in accordance with applicable code requirements.

1.24 FLASHING

- .1 Flash electrical parts passing through or built into a roof, an outside wall, or a waterproof floor.
- .2 Provide 8 pound sheet lead flashing for cast iron or wrought iron sleeve passing through roof.
- .3 Flashing shall suit roof angle and shall extend minimum 457mm (18") on all sides; leave flashing as directed by the Contractor to build into roofing, rendering a watertight connection.
- .4 Provide counter flashing on ducts and conduits passing through roofs to fit over flashing or curbs.
- .5 Provide sleeves passing through outside walls with lead or copper flashing as directed in the Contract Documents.

1.25 WORKMANSHIP

- .1 Install equipment, ductwork, conduit and cables to best suit space, to present a neat appearance and to function properly to the satisfaction of the Consultant.
- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.
- .3 Include in the work all requirements of manufacturers shown on the shop drawings and manufacturers installation instructions.
- .4 Replace work unsatisfactory to the Consultant without extra cost.
- .5 Protect from damage all equipment delivered to the Site and during installation. Any damage or marking of finished surfaces shall be made good to the satisfaction of the Consultant.

1.26 GUARANTEE - WARRANTY

- .1 Guarantee and warranty requirements of the Contract shall apply except for incandescent lamps which shall be guaranteed for a period of ninety days after acceptance by the Owner.
- .2 In addition to the guarantee covered by the General Conditions, all equipment installed under this Contract shall receive emergency service for the full guarantee period, at no charge to the Owner.

1.27 OWNER RIGHT TO RELOCATE ELECTRICAL ITEMS

- .1 The Owner reserves the right to relocate electrical items (light fixtures) during construction,

- but prior to installation, without cost, assuming that the relocation per item does not exceed 3 m (10'-0") from the original location. No credits shall be anticipated where relocation per item of up to and including 3m reduces materials, products and labour.
- .2 Should relocations per item exceed 3m from the original location the Contract Price will be adjusted in accordance with the requirements of the Contract Documents.
 - .3 Necessary changes, due to lack of co-ordination, and as required and when approved by the Consultant, shall be made at no additional cost, to accommodate structural and building conditions. The location of pipes and other equipment shall be altered without charge to the Owner, if approved by the Consultant, provided the change is made before installation.

1.28 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

- .1 Refer to Division 1.
- .2 Each copy of the manual shall include:
 - .1 A set of as-built prints;
 - .2 Letters of Owner's Instructions;
 - .3 Final Electrical Safety Authority Certificate of Inspection;
 - .4 Verification Certificates for all systems as specified hereinafter;
 - .5 A copy of "reviewed" shop drawings;
 - .6 Complete explanation of operation principles and sequences;
 - .7 Complete part lists with numbers;
 - .8 Recommended maintenance practices and precautions;
 - .9 Parts manual and repair manuals
 - .10 Complete wiring and connections diagrams;
 - .11 Certificates of guarantee;
- .3 Ensure that operating and maintenance instructions are specific and apply to the models and types of equipment provided.

1.29 SYSTEM ACCEPTANCE

- .1 Submit original copies of letters from the manufacturers of all systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the method of installation, connection and operation.
- .2 These letters shall state the names of persons present at testing, the methods used, and a list of functions performed with location and room numbers where applicable.
- .3 Submit such letters for the following:
 - Emergency lighting system testing
 - Fire Alarm System Verification

1.30 CLEANING

- .1 Before energizing any systems, inspect and clean the inside of panel boards, switchgear, and cabinets to ensure that they are completely free from dust and debris.
- .2 Clean all polished, painted and plated work bright. Clean all lighting fixtures.
- .3 Remove all debris, surplus material and all tools
- .4 Carry out additional cleaning operating of systems as specified in other sections of this Division.

1.31 PAINTING WORK SUPPLIED UNDER DIVISIONS 26, 26, 27, 28 AND 29

- .1 Touch up minor chips or damage to electrical equipment, installed in this Division, with standard, factory supplied, enamel finish.
- .2 Colour code, as specified herein, outlet boxes, pull boxes, junction boxes by applying a small dab of paint to inside of each item during installation.
- .3 Colour code, as specified herein, all exposed ducts, conduits, outlet boxes, and similar

items by applying a 25 mm (1") wide band of paint around ducts and conduits adjacent to boxes described in above paragraph and on both sides of wall penetration.

.4 Use following paint colour-code:

- Lighting	Yellow
- Power	Blue
- Emergency Power	Orange
- Fire Alarms	Red
- Telephone	Cream
- Control	Brown
- Intercom & Sound	Green

1.32 PAINTING WORK SUPPLIED BY SECTION 09 91 00

- .1 Priming and finish painting of exposed unfinished raceways, fitting, outlet boxes, junction boxes, pull boxes and similar items.
- .2 Electrical subcontractor shall assist in form of supervision, painting works by Section 09 91 00.

1.33 COMMISSIONING

- .1 Be responsible for commissioning of all work provided. The total commissioning requirements:
 - .1 Complete activation of all systems.
 - .2 Re-torquing of all bolted connections in all distribution equipment.
 - .3 Calibration, testing and verification of all systems.
- .2 Commissioning shall commence with activation and verification of all systems in accordance with requirements of the Specifications. This will include but not be limited to the following items to be tested, adjusted and verified:
 - .1 TVSS.
 - .2 Power distribution systems.
 - .3 Emergency lighting system.
 - .4 Generator & ATS.

END OF SECTION

1 GENERAL

1.1 RELATED INSTRUCTIONS

1.1.1 Refer to Section 26 00 00, Electrical General Requirements.

1.2 SCOPE

1.2.1 Provide labelling of electrical power outlets and receptacles throughout the entire building to provide identification of electrical circuit.

2.0 PRODUCT

RECEPTACLE LABELLING

Provide labelling as per photograph below and as follows:

1.1.1.1 Labels for circuits on normal power shall be in black lettering.

1.1.1.2 Labels for circuits on emergency power shall be red lettering.

1.1.1.3 Each label shall contain the distribution panel identification number and circuit number.

1.1.1.4 As-built drawings shall show the distribution panel identification number and circuit number at each receptacle location.

Photograph of typical receptacle labelling:



END OF SECTION

PART 1 GENERAL

1.1 SCOPE / SUMMARY

- .1 Provide all metering equipment required to measure and trend electrical consumption and demand by end use.

1.2 RELATED INSTRUCTIONS

- .1 Refer to Section 26 00 00, Electrical General Requirements.

1.3 DESIGN REQUIREMENTS / PRODUCTS

Provide and install electrical energy sub-meter for measuring:

- .1 Facility incoming electricity

1.4 METERING EQUIPMENT

Electricity Meters

- .2 Internet Protocol (IP) based meter complete with:
 - 1. Built-in web server.
 - 2. Capable of operating with a dedicated IP address (to be provided by the Region).
 - 3. Communications Protocols:
 - A) HTTP/Post capable of pushing data to 3rd party applications/databases.
 - B) Modbus TCP
 - 4. Built-in real-time and historic graphics accessible with any HTML 5 internet browser (computer, tablet, phone) on the Region's network. Data to be displayed in local time, adjusted for daylight savings time.
 - 5. Real-time clock with battery backup and email alert for battery end of life.
 - 6. Time-Stamp:
 - A) Represent date and time
 - B) In UTC time or offset from a specified UTC time
 - C) Resolution: Minimum 1 second
 - 7. Ability to export all stored trend data to comma separated value (.csv) or Microsoft Excel format for importing into spreadsheets. Time-stamps to be exported as a single field with a numeric (non-text) value in local time.
 - 8. Published application programming interface (API) allowing data to be retrieved from the meter via non-proprietary means, such as JavaScript Object Notation (JSON).
 - 9. Built-in trending and data storage:
 - A) years of consumption data (kWh) at 1 minute intervals with time-stamp; and
 - B) 10 years of consumption data (kWh) at 1 hour intervals with time-stamp.
 - C) Stored in non-volatile memory.
 - 10. No special software required to set up meter or access data.
 - 11. Security:
 - A) Unrestricted access to data and graphics over the Region's network.
 - B) Password protection for access to setup, changing settings/parameters and deleting data.

12. Ability to measure, store and trend the following data complete with time-stamp:

- A) Accumulated energy per phase (kiloWatts per hour)
- B) Accumulated total energy (kWh)
- C) Active power per phase (kW)
- D) Active total power (kW)
- E) RMS voltage per phase
- F) RMS current per phase
- G) Power factor per phase
- H) Total power factor.
- I) Line frequency

13. Acceptable product: z3 Controls Inc. NetMeter or equivalent

Current Transformers

- 14. Compatible with electricity meter input without the use of transformers or other devices.
- 15. Linear accuracy +/-1% of reading.
- 16. Accuracy at 10% to 130% of rated current.
- 17. Unburdened current transformers shall not be permitted.
- 18. Acceptable product: Magnelab, Inc. SCT series or equivalent.

Data Cabling

- 19. Cat 5e or Cat 6 Unshielded Twisted Pair (UTP)
- 20. Colour: Green

PART 2 PRODUCTS

2.0 ENERGY METER & SUB METER

- 1. Meter to be supplied and installed by electrical contractor as shown on the drawings.
- 2. Meter to be supplied complete with pulse output.
- 3. Meters must be BACnet listed.
- 4. Manufacturer's technician shall be on site for the startup, to be included with meter supply

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- 1. Optimize electrical distribution to allow reduction in number of meters by grouping similar/like end use loads.
- 2. Install meter in a painted, hinged NEMA 1 (or better) enclosure complete with modular terminal blocks, finger safe fuse holders, fuses and power supply. Label front of enclosure with meter name, IP address and load(s) measured.
- 3. Provide disconnect at panel board for voltage reference.
- 4. All communication cables to be continuous. No splicing is allowed.
- 5. Affix York Region Property Services Branch Asset Identification tag (to be provided by the Region) to meter prior to installation.
- 6. Sensor and network configuration to be done in consultation with the Region's Property Services Branch.
- 7. Connect meter to the Region's Infrastructure Technology network.
- 8. Commission meter:

- 1. Ensure latest available firmware version is installed in meter.

-
2. Obtain Network information from York Region project manager and program into meter, including IP address, subnet mask, default gateway, primary and secondary DNS addresses.
 3. Set meter clock to current local time.
 4. Set up email alerts as specified and/or requested by the Region's project manager.
 5. Set up trend logging as specified and/or requested by the Region's project manager.
 6. Set default homepage to display real-time demand graphs and consumption statistics.
 7. Verify CT rating is correctly entered in meter setup.
 8. Confirm each voltage and current reading displayed on meter software using voltmeter and clamp-on ammeter.
 9. Verify CT's are wired to corresponding voltage reference and that CT's are installed in correct orientation.
 10. Verify meter information is viewable through a web browser on a device on the Region's network.
 11. Complete and submit Energy Meter Installation/Startup Verification Form
 12. Provide training on meter software use to Region staff including Facilities Operations and Maintenance, and Corporate Energy Services.
 13. Provide meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals and recommended meter recalibration interval(s).

END OF SECTION

1. GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Conform to General Requirements, Division 1 and Instructions to Bidders.

1.2 REFERENCES

- .1 Comply with Division 1, General Requirements, Instructions to Bidders and all documents referred to therein, and to Section 26 00 00, Electrical General Requirements.

1.3 SCOPE OF WORK

- .1 Supply all labour, tools, service and equipment and provide all the materials required to complete the electrical work specified in Division 26.

1.4 SHOP DRAWINGS

- .1 Shop drawings need not be submitted for standard manufactured items and materials provided they are as specified in the Contract Documents.

1.5 SUBMITTALS

- .1 Submit the following to the Consultant for review:
 - 1. A sample of each proposed type of access door and three (3) prints of reflected ceiling plan drawings showing proposed ceiling access door locations;
 - 2. Location drawings for all required sleeves and formed openings in poured concrete construction.
 - 3. Location drawings for all required openings. These locations must be reviewed and accepted by Consultant prior to the contractor drilling or core drilling.
 - 4. A sample of lamicoid nameplates and list of proposed nameplate legends.
 - 5. Samples of wiring devices and cover plates.

1.6 QUALITY ASSURANCE

- .1 All components shall be C.S.A. and/or U.L.C approved listed and labelled.

2. PRODUCTS

2.1 CONDUIT AND RACEWAYS

- .1 Conduits and Fittings
 - 1. Rigid Galvanized Steel Conduit
 - a. To CAN/CSA C22.2 NO.45-M
 - b. Rigid thickwall galvanized steel threaded conduit
 - 2. EMT
 - a. To CSA C22.2 NO.83-M
 - b. EMT galvanized cold rolled steel tubing
 - 3. Liquid Tight Flexible Steel Conduit Fittings
 - a. To CSA 22.2 No. 56.
 - b. Liquid-tight flexible steel conduit with PVC cover.

- c. Watertight connectors with nylon insulated throat.
- 4. Rigid PVC Conduit
 - a. To CSA C22.2 No. 211.2-M
 - b. Rigid PVC conduit
- 5. Non-Metallic Flexible Conduit
 - a. Non-metallic extra flexible PVC conduit
- 6. Surface Metallic Raceway (SMR)
 - a. Surface metallic raceway to CSA 22.2 No 62
- 7. Rigid Steel Conduit Fittings
 - a. To CAN/CSA C22.2 No. 18
 - b. Galvanized or polymer coated cast steel fittings
 - c. Expansion fittings, watertight with integral bonding jumper suitable for linear expansion and 19 mm³/₄" deflection in all directions
 - d. Sealing condulets for hazardous areas
 - e. Corrosive resistant coated cast steel fittings for corrosive resistant conduit
- 8. Rigid PVC Conduit Fittings
 - a. To CSA C22.2 No. 85-M
 - b. Rigid PVC fittings of same manufacture as rigid PVC conduit
- 9. Liquid Tight Flexible Steel Conduit Fittings
 - a. Watertight connectors with nylon insulated throat
- 10. EMT Fittings
 - a. Compression type, steel
 - i. Gland compression connectors with insulated throats
 - ii. Compression couplings
- 11. Set screw type, steel, concrete-tight
 - a. Connectors with insulated throats
 - b. Couplings
- 12. Minimum size conduit will be 21mm diameter.
- 13. All conduit shall contain a ground conductor.
- 14. All conduit must have adequate support systems complete with fittings as noted in the Contract Documents, outlet boxes, junction boxes, sealing fittings and drains as indicated or as required. Provide hot dipped galvanized steel beam clamps, hot dipped galvanized steel channel type supports where required. Provide six (6) mm threaded galvanized steel rods to support suspended channels and provide all necessary galvanized steel spring loaded bolts, nuts, washers and lock washers. Support systems shall be Thomas & Betts Superstrut or equivalent.
- 15. Provide all conduit, fittings and ducts necessary to complete the distribution of all power, lighting and control conductors to electrical equipment specified under the corresponding Section. Include that necessary for connecting to mechanical heating and ventilating equipment, also equipment specified under other Divisions.
- 16. Fasten conduit with malleable PVC coated galvanized steel two-hole straps at intervals to suit code requirements and job conditions.

2.2 FASTENINGS, SUPPORTS AND SLEEVES

- .1 Galvanized steel, size and load rating to suit application.
- .2 One hole steel straps to secure surface mounted conduits or surface mounted cables 50 mm dia. and smaller. Two hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Channel type supports for two or more conduits.
- .5 6 mm minimum dia. threaded rods to support suspended channels.
- .6 6 mm minimum dia. U-bolts.
- .7 Sleeves - schedule 40 steel pipe minimum I.D. 13 mm larger than outside diameter
- .8 . of conduit or cable passing through.
- .9 Acceptable Manufacturers: Burndy, Electrovert, Unistrut or equivalent.

2.3 JUNCTION BOXES

- .1 Code gauge (galvanized) sheet steel EEMAC Type 1 size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminals and mounting channels.
- .2 Screw-on sheet steel covers to match enclosure for surface mounting boxes.
- .3 Covers with 25 mm minimum extension around for flush-mounted junction boxes.

2.4 CONDUIT BOXES - GENERAL

- .1 Size boxes in accordance with latest edition of Electrical Safety Authority (ESA) Ontario Electrical Safety Code.
- .2 Code gauge, galvanized pressed steel for EMT.
- .3 Galvanized cast or pressed steel, for rigid thickwall threaded conduit.
- .4 Corrosive resistant coated: cast boxes for corrosive resistant coated rigid steel conduit with same finish as conduit.
- .5 200 mm square or larger outlet boxes as required for special devices.
- .6 Gang boxes where wiring devices are grouped except in classified hazardous areas.
- .7 Blank cover plates for boxes without wiring devices.
- .8 50 mm x 100 mm outlet boxes for devices, ganged for grouped devices, barriers where required by code.
- .9 Rigid PVC boxes for rigid PVC conduit.

2.5 PULL BOXES

- .1 Code gauge galvanized sheet steel welded construction, EEMAC Type 1.
- .2 Screw-on galvanized sheet steel covers for surface mounting boxes.
- .3 Covers with 25 mm minimum extension around, for flush mounted pull boxes.

2.6 OUTLET BOXES - SHEET STEEL

- .1 Pressed steel single and multi-gang flush device boxes for flush installation, minimum size 100 mm x 50 mm x 38 mm. 100 mm square outlet boxes where more than 1 conduit enters 1 side, with extension rings as required.
- .2 100 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3 119 mm square outlet boxes with extension and plaster rings as necessary for flush mounting devices in gypsum board, plaster or panelled walls.

2.7 MASONRY BOXES

- .1 Pressed steel masonry single and multi-gang boxes for devices flush mounted in exposed masonry walls.

2.8 CONCRETE BOXES

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

2.9 RIGID CONDUIT BOXES

- .1 Zinc electroplate and polymer enamelled cast FS boxes with factory-threaded hubs and mounting feet for surface mounted switches and receptacles, with gasketed coverplate for exterior work and wet areas.

2.10 OUTLET BOXES - FITTINGS

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

2.11 SURFACE METALLIC RACEWAY

- .1 Surface metallic raceway system for branch circuit and data/control network in finished areas. Surface raceway system shall consist of raceway bases, covers, appropriate fittings and device mounting plates necessary for a complete installation.
- .2 Configuration: Raceways shall be one- or two-piece design with base and snap-on cover. Provide raceways from a company which can provide custom sizes if required. Raceway covers shall be available in tamper-resistant form with screws on access plates and covers of fittings, but not on standard cover lengths.
- .3 Fittings: Fittings shall include flat elbows, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable. Where required, provide tamper-resistant form matching the size of the accompanying raceway base. Provide full capacity corner elbows and tee fittings to maintain a controlled 2 inch cable bend radius,
- .4 Device Brackets and Plates: Provide in sizes to match the raceway width and with mounting holes located to ensure proper mounting of devices.
- .5 Two-piece system of galvanized steel consisting of a base and snap-on cover. Acceptable Product: Wiremold 2000 Series Two-Piece Single-Channel Metal Raceway by Legrand/Wiremold or equivalent. Construction: 0.040 inch (1 mm) metal thickness; 1-9/32 inches (33 mm) wide by 3/4 inch (19 mm) deep; downward facing devices, bend radius control fittings. Finish: Manufacturer's standard Ivory, Gray or custom color as selected.
- .6 Acceptable alternate manufactures include:
 - 1. Hubbell: Base Trak
 - 2. Panduit: Pan-Way

2.12 BRANCH CIRCUIT CONDUCTORS

- .1 Conductors
 - 1. ASTM Class B, soft drawn, electrolytic copper
 - 2. Stranded
- .2 Insulation
 - 1. CSA type RW90 XLPE (-40°C)
 - a. Heat and moisture resistant

- b. Low temperature, chemically cross-linked thermosetting polyethylene material
 - c. 600V rated
 - d. For maximum 90°C conductor temperature
 - e. For installation at minimum -40°C temperature
 - f. To CSA C22.2 No. 38
 - 2. CSA type RWU90 XLPE (-40°C):
 - a. Heat and moisture resistant
 - b. Low temperature, chemically cross-linked thermosetting polyethylene material
 - c. 1000V rated
 - d. For maximum 90°C conductor temperature
 - e. For installation at minimum -40°C
 - f. To CSA C22.2 No. 38
 - 3. CSA type T90 NYLON (-10°C):
 - a. Heat resistant
 - b. Flame retardant
 - c. Thermoplastic PVC material with extruded nylon cover
 - d. 600V rated
 - e. For maximum 90°C conductor temperature dry and 75°C in wet locations
 - f. For installation at minimum -10°C
 - g. To CSA C22.2 No. 75-M
- .3 CSA Type AC90 XLPE (-40°C)
 - 1. Conductors
 - a. ASTM Class B, soft drawn, electrolytic copper
 - b. Solid for sizes #10 AWG and smaller
 - c. Stranded for sizes #8 AWG and larger
 - 2. Insulation
 - a. Heat and moisture resistant
 - b. Low temperature, chemically cross-linked thermosetting polyethylene material
 - c. 600V rated for sizes #10 AWG and smaller
 - d. 1000V rated for sizes #8 AWG and larger
 - e. For maximum 90°C conductor temperature
 - f. For installation at minimum -40°C temperature
 - g. To CSA C22.2 No. 38
 - 3. Construction
 - a. 2, 3 or 4 insulated conductors
 - b. Bare ground conductor
 - c. Overall interlocking aluminum armour
 - d. To CSA C22.2 No. 51
- .4 Branch circuit conductors up to and including #12 AWG shall be solid. Branch circuit conductors in sizes larger than #12 AWG shall be stranded. All branch circuit conductors shall be constructed of 90% conductive copper, unless otherwise noted, and shall be approved for 600 volts.
- .5 Electric service, distribution and special conductors are specified in this Section and/or on the drawings.

2.14 FIRE ALARM CONDUCTORS

- .1 Color coded No., 18 AWG twisted pairs, shielded FAS105, FT4, ULC listed meeting specification C22.2 No.208

2.15 WIRE AND CABLE CONNECTORS

- .1 Copper compression type wire and cable terminations for #8 AWG and larger

conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.

1. Acceptable Manufacturers: Thomas & Betts series 54000, Ideal Powr-Connect, Burndy Hylug or equivalent.
- .2 Twist type splicing connectors, copper, sized to suit, with nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.
 1. Acceptable Manufacturers: Thomas & Betts spring type, Ideal Twister, Marr Marrette or equivalent.
- .3 Conductor compression splice for #10 AWG or smaller.
 1. Acceptable Manufacturers: Thomas & Betts STA-Kon series, Ideal Splices, Burndy or equivalent

2.16 HEAT SHRINKABLE TUBING INSULATION, HEAVY WALL

- .1 Acceptable Manufacturers: Thomas & Betts, Shrink-Kon series, Ideal Thermo-Shrink, TS-46, Raychem tubing WCSM, 3M cable sleeve ITCSN or equivalent.

2.17 WIRING DEVICES - SWITCHES

- .1 Specification grade, general purpose AC switches, manual toggle operated, ivory color, 15A or 20A, 120V, single pole, double pole, three-way, four-way switches as required.
- .2 Acceptable materials:
 1. Single pole: Hubbell - HBL1201 Series or equivalent
 2. Three way: Hubbell - HBL1203 Series or equivalent
 3. Four way: Hubbell - HBL1204 Series or equivalent
 4. Keyed: Hubbell - HBL1221 Series or equivalent complete with 2 keys per switch
 5. (Keys): Hubbell - HBL1209 or equivalent
 6. Motor rated: Hubbell - HBL1221PL c/w pilot light (20A) or equivalent
- .3 Acceptable alternate manufactures include:
 1. Pass & Seymour
 2. Leviton
 3. Arrow Hart
 4. Or equivalent

2.18 WIRING DEVICES - RECEPTACLES

- .1 Standard 15 amp. 125 volt duplex receptacles generally shall be Specification grade Pass & Seymour Cat. No. 26252-WH, CSA #5-15R white finish or equivalent.
- .2 Standard Duplex receptacles indicated to have 'split-feed' shall be two-circuit type wired and connected to a 2 pole common trip circuit breaker in associated panelboard. Orientation of common circuit shall be similar throughout project.
- .3 Special purpose receptacles as noted on the drawings shall be Hubbell Conforming to CSA configurations (Table 46 and Table 47 of Canadian Electrical Code) for non-locking and locking receptacles. Provide attachment cap for each special purpose receptacle.
- .4 Receptacles with integral ground fault interrupter shall be Hubbell No. GF-5262 with matching thermoplastic faceplate.
- .5 Standard T-slot duplex receptacle shall be specification grade 26252-WH. (20A rated – suitable for 15A and 20A rated plug).
- .6 Isolated ground receptacles shall be Pass & Seymour IG26262W or equivalent.
- .7 Receptacles: specification grade suitable for back and side wiring, complete with grounding terminal, colour as required for type of area for straight blade devices and black colour for twist lock devices.

- .8 Receptacles of one manufacturer.
- .9 Acceptable Manufacturers:
 - 1. Pass & Seymour
 - 2. Leviton
 - 3. Arrow Hart
 - 4. Or equivalent

2.19 WIRING DEVICES - COVER PLATES

- .1 Stainless steel Type 302 alloy, vertically brushed, 1mm (1/32") thick cover plates.
- .2 Pressed steel, galvanized.
- .3 Cast covers for cast boxes with gaskets.
- .4 Cover plates of same manufacture as devices.
- .5 Submit samples of each device and cover plate to Consultant for approval. All devices must be approved prior to installation.
- .6 Weatherproof covers shall be while-in-use type polycarbonate body, cover and plates, conform to NEMA3R. Hubbell # WP826MP or equivalent.

2.20 SLEEVES

- .1 In concrete slabs, except as noted below, sleeves shall be #24 gauge galvanized steel or factory fabricated plastic sleeves, each with an integral flange to secure the sleeve to form work construction.
- .2 In waterproof concrete slabs and in other slabs where waterproof sleeves are required sleeves shall be Schedule 40 mild steel galvanized.

2.21 ESCUTCHEON PLATES

- .1 One-piece chrome plated steel sized to completely cover sleeves and complete with set screws to secure the plates to the conduit. Split plates will not be acceptable.

2.22 INSERTS, BEAM CLAMPS FASTENERS, EQUIPMENT HANGERS AND SUPPORTS

- .1 Inserts for concrete formwork shall be Crane Canada type, #4-M Unistrut, or equivalent cast iron inserts, multiple type where required.
- .2 Inserts for precast concrete and existing concrete shall be lead cinch anchors of "WEJ-IT" or self-drilling "STARR" or "PHILLIPS" or equivalent anchors.
- .3 Beam clamps for hanging and support to structural steel shall be Crane Canada Ltd., or equivalent.

2.23 ACCESS DOORS

- .1 Minimum #12 gauge prime coat painted bonderized steel flush access doors, each complete with a heavy frame and anchor, heavy duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing provisions to suit the particular construction in which it is installed. Access door sizes shall suit the concealed work for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc., shall be U.L.C. listed and labelled and of a rating to maintain the fire separation integrity.
- .2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.
- .3 Access doors shall be, wherever possible, of a standard size, for all applications. Confirm exact dimensions with the Consultant, prior to ordering.
- .4 Submit a sample of each proposed type of access door to the Consultant for approval.

2.24 WATER RESISTANT PROTECTION

- .1 Where the area is sprinklered and electrical distribution equipment is located in sprinklered areas, enclosures shall be louvred and gasketed and provided with water-tight roof assemblies with overhanging drip shields. The equipment shall be fabricated by the manufacturer in such a way as to prevent sprinkler fluid from entering the equipment and/or interfering with its operation as per the requirements of C.S.A. C22.1 Rule 26-006.
- .2 Weatherproof equipment where noted in the Contract Documents and/or Drawings shall have EEMAC4X enclosures in accordance with the requirements of C.S.A. C22.2 No. 94 Standard.

2.25 PLYWOOD BACKBOARDS

- .1 Plywood backboards, good one side, 4' x 8' x 3/4" fire rated type, unless indicated otherwise. Treat with primer and two coats of fire retardant paint.
- .2 Mount plywood on vertical strapping, on 40 mm centres to provide 10 mm clearance between wall and rear of plywood. Treat strapping similar to plywood.

2.26 FINISH

- .1 Equipment enclosure finish: baked grey enamel, ANSI 49 or ANSI 61.

2.27 PANELBOARDS

- .1 Panelboards as scheduled, shall comprise "Branch" panelboards, with fixed bolted connection thermal-magnetic, quick-make, quick-break, 40°C, calibrated ULC rated 'SWD' switching duty, molded-case circuit breaker branches. "Plug-in" breakers are not acceptable. Multipole breakers shall be common trip type.
- .2 Panelboards shall include the following features:
 1. Flush or surface trim as noted in the Contract Documents.
 2. Concealed hinges.
 3. Combination catch and lock semi flush tumbler type - all keyed alike.
 4. Adjustable self-positioning trims.
 5. Plain trims not displaying any names or Symbols. "Vault" type handles shall not be used except in unfinished areas.
 6. Typed schedules of circuits indicating equipment and area controlled on the backs of panel doors, in a steel trim pocket, covered with transparent non-inflammable plastic.
 7. Insulated neutral block.
 8. Supplementary ground block.
 9. Copper Bus.
 10. Isolated ground bar, as noted.
 11. Surge-suppression system, as noted.
 12. Sprinklerproof design
- .3 Power and Distribution type panelboards shall be breaker type, as scheduled on the Drawings.
- .4 Fusible switch type panelboards shall be complete with suitable fuses as specified under "2.29 Fuses".
- .5 Unless noted otherwise in the Contract Documents, panelboards with main breakers or remote controlled switches shall be provided with an indicating pilot lamp flush mounted in top of face trim which shall be connected to a 15 amp. circuit in the panelboard which shall be locked on and shall serve to indicate when the main breaker is in the closed position. Pilot lamp units shall be LED type or other types approved by the Consultant designed to provide maximum lamp life. Provide

lamacoid nameplate to identify main breaker

- .6 Panelboards of the types scheduled shall comprise the following:

Type 1

Branch panelboards circuit breaker type, 120/208 volt, 3 phase, 4 wire mains, minimum interrupting rating of 14,000 amps. RMS asymmetrical at 120 volts.

Type 2

Power distribution panelboard (CDP), circuit breaker type 120/208 volt, 3 phase, 4 wire mains, minimum interrupting rating of 35,000A, RMS symmetrical at 208 volt. Refer to panel schedules/riser diagram in the Contract Documents for IC rating different than the minimum.

- .7 Interrupting capacity indicated for panels is minimum rating. The rating shall be increased as required to suit Coordination Study at no extra cost. A Series Rated System is acceptable if it meets all CSA and approvals for short circuit current protection.

- .8 Acceptable Manufacturers are:

1. Cutler-Hammer
2. Square 'D'
3. Siemens
4. GE
5. Or equivalent

2.28 SWITCHES

- .1 Provide fusible and non-fusible switches, NEMA Type 'HD' with quick-make, quick-break contacts, horsepower-rated where required, to match the motor protected. Provide holders to accept specified fuses. Switches to include mechanical cover interlocks and line side Barriers.
- .2 Where applicable and available, switches shall be CSA "Approved For High Service Factor".
- .3 Provide safety disconnect switches adjacent to motors and other equipment when required by regulations.
- .4 Acceptable Manufacturers are:
Square 'D'
Cutler-Hammer
Siemens
Or equivalent

2.29 FUSES

- .1 Provide fuse holders in fusible equipment with a complete set of proper size Form 1, HRC Nema J or L current limiting fuses. Fusible equipment so provided shall be adapted to reject CSA Standard C22.2 No. 59 fuses. Fuses shall be of one manufacturer throughout.
- .2 Provide one complete set of spare fuses for each rating and type used, unless otherwise scheduled.
- .3 Fuses for motor circuits shall be Class J time delay, selected for motor protection as recommended by manufacturer.
- .4 Apply Thomas & Betts "Kopr/Shield" or equivalent conductive anti-seize compound to all fuse ferrules and holders.
- .5 Acceptable Manufacturers are:
Bussman Limitron

English Electric
Federal Pioneer Electric - "Econolim" Gould – Shawmut
Or equivalent

3. EXECUTION

3.1 GENERAL CONDUIT AND CONDUCTOR INSTALLATION REQUIREMENTS

- .1 Install conduit and conductors concealed in all finished areas, and concealed to the degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished area such as Electrical Rooms and Mechanical Rooms, unless otherwise noted on the Drawings or specified in the Contract Documents. Refer to and examine the architectural Drawings and room finish schedules in the Drawings to determine finished, partially finished and unfinished areas of the building.
- .2 Arrange exposed conduit and/or conductors to avoid interference with other work and parallel to the building lines, where horizontal conduits and/or conductors are exposed, install as high as possible. Do not install conduit and/or conductors within 150mm of flue or heating pipes or equipment.

3.2 CONDUIT AND EMT - GENERAL

- .1 Run parallel or perpendicular to building lines.
- .2 Group raceways wherever possible. Support on channels.
- .3 Install expansion joints as required.
- .4 Run raceways in web portion of structural steel columns and beams.
- .5 Do not drill structural members to pass through conduit.
- .6 Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.
- .7 Use metallic raceway where temperatures exceed 75°C or where enclosed in thermal insulation.
- .8 All conduits to contain insulated green ground wire.
- .9 Install 6 mm diameter nylon pull cord in empty raceways.
- .10 EMT and non-metallic conduits to contain insulated green ground wire.

3.3 CONDUIT AND FITTINGS

- .1 Minimum conduit sizes:
 1. Surface installation 21mm trade size conduit
 2. Embedded in concrete 27mm trade size conduit
 3. Directly buried 53mm trade size conduit
- .2 Conduit application and type:

Application	Type
.1 Corrosive Areas	Rigid Steel
.2 Hazardous Areas	Rigid Steel
.3 Outdoor Areas	Rigid Steel
.4 Embedded in Concrete,	Rigid
Other than Grade Slab	PVC
.5 In or Below Grade Slab	Rigid
	PVC
- .3 Exposed in unfinished areas up to 3m above finished floor, use rigid galvanized steel, above 3m use EMT.
- .4 Connection to motors and equipment subject to vibration use liquid tight flexible steel conduit.
- .5 Use field threads on rigid conduit of sufficient length to draw conduits up tight.
- .6 Do not bend coated steel conduit. Use elbows for deflections.

- .7 Do not install conduit in or under slab.
- .8 Use factory "ells" where 90° bends are required for 27mm trade size and larger conduits.
- .9 Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.
- .10 Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.
- .11 Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, and similar items, with standard galvanized plumber's pipe caps.
- .12 Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.
- .13 Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.
- .14 Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.
- .15 Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.
- .16 Mechanically bend steel conduit.
- .17 Install sealing condulets in conduits at hazardous area boundaries.

3.4 CONDUITS IN POURED CONCRETE

- .1 Locate conduits to suit reinforcing steel. Secure firmly to prevent movement during pour.
- .2 Clear each conduit with mandrel and brush before concrete sets.
- .3 Protect conduits from damage where they stub out of concrete.
- .4 Install sleeves where conduits pass through slab or wall.
- .5 Provide oversized sleeve before membrane is installed where conduits pass through waterproof membrane. Use cold mastic between sleeve and conduit.
- .6 Encase conduits completely in concrete; provide 50 mm (2") minimum concrete cover.
- .7 Replace with exposed conduit, any conduit run found to be obstructed after concrete sets.
- .8 Core-line conduit is not allowed and shall not be used.

3.5 EMT AND FITTINGS

- .1 Minimum EMT size: ¾ (21) trade size conduit.
- .2 EMT Application
 - 1. Exposed in unfinished areas, above truss level and for drops in column web to 3m above finished floor. Use rigid steel conduit below 3m.
 - 2. In block walls and stud partitions.

3.6 JUNCTION BOXES

- .1 Install junction boxes in inconspicuous but accessible locations. Secure to structure.
- .2 Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.
- .3 Only one voltage source is permitted in a junction box.
- .4 Install barriers to separate different auxiliary systems

3.7 PULL BOXES

- .1 Install pull boxes in inconspicuous but accessible locations. Secure to structure.
- .2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

- .3 Only one voltage source is permitted in a pull box.
- .4 Install barriers to separate different auxiliary systems.

3.8 OUTLET AND CONDUIT BOXES

- .1 Install conduit outlet boxes for conduit up to 32 mm and pull boxes for larger conduits.
- .2 Support boxes independently of connecting conduits.
- .3 Seal boxes during construction to prevent entry of debris, dust and dirt.
- .4 For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.
- .6 Install switches and other controls close to door lock or latch jambs and other openings, maintaining a minimum of 100 mm from trims of doors (except where installed in door frames of metal partitions) check door swings.
- .7 Install 100 mm square or octagonal outlet boxes for lighting fixture outlets.

3.9 MASONRY BOXES

- .1 In block walls use deep boxes to provide clear space around knockout for AC90 cable entry.

3.10 SURFACE METALLIC RACEWAY

- .1 Install surface metallic raceway in finished areas where conductors – both power and data/control cannot be run in the existing raceway. Raceway is to be supplied and installed complete with all necessary fittings, hardware and device brackets for configuration as noted on the drawings for a complete functional system.
- .2 Install conduit system, wiring and devices as indicated.
- .3 Ensure raceway is installed as per manufactures recommendations.
- .4 Where the raceway ends at a wall install end cap.

3.11 INSTALLATION OF BRANCH CIRCUIT CONDUCTORS

- .1 Install wiring in raceways unless noted otherwise in the Contract Documents.
- .2 Minimum wire sizes:
 - 1. Power and lighting -No. 12 AWG
 - 2. Control -No 16 AWG
- .3 Wire and cable application and type:
 - 1. Lighting branch circuit in classrooms use T90 nylon in existing raceway of surface metallic raceway.
 - 2. Lighting branch circuits in gymnasium use T90 in raceway surface mounted
 - 3. Lighting branch circuits in corridors use T90 in raceway surface mounted to ceiling boxes
 - 4. Receptacle branch circuits use T90 nylon.
 - 5. Ceiling boxes to luminaires in suspended ceiling use T90 nylon or AC90 cable.
 - 6. Branch circuits other than those covered above use RW90
 - 7. Equipment feeders and circuits use RW90
 - 8. Type AC90 cable length limitations:
 - a. Ceiling box to luminaire:
 - 1.2m maximum in non-accessible ceilings
 - 1.8m in accessible ceilings
 - b. Junction box to outlet: 3m maximum.
 - 9. Use lubricant when pulling wires into conduit. Ensure that wires are kept straight and are not twisted or abraded.
 - 10. Neatly secure exposed wire in apparatus enclosures with approved supports or ties.

11. Junctions of all conductors shall be done with Ideal Wing nut #450 Series for conductors from #14 AWG to #8 AWG.
12. For all conductors larger than #8 AWG junctions shall be done with Burndy Servit or approved equivalent connectors wrapped with 3 M #33 Scotch tape.
13. Maximum voltage drop for 24V DC wiring to remote lighting heads shall be 5% max at the farthest remote head. Size conductors accordingly.

3.12 CONNECTORS

- .1 Install compression terminations and splices in accordance with manufacturer's written instructions.
- .2 Make splices in junction boxes.
- .3 Make connections in lighting circuits with twist type splicing connectors.
- .4 Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.
- .5 Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.
- .6 Install fixture type connectors and tighten. Replace insulating cap.

3.13 INSTALLATION OF FIRE ALARM CONDUCTORS

- .1 Provide all required Fire Alarm conductors, generally as specified unless otherwise noted in the Contract Documents.
- .2 Install all Fire Alarm wiring in conduit, unless specifically otherwise noted in the Contract Documents.
- .3 Any special requirements pertaining to Fire Alarm wiring will be specified on the Drawings.

3.14 WIRING DEVICES – RECEPTACLES

- .1 Install receptacles vertically, use gang type outlet box where more than one receptacle is required in a location.
- .2 Where split receptacle has a portion switched, mount vertically and switch upper portion.
- .3 Coordinate with the requirements of architectural and interior design Drawings for final positioning and mounting heights of power and voice/data receptacles. Where there is disagreement between electrical and architectural Drawings, take the architectural Drawings as correct.
- .4 Maintain clearances between receptacle outlet boxes and millwork as stipulated on the Drawings.
- .5 Align and evenly space outlet boxes that are mounted as a group.

3.15 WIRING DEVICES - SWITCHES

- .1 Install single throw switches with handle in UP position when switch is closed.
- .2 Install switches in gang type outlet box when more than one switch is required in a location.
- .3 Mount toggle switches at height indicated in the Contract Documents.

3.16 WIRING DEVICES - 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 designed for flush outlet boxes on surface-mounted boxes.
- .4 Provide plaster ring where necessary.

3.18 INSTALLATION OF SLEEVES

- .1 Where conduits, raceways and conductors pass through structural poured concrete, install

- sleeves, to suit structural details.
- .2 Size sleeves, unless otherwise noted in the Contract Documents, to leave 12mm clearance around the conduit, raceway, etc. Pack and seal the void between the sleeves and the conduit, raceway, conductor etc. for the length of the sleeves as follows:
 1. Pack sleeves set in interior concrete slabs, masonry walls, fire rated partitions, etc., with a U.L.C. and C.S.A. approved fire barrier caulk equal to 3M #CP25.
 2. Pack sleeves set in exterior walls with lead wool or oakum and seal the ends of the sleeves water-tight with an approved non-hardening sealant compound. Co-ordinate with the waterproofing trade.
 3. Submit the concrete reinforcement detailed, at the proper times, drawings, indicating all required sleeves, recesses and formed openings in poured concrete work. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.
 4. Install sleeves of a water protecting type in the following locations:
 - a. In Mechanical Room floor slabs except where on grades.
 - b. In slabs over Mechanical, Fan, Electrical and Telephone equipment rooms or closets.
 - c. In all floors equipped with waterproof membranes.
 - d. In the roof.
 5. "Gang" type sleeving will be permitted only with the Consultant's approval. All sleeves locations in slabs shall be approved by structural Engineer.
 6. Terminate sleeves for work which will be exposed so that the sleeve is flush at both ends with the wall, partition or slab surface so that the sleeves may be completely covered by escutcheon plates.
 7. Openings for multiple conduit or conductor runs, etc., will be provided by the Contractor in accordance with the Division of Work which specifies the particular construction in which the opening is required. Carefully co- ordinate the opening locations with the requirements of the particular Division and ensure that openings are suitably sized and located. Seal the space between the opening and the conduit, conductors, etc., for the length of the opening as for sleeves above.
 8. Where a round or formed opening is required, where placement of a sleeve has been missed, or where provision of an opening has not been properly coordinated with the requirement of Division 03 - Concrete, neatly cut a suitably sized hole or opening using proper tools to the approval of the Consultant. Prior to cutting any such hole or openings, determine whether or not any reinforcing steel or services, are concealed behind the surface where the holes or openings are to be cut and be responsible for all costs incurred for correcting any damage caused to the structure or services due to cutting holes or openings without prior study and approval by the Consultant.

3.19 INSTALLATION OF ESCUTCHEON PLATES

- .1 Provide escutcheon plates over all exposed conduit passing through walls, floors, ceilings, partitions, furrings etc., in finished areas.

3.20 INSTALLATION OF INSERTS, BEAM CLAMPS, FASTENERS, HANGERS AND SUPPORTS

- .1 Install all inserts, beam clamps, fasteners, and similar hardware required for conduit, duct, raceway, conductor, etc., and equipment hanger and/or support materials in a manner that best suits structural details.
- .2 Accurately and properly set concrete inserts in the concrete framework.
- .3 For runs of three (3) or more conduits, raceways, or conductors in concrete formwork, use multiple type inserts used for the smallest conduit in the group.
- .4 Where inserts are required in precast concrete and in concrete work where concrete inserts have not been installed, drill a neat hole of the proper diameter

- and depth in the concrete and insert an anchor to accept the hanger rod, bolt, etc., or where concrete mass permits, use self-drilling concrete anchors.
- .5 Fasten hangers and support provisions to brick or masonry with expansion shields and machine bolts, or for light loads, use plugs, and screws.
 - .6 In cavity walls and/or ceilings use two (2) wing toggles and for heavy loads, provide steel anchor plates with two (2) or more toggles to spread the load.
 - .7 Provide beam clamps for attaching, hanging and/or support provisions to the Consultant, weld the hanging and support provisions to the structural steel.
 - .8 Explosive power actuated fasteners will not be permitted unless specific approval for their use has been obtained from the Consultant.
 - .9 Securely mount plywood backboards to structure or use independent mounting channels, secured to floor.

3.21 INSTALLATION OF ACCESS DOORS

- .1 Install access doors to give access to all junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair but which is concealed in inaccessible construction except as otherwise specified herein or on the drawings.
- .2 Before commencing installation of electrical work, prepare, on a set of reflected ceiling plans, complete layouts of all ceiling access door locations that will be required. Submit these layouts to the Consultant for approval and show the exact sizes and locations of such ceiling access doors. Locate access doors in walls and partitions to the Consultant's approval, and arrange electrical work to suit.
- .3 Access doors shall be supplied and installed by the Contractor according to the requirements of the Division of Work which specifies the particular type of construction in which the access doors are required. .
- .4 Access doors shall be, wherever possible, of a standard size, for all applications. Confirm exact dimensions with the Consultant, prior to ordering.
- .5 Submit a sample of each proposed type of access door to the Consultant for approval.

3.22 PAINTING AND FINISHES

- .1 Provide all painting and patching to match existing services as required.
- .2 All exposed electrical fittings, supports, hangers, frames conduit, racks, boxes, raceways and similar material and apparatus shall be galvanized or finished with corrosion resistant primer ready to accept paint. Take special care when priming work exposed to the elements or in wet areas to prevent rust or corrosion from damaging adjacent surfaces.
- .3 Touch up and/or repaint any factory finished equipment that has been scratched or otherwise damaged during installations.
- .4 Provide for all patching and painting for all removals and as required. Painting shall be completed to the approval of the Consultant and Owner. Paint shall match adjacent surfaces. Include all costs in the Contract Price.
- .5 Where cutting, patching, fire stopping and construction involves painted surfaces these must be painted to match the surrounding surfaces or as directed by Consultant.

3.23 STANDARD IDENTIFICATION

- .1 Identify electrical work as specified below.
- .2 For each piece of electrical equipment from the existing panel board up to and including battery packs and for any other piece of equipment where specified in this Section, provide engraved lamacoid identification nameplates. Nameplates shall generally be lamacoid black with white letters and with bevelled edges, secured to apparatus with stainless steel screws. Warning signs, if and when required, shall be red with white lettering.
- .3 Exact nameplate wording and sizes must be approved by and confirmed by the Consultant prior to manufacture.

- .4 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting the outside of the covers. Paint colours shall be in accordance with the following schedule in 3.23.5 below:
- .5 Colour code conductors throughout to identify phases, neutrals and grounds by means of self-laminating coloured tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours shall be as follows:

.1	Phase A	-	Red
.2	Phase B	-	Black
.3	Phase C	-	Blue
.4	Ground	-	Green
.5	Neutral	-	White

3.24 CUTTING AND PATCHING

- .1 Inform other trades in time concerning required openings. In work already finished, cutting and patching shall be done by the trades installing the affected work at no cost to the owner. Obtain the approval of the Consultant, before doing any cutting.

3.25 PROVISIONS FOR SERVICES CROSSING BUILDING EXPANSION JOINT

- .1 Wherever services (conduit, cables, etc.) cross building expansion joints, install the services in such a manner to permit free movement without imposing additional stress or loading upon the support system, and to prevent excessive movement at joints and connections.

3.27 FIELD FABRICATED METAL WORK

- .1 Clean and prime paint field fabricated metal work.
- .2 After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.
- .3 Prime paint steel with 1 coat of CISC/CPMA 2.75 oil alkyd primer.
- .4 Prime paint aluminum as follows: wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply Glidden #Y-5229 or equivalent primer to 1.5 mils DFT.
- .5 For brass and bronze alloy materials, prepare as for aluminum but apply 1 coat of CAN/CGSB-1.40-M zinc chromate primer.

3.28 TESTS

- .1 Branch circuit balancing.
- .2 Connect all new branch power circuits to existing panel boards so as to balance the actual loads (Wattage) within 5%.

3.29 MOUNTING HEIGHTS

- .1 Mounting heights of outlets, top of outlet to finished floor, except for exposed masonry construction, shall generally be as follows:
- .2 Lighting Switches - 1200 mm
- .3 Receptacles - 400 mm above finished floor or 250 mm above counter top.
- .4 Television Outlets - 400 mm
- .5 Telephone/data Outlets - 400 mm
- .6 Panelboards - 2000 mm to top of trim for standard panels.
- .7 Install all fire alarm equipment/devices in accordance with CAN/ULC-S524 "Standard for the Installation of Fire Alarm Systems" latest edition, the manufacturer's instructions, Ontario Building Code, Underwriter's Laboratory of Canada, Electrical Safety Code, the

- Contract Documents and requirements of Local Authority Having Jurisdiction.
- .8 Refer to Architectural Drawings for exact location. Report to Consultant any discrepancies in the Contract Documents.

3.30 EXCAVATION & BACKFILL

- .1 Provide necessary excavating and backfilling inside and outside of the building required for work of this Division, except as modified below.
- .2 Keep excavations free from water, pump as necessary. Provide and maintain adequate heat, shoring, other necessary temporary protection.
- .3 Trench excavation shall be carried out in strict conformity with the Ontario *Occupational Health and Safety Act* O. Reg 213/91 Construction Projects.
- .4 Excavation for underground services shall be to required depths and dimension and shall be prepared as required, so that no portion of any conduit or duct bank, bears directly against any rock or other hard surface.
- .5 Remove and dispose of all surplus excavated material.
- .6 Backfill promptly after approval of work. Prevent damage to or displacement of walls, piping, conduits, waterproofing and other work.
- .7 For direct buried conduit and cable in all soiled conditions excavate to 150 mm (6") below and a minimum of 200 mm (8") to either side of the cable run. Fill back with a bedding of sand.
- .8 Where excavation is necessary in proximity to and below the level of any footings, provide a sleeve at the proximity line and back fill with 20 mPa concrete to the level of the highest adjacent established by the Architect.
- .9 Provide sleeves under all roads and paved areas.
- .10 Before backfilling, obtain approval. Remove all shoring during backfilling.
- .11 Backfill trenches within building, with clean sharp sand in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum one foot. Hand or machine compact the balance up to grade, using approved equipment.
- .12 Backfill trenches outside buildings, not under roads, parking lots, or traffic areas, up to a compacted level of 450 mm (18") above the duct bank with individual layers of material up to 150 mm (6") thick, hand compacted to a density of 95% Standard Proctor, using sand or granular 'A' gravel. Backfill the balance to 95% Standard Proctor, using industry-approved equipment.
- .13 Backfill all other trenches outside buildings with granular 'A' gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level; manual compaction up to 450 mm (18") and mechanical compaction, using approved equipment, for the balance.
- .14 Make good work where damaged by excavation and filling work of this Division. Repair any subsequent settlement of fill placed under this Division and pay all costs in replacement of other work damaged by such settlement and restoration.

3.31 SUPPORT FOR UNDERGROUND SERVICES

- .1 Provide suitable solid support to comply with requirements of authorities having jurisdiction, where solid, undisturbed earth stratum is not available for support of underground services. Minimum requirements where services pass through backfill or exterior foundation walls shall be 20 mPa concrete fill, full depth to undisturbed earth.
- .2 Reinforced concrete duct banks shall be keyed into sides of foundation walls. Extend and connect reinforcing steel of duct banks to reinforcing steel of foundation wall construction to prevent failure at the junction of the pipe support and wall.

3.32 CONCRETE WORK

- .1 Provide concrete work where required for work of the in accordance with applicable requirements specified in Division 03 - Concrete.

- .2 Electrical subcontractor shall provide all necessary forming and reinforcing required and as noted or detailed for outdoor luminaires, and Duct Bank.
- .3 Provide concrete bases where required for the work of this Division. Comply with applicable requirements specified in Division 03 - Concrete. Use 20 MPa concrete. Make exposed surface smooth finish, with suitable chamfer or radius on exposed external corners and edges. Concrete bases in direct contact with floor slab shall be dowelled into concrete floor slab with not less than four 13 mm (1/2") diameter steel rods which shall be connected to floor slab reinforcing steel.
- .4 Provide 100 mm (4") high housekeeping pads for all floor mounted electrical equipment, such as switchboard, generator, distribution panels and transformers, etc.

3.33 NAMEPLATES & SCHEDULES

- .1 Identify electrical equipment supplied under this Division with 3 mm thick black laminated plastic nameplate to indicate equipment controlled to provide instruction or warning. Fasten each plate with two chrome plated screws. Lettering shall be 6 mm high for small devices such as control stations and at least 13 mm high for all other equipment. Submit a list of proposed nameplates for approval before manufacture.
- .2 Provide panelboards with typewritten schedules identifying outlets and equipment controlled by each branch circuit including existing panels being changed. Protect schedules with non-flammable clear plastic.
- .3 Identify junction boxes, pull boxes, cover plates, conduits and the like, provided for future extension, indicating their function (e.g. power, fire alarm, communication).
- .4 Verify room names and numbers prior to listing on nameplates and schedules.

3.34 PANELBOARDS

- .1 Provide handle locking devices on circuit breakers feeding Plumbing, Heating, Ventilating equipment and controls and all auxiliary systems, time switches, and other devices as noted in the Contract Documents. Paint handles white, to permanently identify location and function. Provide 30 spare handle locking devices for future use.
- .2 Circuit numbers on Drawings do not necessarily correspond to the numbers on the lighting panels. Circuits sharing a common neutral shall not be connected to the same main. Panel circuit breakers which are used directly for the switching of lighting fixtures shall be grouped in consecutive numbers commencing at breaker number one.
- .3 Use "Panduit" lok-strap cable ties for panelboard branch wiring.3.34.4. Provide empty conduits from flush panelboards, and others as noted in the Contract Documents, terminating in accessible ceiling spaces, sized to accommodate spare and space breaker provisions. One 25 mm (1") conduit for each three spare breakers or spaces.

3.35 ELECTRIC WORK FOR OTHER DIVISIONS

- .1 Examine Architectural and Mechanical (Plumbing, Heating, Ventilating and Air Conditioning) Drawings and specifications to determine extent of electrical work in connection with these Divisions which is to be done under the work of the Electrical Division.
- .2 In general, all motor starters and associated controls for mechanical equipment will be supplied under that Division of the work which supplies the equipment, for installation and connection to both source and load under the work of the Electrical Division 16. Refer to the Mechanical Divisions 21, 22 and 23 Specifications, drawings, and schedules for the exact intent and extent of the work to be included in the Electrical Divisions 25, 26, 27, 28 and 29.
- .3 Co-ordinate the exact location and verify characteristics of electrical provisions for the work of the Mechanical Divisions 21, 22 and 23.
- .4 Coordinate locations of starters, motors and associated equipment with the work of the Divisions 21, 22 and 23 Mechanical Trade Sections to ensure proper location of equipment. The exact locations of conduit terminations at Mechanical units shall be determined from

- equipment manufactures' approved shop drawings. Conduits must be installed to enter only in the locations designated by equipment manufactures.
- .5 Provide safety switches required for disconnection of remotely controlled motors, and where required at motors by CEC regulations whether shown on the drawings or not. Where required at fan motors, they shall be concealed in the fan housing if possible.
 - .6 Provide for the 120 volt mechanical equipment where noted in the Contract Documents, all necessary wiring and connections including wiring and installation of starters, thermostats, aquastats, speed controllers and time switches controlling equipment.
 - .7 Where motor starters, switches and the like, are grouped together, a suitable 19 mm (3/4") thick plywood panelboard shall be provided to which all such equipment shall be secured. Provide all necessary angle iron supports for support of panelboard and paint entire assembly with two coats of fire retardant type enamel acceptable to Building Inspection Department.
 - .8 Provide weatherproof unfused safety disconnect switches, fastened to exterior of roof mounted units, to approval.
 - .9 Connect high temperature thermostats "Firestats" provided in ductwork by Mechanical subcontractor, to exhaust fan systems, to provide fan shutdown on activation.
 - .10 Refer to Equipment Schedule, in the Contract Documents, for further Details.
 - .11 Architectural Sections:
 - .12 In addition to the work shown, perform the following:
 1. Provide all wiring and connections for Owner's Equipment, noted in the Contract Documents.
 2. Provide power and empty conduit for door hardware, electric hold open devices, magnetic-locks, and similar items. as indicated in the hardware list in the door hardware schedule.

3.36 GROUNDING

- .1 Ground all electrical systems in accordance with provisions of the Ontario Electrical Safety Code.
- .2 Provide a grounding electrode in accordance with Section 10 of the Canadian Electrical Code.
- .3 Install grounding conductors to permit the shortest and most direct path from equipment to ground. Install grounding conductors in rigid galvanized conduit with both conductor and conduit bonded at both ends. Provide bonding jumpers with industry-approved clamps to maintain ground continuity of metallic raceway systems at all expansion joints.
- .4 Ground connections to grounding conductors shall be accessible for inspection and made with industry-approved solderless connectors bolted to the equipment of structure to be grounded. Clean contact surface prior to making connections to ensure proper metal to metal contact. Connections shall be of the type that grounds both conduit and conductor, and cap screws, bolts, nuts and washers shall be silicon bronze.
- .5 Provide copper ground bus 0.25" deep x 2" wide complete with insulated supports, fastenings and connectors. Install copper grounding bus mounted on insulated supports on wall of main electrical room. Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.
- .6 Provide all non-corroding accessories necessary for the grounding system of 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.
- .7 Testing
 1. Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Consultant and ESA.
 2. Perform tests before energizing electrical system.

3. Disconnect ground fault indicator during tests

END OF SECTION

1. GENERAL

1.1 RELATED INSTRUCTIONS

- .1 Refer to Section 26 00 00, Electrical General Requirements.

1.2 SCOPE

- .1 Work includes, but is not limited to:
 - 1. Secondary ductbank and secondary cables including termination from pole mounted transformer to service entrance switchboard. Terminal connectors shall be provided as per the Local Hydro Authority's requirements/standards.
 - 2. Grounding System.
 - 3. Supply and install a 1.25" rigid PVC conduit complete with fish wire from Service Entrance Board metering compartment to outdoor P-base Hydro meter cabinet (supplied by the Local Hydro Authority and installed by the electrical Subcontractor. Provide phone line to meter and coordinate on site with the Local Hydro Authority for the location of the meter enclosure prior to rough in.
 - 4. Obtaining approvals from, co-operation and scheduling the work with Supply and Inspection Authorities, before commencing work.
 - 5. Preparation of all necessary working drawings for submission to Inspection Authorities.

1.3 SYSTEM CO-ORDINATION & SHORT CIRCUIT STUDY

- .1 Characteristics of protective devices (relays, circuit breakers, fuses and the like) shall be selected to provide a coordinated fully-rated protective system; affording minimum fault-clearing times, and fault values.
- .2 Retain services of approved testing company to perform protective co-ordination study to establish optimum settings and selections for all protective devices.
- .3 Study shall be plotted on reproducible logarithmic paper (K&E #48-5257) illustrating:
 - 1. Study single line diagram, showing steady-state and transient values.
 - 2. Three phase bolted fault current, symmetrical and asymmetrical, and minimal arcing ground fault values.
 - 3. Time-current characteristics curves of all pertinent relays, breakers, fuses, etc. including Supply Authority's primary protective devices, for the complete project.
 - 4. Thermal damage curves for cable, transformers, motors and the like.
 - 5. Summation chart showing all ratings and settings referenced to the appropriate time-current characteristic curve.
- .4 Provide full scale transparencies for time-current characteristic curves of proposed devices.
- .5 Submit study for approval by the Consultant. Make all necessary subsequent changes to form "as-built" document.
- .6 Provide system coordination and short circuit study for complete high voltage and 120/208V power system

1.4 ARC FLASH PROTECTION

- .1 Retain the services of an industry-approved testing company to perform arc flash hazard study and calculation for all switchboards, panel boards, transformer, panels, control panels, MCC, meters, disconnect switches, breakers, etc, that require examination, adjustment, servicing, or maintenance while energized.

- .2 The study and calculation shall meet IEEE 1584-2002, Guide for Performing Arc-Flash Hazard Calculations.
- .3 Provide arc flash report to include the following, but not limited to:
 1. Results of the study and calculation.
 2. Detailed hazard/risk category (0 to 5).
 3. Voltage shock hazard, incident current and energy.
 4. Flash protection boundary and shock approach boundaries.
 5. The protection plan including safe work procedures, preventive maintenance programs, personal protective equipment, etc. The protection plan shall meet CSA Z462-08, workplace electrical safety.
- .4 Based on the arc flash report, provide required labels state the existence of arc flash hazard and the corrective action to take. The labels must meet ANSI Z535.4-2002, product Safety signs and Labels.

1.5 INSPECTION & TESTING

- .1 Systems, equipment and all major items of material shall be tested to the satisfaction of the Consultant, and as required to establish compliance with plans and specifications, and with the requirements for the Supply and Inspection Authorities.
- .2 Faulty and defective equipment shall be replaced with new materials Conductors which are found to be shorted or grounded, or to have less than proper insulation resistance, shall be replaced with new conductors.
- .3 Tests shall include but are not limited to the following:
 1. Test of power cables shall include megger tests to establish proper insulation resistance, and phase-to-ground resistance of cables.
 2. of all adjustable electrical protective devices of switchgear to establish calibration and operation in accordance with specifications and approved co-ordination curves.
 3. Visual examination of switchgear to determine adherence to allowable manufacturing tolerance and compliance with manufacturer's recommended installation requirements.
 4. Proper functioning of all systems.
 5. Polarity tests - to establish proper polarity connections to all sockets and receptacles.
 6. Calibration setting, and test-tripping, of all protective relays and devices, using "Primary-injection" equipment, in accordance with approved co-ordination schedule.
 7. Test of all alarm devices and contacts.
 8. Test of system neutral to establish proper insulations resistance and isolation of neutral from ground except for required ground connection at service
 9. Inspection after system is energized shall include infrared thermographic examination of current carrying parts in switchgear, transformers, and at ducts. The Contractor shall cooperate with inspection personnel, open all equipment enclosures to permit inspection, and make good defective conditions.
- .4 Testing Company
 1. Retain the services of an independent testing company, to the Consultant's approval to perform the above tests.
 2. The testing company shall submit test results directly to the Consultant.
 3. Include copy of tests in Maintenance and Operating Manual.

.5 Certification of Tests

1. When work is complete, submit three copies of test results and a signed statement listing all tests that have been performed as required by specifications and manufacturer's instructions.

2. **PRODUCTS**

2.1 **SERVICE ENTRANCE SWITCHBOARD**

- .1 Provide metal enclosed 120/208 volt switchboard as arranged on the Drawings and further described herein, and detailed on the Drawings.
- .2 The switchboard shall comprise an indoor, metal enclosed free standing assembly employing breakers manufactured by Federal Pioneer or equal.
- .3 Assembly shall be factory assembled CEMA Type 2 "Sprinkler Proof" construction, and constructed in accordance with applicable CEMA and AIEE Standards. The equipment design shall be CSA approved. Note that all other panels and equipment in Electrical Rooms shall be "Sprinkler Proof" as noted in the Contract Documents.
- .4 Bus and connections shall be copper, supported and braced to withstand short-circuit stresses in excess of main breaker rating (50 KA SYM minimum).
- .5 Structures shall consist of metal enclosed steel frame and front enclosures, which shall include separate compartments for each breaker and metering section. All joints of buses shall have tin-plated high pressure contacts and flame retardant bus supports.
- .6 A ground bus shall be provided bolted to each unit.
- .7 Provide bus extensions for connection to outgoing feeders and provide adequate space to suit connections to outgoing cables. Compression indent type terminals shall be used for all cable connections.
- .8 Provide suitable worded engraved plastic laminate nameplates for each device and compartment.
- .9 Provide all necessary fuses, fuse mounts, disconnect switches, small wiring, terminal blocks, and the like, as required for metering and relaying accessories as detailed.
- .10 The switchgear shall be completely assembled, wired and tested at the factory. After assembly, the complete switchgear shall be tested for operation under simulated service conditions to assure the accuracy of the wiring and functioning of the equipment.
- .11 The manufacturer shall provide necessary drawings prior to assembly of the equipment for approvals and provide final drawings upon completion of fabrication.
- .12 The entire structure shall be thoroughly cleaned and phosphated prior to application of the primary and finishing coats of paint.
- .13 Main 120/208 volt switchboard / Splitter - to contain generally as detailed on the Drawings and as follows:
 1. 200 ampere, 3 pole, 208 volt Main Bus - full capacity neutral with provisions for incoming bus and cables.
 2. Main breaker to comprise 200A/200AT amp fixed moulded case circuit breaker, 100% rated, solid state trip unit, for metered distribution. Interrupting rating shall be 50 KA-Symmetrical minimum.

3. Metering compartment for Supply Authority's transformers with hinged door complete with sealing and padlock provisions. Provide removable mounting pan within compartment for mounting of transformers. These provisions shall be submitted to and approved by the Supply Authority before manufacture.
4. Distribution Sections - Distribution Sections have 400 ampere main bus and full capacity neutral and circuit breakers with coordinated fault and trip ratings to suit main and distribution switches.
5. Auxiliary Customer Metering Compartments which shall include:
 - .1 Power Logic Digital Metering system capable of displaying voltage, current, KVA, KVAR, KW, PF, HZ, and the accumulated MWH, and KW demand. It shall be capable of continuously monitoring and storing minimum values of volts and PF and maximum values of amps., - KW-KVA-KVAR-KWS. All minimum/maximum values can be displayed. KYZ Pulse output to BMS. 1pulse=1kwh. Ethernet communications interface and all hardware/software. Field server RS232 to Ethernet Gateway and BACnet drivers for Ethernet and IP interface to BMS.
 - .2 All necessary instrument current and potential transformers and control protection devices.
6. The neutral conductor of the wiring system together with the conduit and service grounding system shall be bonded to the water service as detailed and in accordance with the Local Hydro Authority requirements.
7. All access to unmetered bus to be provided with bolted panels and provisions for sealing and padlocking.
8. Switchboard / Main Splitter shall be provided c/w 200 kA TVSS surge protection system.

3. EXECUTION

3.1 SECONDARY DUCT BANKS

- .1 Provide underground secondary duct bank as detailed to provide for installation of secondary cables. Construction details and exact location of terminations shall be verified on the site prior to installation commencing. Entire installation shall meet OESC requirements and local ESA Inspector's approval.
- .2 Provide warning tapes for secondary duct banks as per latest OESC code & bulletins.
- .3 Provide a secondary duct bank constructed to OESC approval comprising PVC Class 1 CSA approved ducts with minimum internal diameter of 104 mm (4 inches), buried to a depth as indicated on the Drawings to provide cover over the duct run. Ducts shall be laid parallel, spaced 152 mm (6") on centre horizontally and vertically, encased throughout their length in concrete, with a minimum cover of 76 mm (3") on all sides. The duct shall be on even grade, sloped not less than 76 mm (3") in 30 mm (100 feet). The duct bank enclosure shall be steel reinforced as detailed. Provide Bell ends for all ducts.
- .4 Provide in each duct a 5/16" (8 mm) polypropylene Draw Rope, to facilitate the cable installation.
- .5 The ducts shall be encased in a concrete envelope which shall be worked below and between ducts to provide a homogenous mass. Duct spacers shall be plastic to provide required spacing both horizontally and vertically. Minimum of two spacers per 3050 mm (10 ft.) length of duct shall be used.

3.2 GROUNDING

- .1 Provide a grounding system at the transformer and switchgear in accordance with OESC. Provide #2/0 AWG copper conductor connected to building ground system.
- .2 All work in connection with the pole mounted transformer shall be performed in strict accordance with regulations and the OESC. Obtain approval of all details before commencing work.

3.3 ELECTRICAL SERVICE

- .1 Provide complete electrical service as shown on the Drawings and as further described here.
- .2 The Local Hydro Authority will supply electrical service at 208 volt, 3 phase, 4 wire, 60 cycles.
- .3 Grounding service, equipment, feeders, and the like shall be performed in accordance with the Local Hydro Authority requirements.

The neutral conductor of the wiring system together with the conduit system and service equipment shall be bonded to the water service as near as practical to the service entrance. Confirm type of water service pipe system with Mechanical Division and provide grounding system in accordance with O.H.E.P.C. regulations.

Provide an "Artificial Grounding" system in accordance with Canadian Electric Code, Section 10-702 and Ontario Hydro Supplement. Location shall be to approval of the Supply & Inspection Authority requirements.

- .4 Install an outdoor P-base metering cabinet as per requirements and connected to switchboard with an empty 1-1/4" rigid conduit and telephone line all to approval of the Local Hydro Authority.

3.4 SECONDARY CABLES

- .1 Secondary cables c/w termination lugs (coordinate with the Local Hydro Authority for more information regarding termination lugs requirement at transformer secondary side and comply accordingly) shall be supplied and installed by the electrical Subcontractor.

3.5 HYDRO STANDARDS / REQUIREMENTS

- .1 Coordinate on site with the Local Hydro Authority representative for more information and details regarding hydro standards and requirement and exact scope of work prior to commencing the work and comply accordingly.

END OF SECTION

SECTION
SPECIFICATIONS: GENERATOR SET

1. Scope of Work

- 1.1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and the Drawings and specified herein.
- 1.2. Any and all exceptions to the published specifications shall be subject to the approval of the Consultant.
- 1.3. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, the Drawings, and specifications herein.
- 1.4. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
- 1.5. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.

2. General Requirements

- 2.1. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the Ontario Electrical Code and applicable local codes and regulations.
- 2.2. All equipment shall be new and of current production by a firm that manufactures the generator sets and controls, transfer switches, and switchgear, and assembles the generator sets as a complete and coordinated system. There will be one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

3. Submittal

- 3.1. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

4. Codes and Standards

- 4.1. The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
- 4.2. The generator set shall conform to the requirements of the following codes and standards:
 - 4.2.1. CSA C22.2, No. 14-M91 Industrial Control Equipment.
 - 4.2.2. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
 - 4.2.3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 - 4.2.4. IEC8528 part 4, Control Systems for Generator Sets.

- 4.2.5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
- 4.2.6. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- 4.2.7. CSA-C282-09 Emergency Electrical Power Supply for Buildings. The generator set shall meet all requirements of the specification including all alarms, shutdowns, and indications shown on Table-2 of the specification. The generator enclosure shall include dampers, heaters, emergency lighting, and a distribution panel in accordance with this specification.
- 4.2.8. CSA-149.1-10 Natural Gas and Propane Installation Code.

5. Testing

- 5.1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
- 5.2. **Design Prototype Tests.** Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - 5.2.1. Maximum power (kW).
 - 5.2.2. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - 5.2.3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
 - 5.2.4. Governor speed regulation under steady-state and transient conditions.
 - 5.2.5. Voltage regulation and generator transient response.
 - 5.2.6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - 5.2.7. Three-phase short circuit tests.
 - 5.2.8. Alternator cooling air flow.
 - 5.2.9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 - 5.2.10. Endurance testing.
- 5.3. **Final Production Tests.** Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - 5.3.1. Single-step load pickup
 - 5.3.2. Safety shutdown device testing
 - 5.3.3. Rated Power @ 0.8 PF
 - 5.3.4. Maximum power
 - 5.3.5. Upon request, a witness test, or a certified test record sent prior to shipment.
- 5.4. **Site Tests.** The manufacturer's distribution representative shall perform an installation check, start-up, and building load test. The Consultant, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
 - 5.4.1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present

and expected.

- 5.4.2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
- 5.4.3. Generator set start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
- 5.4.4. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

6. Warranty and Maintenance

- 6.1. The generator set shall include a standard one year warranty to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of start-up. Optional warranties shall be available upon request.
- 6.2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and function tests performed on all systems.

7. Equipment

- 7.1. The generator set shall be a Kohler model 50REZGB with a 4P7BX alternator or equivalent. It shall provide 50kW/62.5 kVA when operating at 120/208 volts, 60 Hz, .8 power factor. The generator set shall be capable of a Standby 130°C rating while operating in an ambient condition of less than or equal to 77° F and a maximum elevation of 656 feet above sea level.
- 7.2. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 135 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip i.e. engine, alternator, voltage regulator and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.
- 7.3. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

8. Engine

- 8.1. The minimum 305-cubic-inch displacement engine shall deliver a minimum of 89 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
 - 8.1.1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation. Engine speed shall be nominally 1800 rpm. Engines running at higher rpm's and featuring speed reduction gear drives are not acceptable.
 - 8.1.2. 12-volt positive-engagement solenoid shift-starting motor.
 - 8.1.3. 70-ampere automatic battery charging alternator with a solid-state voltage

regulation.

- 8.1.4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
- 8.1.5. Dry-type replaceable air cleaner elements for normal applications.
- 8.1.6. Engine-driven or electric fuel-transfer pump including fuel filter and electric solenoid fuel shutoff valve capable of lifting fuel.
- 8.2. The turbocharged engine shall be fueled by natural gas.
- 8.3. The engine shall have a minimum of 8 cylinders and be liquid-cooled by Unit Mounted Radiator 122°F/50°C.
- 8.4. The engine shall be EPA certified from the factory, and shall not require a site performance test.
- 8.5. Natural Gas fuel supply pressure, measured at the generator set fuel inlet downstream of any fuel system equipment accessories shall be within the operating range of 1.74-2.74 kPa (7.0-11.0 in. H₂O). Engines requiring higher gas pressures are not acceptable.

9. Alternator

- 9.1. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to Standby 130°C. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within $\pm 2.0\%$ at any constant load from 0% to 100% of rating. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
- 9.2. The alternator shall have a single maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- 9.3. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

10. Controller

10.1. Decision-Maker® 550 Controller

- 10.1.1. The generator set controller shall meet CSA-C282-09 requirements and shall include an integral alarm horn as required by NFPA.
- 10.1.2. The controller shall meet all alarms, shutdowns, and indication stipulated in Table 2 of the CSA-C282-09 specification.
- 10.1.3. The controller shall be UL 508 listed.
- 10.1.4. Controller shall have a key switch to meet local code requirements and shall be removable only in the AUTO position.
- 10.2. Applicability
 - 10.2.1. The controller shall be standard on a 50REZGB.
 - 10.2.2. The controller shall support 12-volt starting systems.
 - 10.2.3. The controller's environmental specification shall be: -40°C to 70°C operating

temperature range and 5-95% humidity, non-condensing.

- 10.2.4. The controller shall mount on the generator or remotely within 40 feet with viewable access.

10.3. Hardware Requirements

10.3.1. Control Panel shall include:

1. The control shall have a run-off/reset-auto three-position selector switch.
2. A controller-mounted, latch-type emergency stop pushbutton.
3. Five indicating lights: System Ready - green Not in Auto - yellow Programming Mode - yellow System Warning - yellow System Shutdown - red
4. Display with two lines of 20-alphanumeric characters, viewable in all light conditions.
5. Sixteen position snap action sealed keypad for menu selection and data entry.
6. For ease of use, an operating guide shall be printed on the controller faceplate.
7. An audible alarm with alarm silence capability.
8. Panel lights shall be supplied as standard.

10.4. Control Functional Requirements

- 10.4.1. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.
- 10.4.2. Field-programmable time delay engine cooldown. Adjustment range 0-10 minutes in 1 second increments.
- 10.4.3. Capability to start and run at user-adjustable idle speed during warmup for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.
- 10.4.4. The idle function including engine cooldown at idle speed.
- 10.4.5. Real-time clock and calendar for time stamping of events.
- 10.4.6. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds.
- 10.4.7. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.
- 10.4.8. Programmable cyclic cranking that allows up to six crank cycles and up to 35 seconds of crank time per crank cycle.
- 10.4.9. The capability to reduce controller current battery draw, for applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.
- 10.4.10. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
- 10.4.11. Control logic with RMS digital voltage regulation. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems.
- 10.4.12. The capability to exercise the generator set by programming a running time into

the controller. This feature shall also be programmable through the PC software.

- 10.4.13. Control function shall include output voltage adjustment.
- 10.4.14. Battle switch function selection to override normal fault shutdowns, except emergency stop and overspeed shutdown.
- 10.4.15. The control shall detect the following conditions and display on control panel:
 - 1. Customer programmed digital auxiliary input ON (any of the 21 inputs available)
 - 2. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines)
 - 3. Emergency stop
 - 4. High & low coolant temperature
 - 5. High oil temperature
 - 6. Controller internal fault
 - 7. Locked rotor - fail to rotate
 - 8. Low coolant level
 - 9. Low oil pressure
 - 10. Master switch error
 - 11. CSA-C282-09 common alarm
 - 12. Overcrank
 - 13. Overspeed with user-adjustable level, range 60-70 Hz.
 - 14. Overvoltage with user adjustable level, range 105% to 135%
 - 15. Overfrequency with user adjustable level, range 102% to 140%
 - 16. Underfrequency with user adjustable level, range 80% to 90%
 - 17. Undervoltage with user adjustable level, range 70% to 95%
 - 18. Coolant temperature signal loss
 - 19. Oil pressure gauge signal loss

Conditions resulting in generator warning (generator will continue to operate):

- 1. Battery charger failure
- 2. Customer programmed digital auxiliary input on (any of the 21 inputs available)
- 3. Customer programmed analog auxiliary input on (any of the 7 inputs available on ECM engines and 5 inputs for non ECM engines)
- 4. Power system supplying load
- 5. Ground fault detected - detection by others
- 6. High battery voltage - Level shall be user adjustable.
- 7. Range 29-33 volts for 24-volt systems.
- 8. High coolant temperature
- 9. Load shed

10. Loss of AC sensing
11. Underfrequency
12. Low battery voltage - level shall be user adjustable, range 20-25 volts for 24-volt systems.
13. Low coolant temperature
14. Low fuel level or pressure
15. Low oil pressure
16. CSA-C282-09 common alarms
17. Overcurrent
18. Speed sensor fault
19. Weak battery
20. Alternator protection activated

10.5. Control Monitoring Requirements

- 10.5.1. All monitored functions must be viewable on the control panel display.
- 10.5.2. The following generator set functions shall be monitored:
 1. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
 2. All single phase and three phase currents, 0.25% accuracy
 3. Output frequency, 0.25% accuracy
 4. Power factor by phase with leading/lagging indication
 5. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
 6. kVARS total and per phase, 0.5% accuracy
 7. kVA total and per phase, 0.5% accuracy
 8. kW hours
 9. A display of percent generator set duty level (actual kW loading divided by the kW rating)
- 10.5.3. Engine parameters listed below shall be monitored: (*available with ECM equipped engines)
 1. Coolant temperature both in English and metric units
 2. Oil pressure in English and metric units
 3. Battery voltage
 4. RPM
 5. Lube oil temperature*
 6. Lube oil level*
 7. Crankcase pressure*
 8. Coolant level*
 9. Coolant pressure*
 10. Fuel pressure*
 11. Fuel temperature*

- 12. Fuel rate*
- 13. Fuel used during the last run*
- 14. Ambient temperature*

10.5.4. Operational records shall be stored in the control beginning at system start-up.

- 1. Run time hours
- 2. Run time loaded hours
- 3. Run time unloaded hours
- 4. Number of starts
- 5. Factory test date
- 6. Last run data including date, duration, and whether loaded or unloaded
- 7. Run time kilowatt hours

10.5.5. The following operational records shall be a resettable for maintenance purposes:

- 1. Run time hours
- 2. Run time loaded hours
- 3. Run time unloaded hours
- 4. Run time kilowatt hours
- 5. Days of operation
- 6. Number of starts
- 7. Start date after reset

10.5.6. The controller shall store the last one hundred generator set system events with date and time of the event.

10.5.7. For maintenance and service purposes, the controller shall store and display on demand the following information:

- 1. Manufacturer's model and serial number
- 2. Battery voltage
- 3. Generator set kilowatt rating
- 4. Rated current
- 5. System voltage
- 6. System frequency
- 7. Number of phases

10.6. Inputs and Outputs

10.6.1. Inputs

- 1. There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
- 2. There shall be 7 user-programmable analog inputs for ECM-equipped engines (5 for non-ECM engines) for monitoring and control.
- 3. Each analog input can accept 0-5 volt analog signals
- 4. Resolution shall be 1:10,000

5. Each input shall include range settings for 2 warnings and 2 shutdowns.
6. All values shall be on the control panel display.
7. Shall be user-assigned.
8. Additional standard inputs required:
 - Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
 - Reset of system faults.
 - Remote two-wire start.
 - Remote emergency stop.
9. Idle mode enable.

10.6.2. Outputs

1. All CSA-C282-09 outputs shall be available.
2. Thirty outputs shall be available for interfacing to other equipment:
 - All outputs shall be user-configurable from a list of 25 functions and faults.
 - These outputs shall drive optional dry contacts.
3. A programmable user-defined common fault output with over 40 selections shall be available.

10.7. Communications

- 10.7.1. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
- 10.7.2. Industry standard Modbus communication shall be available.
- 10.7.3. A Modbus master shall be able to monitor and alter parameters, and start or stop a generator.
- 10.7.4. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows '9X or Windows NT.
- 10.7.5. Communications shall be available for serial, CAN, and Ethernet bus networks.
- 10.7.6. A variety of connections shall be available based on requirements:
 1. A single control connection to a PC.
 2. Multiple controls on an intranet network connected to a PC.
 3. A single control connection to a PC via phone line.
 4. Multiple controls to a PC via phone line.
- 10.7.7. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
- 10.7.8. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
- 10.7.9. Cabling shall not be limited to the controller location.
- 10.7.10. Network shall be self-powered.

11. Accessories

- 11.1. **Air Restriction Indicator.** The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
- 11.2. **Battery Charger.** A 6-ampere automatic float to equalize battery charger with the following features:
 - 1. 12 VDC output
 - 2. 1% steady-state voltage regulation from no load to full load over 10% AC input line voltage variation
 - 3. LED lamps for charge state indication
 - 4. Temperature compensated for ambient temperatures for -40°C to 70°C
 - 5. Potting for durability
 - 6. Short-circuit and reverse polarity protection
 - 7. UL 1236 listed
- 11.3. **Battery Rack and Cables.** Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
- 11.4. **Circuit Breaker.** The generator shall come with a primary, factory installed, 100% rated line circuit breaker of 200 amperes that is UL2200 listed. Line circuit breakers shall be sized for the rated ampacity of the genset. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections. When GFI breakers are required, additional neutrals shall be factory installed.
- 11.5. **Dry Contact Kits.** The 10 Dry Contact Kit shall provide normally open and normally closed, gold-plated contacts in a form C configuration to activate warning devices and other customer-provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.
- 11.7. **Failure Relay.**
 - 11.7.1. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
 - 11.7.2. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
 - 11.7.3. Once energized the relay shall remain latched until the system is reset by the main controller switch.
- 11.8. **Remote Annunciator Panel.** The remote annunciator shall meet CSA-C282-09 Table 2 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Options shall be available to provide ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.
- 11.9. **Rodent Guards.** Generator rodent guards shall prevent intrusion and protect internal components.
- 11.10. **Run Relay.** The run relay shall provide a three-pole, double-throw relay with 10-amp/ 250 VAC contacts to indicate that the generator is running. The relay provides three sets of dry contacts for energizing or de-energizing customer devices while the generator is running

(e.g. louvers, indicator lamps, etc.)

- 11.11. **Skid End Caps.** The generator shall include skid end caps.
- 11.12. **Standard Air Cleaner.** The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.
- 11.13. **Block Heater.** The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of CSA-C282-09.

12. Sound Enclosure

- 12.1. The enclosure shall be constructed from high strength, low alloy steel, aluminum or galvanized steel.
- 12.2. The enclosure shall be finish coated with powder baked paint for superior finish, durability and appearance. Enclosures will be finished in the manufacturer's standard color.
- 12.3. The enclosure shall allow the generator set to operate at full load in an ambient of 40°C - 45°C with no additional de-rating of the electrical output.
- 12.4. The enclosure shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the Ontario Electric Code.
- 12.5. Doors shall be equipped with lockable latches. Locks must be keyed alike.
- 12.6. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
- 12.7. The complete exhaust system shall be internal to the enclosure.
- 12.8. All acoustical insulation shall be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane shall be mechanically fastened. The acoustical insulation shall be flame retardant.
- 12.9. The enclosure shall include an exhaust scoop to direct the cooling air in a vertical direction.
- 12.10. The enclosure shall include a mounted load centre to be fed from the buildings normal electrical supply. The load centre shall include individual feeder breakers pre-wired to all engine and enclosure electrical devices requiring normal supply power including, but not limited to: block heater, battery heater, battery charger, enclosure space heater, enclosure dampers, and 2-hour battery back-up emergency light pack (as specified in CSA-C282-09).
- 12.11. The enclosure dampers and space heater shall be configured so as to keep the interior space of the enclosure at 10°C at all times when the engine is not running. Dampers shall be installed in a fail-safe to open configuration. The dampers shall be configured to open upon failure of normal power. Dampers shall also be configured to open upon engine running, regardless of the condition of normal supply power.
- 12.12. If the plans show the generator is not being installed on a solid concrete pad and will be elevated in any way such the bottom of the generator set enclosure will be open to the elements, provide a solid sheet metal bottom to the enclosure. The solid bottom shall be installed in such a way that it does not compromise the enclosure heating, engine cooling, or sound emissions of the unit, while also preventing rodent intrusions.

END OF SECTION

1. GENERAL

1.1 SUMMARY

- A This section includes the following items from a single supplier:
 - 1. Automatic transfer switch
 - 2. Related Accessories as specified
- B Products Furnished or Supplied but not installed
- C Products Installed but not furnished or supplied
- D Related Requirements
 - 1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
 - 2. It is the intent of this specification to secure an automatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
 - 3. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacture shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

1.2 SUBMITTALS

- A Action Submittals
 - 1. Product Data
 - a The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
 - 2. Shop Drawings
 - 3. Samples
- B Informational Submittal
 - 1. Certificates
 - 2. Test and Evaluation Reports
 - 3. Manufacturer's Instruction
 - 4. Source Quality Control Submittals
 - 5. Field or Site Quality Control
 - 6. Manufacturer's Report
 - 7. Special Procedure Submittal
 - 8. Qualification Statement
- C Closeout Submittals
 - 1. Maintenance Contracts
 - 2. Operation And Maintenance Data
 - 3. Bonds
 - 4. Warranty Documentation
 - 5. Record Documentation
 - 6. Software

- D Maintenance Material Submittals
 - 1. Literature
 - 2. Spare Parts
 - 3. Extra Stock Materials
 - 4. Tools

1.3 Quality Assurance

- A Regulatory Agency
 - 1. The automatic transfer switch shall conform to the requirements of the following codes and standards:
 - a UL 1008 - Standard for Transfer Switch Equipment
 - b IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 - c NFPA 70 - National Electrical Code
 - d CSA-C282 (current edition) Emergency Electrical Power Supplies for Buildings
 - e IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - f NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.
 - g EN61000-4-4 Fast Transient Immunity Severity Level 4
 - h EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
 - i IEEE 472 (ANSI C37.90A) Ring Wave Test
 - j IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
 - k CSA C22.2 No. 178 certification
 - 2. Qualifications
 - a The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
 - b A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year shall produce the automatic transfer switch.
 - 3. Manufactures
 - a The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
 - b The manufacturer shall maintain a national service organization of employing personnel located throughout Canada. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
 - c The manufacture shall maintain records of each switch, by serial number, for a minimum of 20 years.

1.4 Delivery, Storage, and Handling

- A Delivery and Acceptance Requirements refer to 01 60 00.
- B Storage and Handling Requirements refer to 01 60 00.
- C Packaging Waste Management refer to 01 74 19.

1.5 Field or Site Conditions

- A Ambient Conditions
 - 1. Automatic transfer switch shall operate in the following conditions without any damage to the unit or its loads.

- a Ambient Temperature: -4 to 158 Degrees F
- b Relative Humidity: 5% to 95% noncondensing

B Existing Conditions

1.6 Warranty or Bond

A Manufacture Warranty

- 1. The ATS shall include a standard warranty covering two (2) years or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
- 2. The ATS manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

2. PRODUCTS

2.1 Equipment

A Equipment

- 1. Furnish and install an automatic transfer switches system(s) with 3-Pole / 4-Wire, Solid Neutral, 208V/60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

B Manufacture

- 1. Automatic transfer switches shall be Kohler Any Breaker Rated - Standard Transition (KCS)/KCS-DCTA-00. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid date. Alternate bids shall include a line-by-line clarification of the specification marked with "D" for deviation; "E" for exception, and "C" for comply.
- 2. The ATS shall be the same manufacture as the generator set for maximum compatibility and single-source supply.

C Construction

- 1. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism. Main operators shall include overcurrent disconnect devices; linear motors or gears shall not be acceptable.
- 2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- 3. The switch shall be positively locked and unaffected by momentarily outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- 4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
- 5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amperes and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
7. For two and three pole switches, where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.
8. For four pole switches with a switching neutral, where neutral conductors must be switched as shown on the plans, the contactor shall be provided with fully rated switched neutral transfer contacts. Overlapping neutral contacts may be used as an alternative.

D Enclosure

1. The ATS shall be furnished in a NEMA 1 enclosure.
2. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

2.2 Operation

A Operators

B Controls

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
 - a Nominal line voltage and frequency
 - b Single or three phase sensing
 - c Operating parameter protection
 - d Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

C Voltage and Frequency

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

a	Parameter	Dropout/Trip	Pickup/Reset
b	Under voltage	75 to 98%	85 to 100%
c	Over voltage	106 to 135%	95 to 100% of trip
d	Under frequency	95 to 99%	80 to 95%
e	Over frequency	01 to 115%	105 to 120%
f	Voltage unbalance	5 to 20%	3 to 18%
2. Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20°C to 70°C.
3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the

service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.

6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

D Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.
2. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.
6. All time delays shall be adjustable in 1 second increments.
7. All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB.
8. Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications interface port or USB.

E Additional Features

F Operation Sequence

2.3 Materials

2.4 Assembly or Fabrication

- A Factory Assembly
- B Shop Fabrication
- C Assembly or Fabrication Tolerances

2.5 Mixes

2.6 Finishes

- A Primer Materials
- B Finish Materials
- C Shop Finishing Materials

2.7 Accessories

- A. Programmable Exerciser. A programmable exerciser shall be supplied to allow programming of up to 56 on/off events.

2.8 Source Quality Control

- A Test and Inspection

1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

END OF SECTION

1.0 GENERAL

1.1 RELATED INSTRUCTIONS

- .1 Refer to Section 26 00 00 - Electrical General Requirements.

1.2 WORK INCLUDED

- .1 Provide electrical lighting fixtures and systems scheduled, complete with lamps, ballasts and necessary accessories required for their installation and performance.

1.3 LAMP AND BALLAST CONDITIONING

- .1 Upon first energizing all Lighting fixtures shall remain energized for a stabilizing period of 100 hours.

1.4 SHOP DRAWINGS

- .1 Submit for review a PDF-electronic copy containing illustrations of each fixture. Illustrations to be complete showing dimensions light distribution and mounting requirements. Illustrations to be noted to indicate special features and finishes. A copy is to be retained by the Contractor on the site, to ensure co-ordination of installation requirements.

2.0 PRODUCTS

2.1 REFERENCE NUMBERS

- .1 Catalogue reference numbers given for individual fixture types are intended as a guide when read with the description and the fixture as finally applied. Verify catalogue references with description and co-ordinated with installation conditions, with particular regard to ceiling construction details, type and finish before ordering fixtures.

2.2 BALLASTS

- .1 Programmable start high efficiency electronic fluorescent ballast, unless otherwise noted.
- .2 CSA and UL listed, Class P and type 1 outdoor, integrated electronic circuitry, less than 10% of voltage and frequency sustained variations with no damage to ballast. Less than 15% THD. Ballasts shall have an average lamp crest factor of less than 1.7. Ballast shall have frequency of operation in range 20-30 kHz or greater than 42KHz and operate without visible flicker. Power factor shall exceed 95%. No polychlorinated biphenyls (PCBs) will be permitted. Comply with ANSI C62.41 Category A for transient protection. Class A sound rating, -18°C (0°F) starting temperature, minimum 0.85 ballast factor. Meet FCC Standard for EMI/RFI.
- .3 Ballasts for compact fluorescent lamps shall be high power factor electronics c/w end of lamp life protection.
- .4 All ballasts shall be of single acceptable manufacturer, unless not feasible.
- .5 Acceptable ballast manufacturers are:

Philips Lighting
Osram Canada

or equivalent

2.3 LENSES

- .1 Plastic lenses in lighting fixtures shall be acrylic with minimum thickness of 3 mm (.125 inches) and, providing flame spread and smoke density ratings, complying with applicable Federal and Provincial Codes; Ontario Fire Marshal's Fire Safety Design Standard; and the Ontario Building Code.
- .2 Removable components of fixtures (louvres, lenses, wire guards, and the like) to be limited to maximum 1220 mm (48") in length.

2.4 NIL

2.5 FIXTURE SCHEDULE

- .1 See Drawings for lighting fixtures Schedule.
- .2 All LED lighting fixtures to come with dimming capability.

2.6 LED FIXTURES

Light Emitting Diode (LED) Systems:

- .1 LED systems shall be tested for performance in accordance with IES Standard LM78-08 and LM-80-08.
- .2 White LED's shall be of a Colour Temperature as stated in the luminaire description and colour rendering of no less than 70 for outdoor applications and no less than 80 for indoor applications.
- .3 LED's shall have a lumen maintenance rating of no less than L70 after 50,000 hours @25°C.
- .4 LED luminaires shall be warranted by the luminaire manufacturer as a complete system, Comprised of LED's, Drivers and Fixtures.
- .5 LED drivers and/or power supplies shall be suitable for 120V or 347V operation, as specified in fixture description, and have a Power Factor of >0.9 and THD of <20%.
- .6 LED luminaires shall be cUL, CSA and Energy Star Certified.
- .7 LED Systems shall be guaranteed for a period of 360 days from the date of Substantial Performance. Labour to install replacement luminaires or replacement parts shall be included in the guarantee.
- .8 Refer to fixture designations for detailed lamp characteristics (i.e. size, beam spread, etc.).
- .9 Acceptable Manufacturers:
 - .1 Philips Lighting
 - .2 Osram Sylvania
 - .3 Cree Canada
 - or equivalent

2.7 EMERGENCY LIGHTING SYSTEM

- .1 Provide Emergency Lighting Units and Wiring Systems as noted.
- .2 Emergency battery units shall be designed to provide emergency lighting for at least 30 minutes automatically upon failure of a normal power source. Upon restoration of the normal power, the battery unit shall be restored automatically to a charging condition. The charging cycle shall raise the battery to an equalized voltage and then electronically sense the full state of charge in the battery and return the battery to a lower float voltage.

The charger shall be regulated to a plus or minus 20 mV output for plus or minus 10% input voltage fluctuation. In order to extend battery life at ambience other than room temperature, the charger shall reduce the battery voltage by 4 mV per cell per °C rise in temperature and shall raise the battery voltage by 4 mV per

cell per °C reduction in temperature from a 20°C reference temperature. The unit shall be equipped with a phase loss and brown out protection circuit which shall turn on emergency lights when input voltage to the unit falls below 90 volts or 75% full voltage. The unit shall include a test switch, charge and on pilot lights which shall be light emitting diodes. The unit shall include a low voltage disconnect circuit.

- .3 Battery units shall be Lumacell of the types noted, complete maintenance-free, sealed pure lead Model No. RG24S series rated as indicated on the drawings with design life of 10 years, 24 volt. The unit shall be performance certified and carry C.S.A. C22.2 No. 141 approval for the wattage noted.
- .4 Wall mounted unit shall be provided with recessed back box and mounting template to allow pre-installation feeds of A.C. input and D.C. output. Both A.C. input and D.C. output shall enter unit through back face without any visible cable or conduit feeds. Provide wall mounted shelf for each battery unit.
- .5 Provide a 120 volt input circuit for each unit wired to unswitched circuit indicated. Wire to exit signs from battery units. Size conductors to all remote lamps to provide maximum voltage drop of five percent.
- .6 Emergency Equipment Types:

Type 1 - Shall comprise a Model MQM124V20W ceiling mounted adjustable MR16 remote lighting unit 20 watt 24 volt.

Type 2 - Same as Type 1 except double head, Model MQM224V20W.

Type 3 - Weatherproof model WP series, MR 16 20watt, 24 volts.

.7 Emergency Lighting Level Measurement

1. Include for services to measure and plot lighting levels on floor plans upon completion of work. Provide copies for review by Consultant and Fire Department.

.8 Exit Signs

1. Shall be Lumacell LA Series or equal, LED panel, extruded aluminum Pictogram Exit Signs, direction arrows as required, having less than 2.5 watts white LED panel for universal AC/DC connection. Weatherproof exit signs shall be Lumacell # LN Series as Pictogram exit signs

- .9 Include for the supply, installation and wiring (to nearest normal & emergency lighting circuit) of 3 additional exit signs at locations later directed on site.

.10 Acceptable Emergency Equipment Manufacturers are:

- Lumacell
- Luxnet
- Emergi-lite
- Baghelli Canada Inc.
or equivalent

3.0 EXECUTION

3.1 INSTALLATION

- .1 Do not install or energize lamps until directed by Consultant which generally shall be just prior to occupancy of the building by the Owner. Read 'Temporary and Trial Usage'.

3.2 RECESSED FIXTURES

- .1 Provide plaster and/or framing rings for recessed fixtures (except for 'Lay-in Tee-Bar' types) the installation of which shall be the responsibility of this Section.
- .2 Recessed incandescent fixtures shall conform to requirements of latest bulletin of Electrical Safety Authority. Thermal insulation and combustible materials shall be kept clear of recessed fixtures.

3.3 COMPLETION

- .1 Fixtures shall be clean at the time of final acceptance.

END OF SECTION

1. GENERAL

1.1 RELATED INSTRUCTIONS

- .1 Refer to Section 26 00 00 - Electrical General Requirements.
- .2 Section Includes:
 1. Digital Occupancy and Daylighting Control
 2. Emergency Lighting Control SYSTEM DESCRIPTION & OPERATION
- .3 The Lighting Control and Automation system as defined under this section covers the following equipment:
 1. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relays controllers with 0-10 volt control for ballasts (if applicable) and single relay application- specific plug load controllers.
 2. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 3. Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
 4. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
 5. Configuration Tools – Handheld remote for room configuration provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Computer software also customizes room settings.
 6. Handheld remotes for personal control – One-button dimming, two-button on/off, or five- button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
 7. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 8. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS).
 9. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
 10. After installation of the lighting controls system, it has to be commissioned in accordance with ASHRAE90.1-2013 sub-section 9.4.3.

1.2 LIGHTING CONTROL APPLICATIONS

- .1 Meet the requirements of Ontario building Code and also ASHRAE 90.1- 2013.
provide an application of lighting controls as follows:
 1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy

sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner- mounted sensors and Manual-ON switches.

2. Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.
3. Daylit Areas – All luminaires within 15' of windows or within 7' of skylights (the daylit zone) shall be controlled separately from luminaires outside of daylit zones. Luminaires closest to the daylight aperture shall be controlled separately from luminaires farther from the daylight aperture, within the daylight zone.
4. Daytime setpoints for total ambient illumination (combined daylight and electric light) level that initiate dimming shall be programmed to be not less than 125% of the nighttime maintained designed illumination levels.
5. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.
6. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

.2 Additional controls.

1. Provide occupancy/vacancy sensors for any enclosed office, conference room, meeting room, and training room. For spaces with multiple occupants or where line-of-sight may be obscured, provide ceiling- or corner-mounted with manual-on switches.
2. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space.

1.3 SUBMITTALS

- .1 Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- .2 Shop Drawings:
 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
- .3 Product Data: Catalog sheets, specifications and installation instructions.
- .4 Include data for each device which:
 1. Indicates where sensor is proposed to be installed.
 2. Prove that the sensor is suitable for the proposed application.

1.4 QUALITY ASSURANCE

- .1 Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.5 PROJECT CONDITIONS

- .1 Do not install equipment until following conditions can be maintained in spaces to receive

equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.6 WARRANTY

- .1 Provide a five year complete manufacturer's warranty on all products to be free of manufacturers' defects.

1.7 MAINTENANCE

- .1 Spare Parts:
 1. Provide 2 of each product to be used for maintenance.

2. PRODUCTS

2.1 MANUFACTURERS

- .1 Acceptable Manufacturer:
 1. WattStopper
 - a. System: Digital Lighting Management (DLM)
 2. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, one of the following:
 - a. WattStopper Digital Lighting Management (DLM)
 - b. Douglas Lighting Control
 - c. Light system by SensorSwitch
 - d. Or Equivalent
- .2 Substitutions:
 1. All proposed substitutions (clearly delineated as such) may be submitted by the Contractor after the Contract award in writing for approval by the Consultant. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
 2. By using pre-approved substitutions, the Contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The Contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SINGLE / DUAL RELAY WALL SWITCH OCCUPANCY SENSORS

- .1 Type PW: Manual-ON, Automatic-OFF passive infrared (PIR) wall switch occupancy sensor
Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper PW-100, PW-200, PW-103, PW-203 or equivalent.
- .2 Type UW: Manual-ON, Automatic-OFF ultrasonic wall switch occupancy sensor with
Furnish the Company's model which suits the electrical system parameters and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper UW-100, UW-200 or equivalent..
- .3 Type DW: Manual-ON, Automatic-OFF dual technology (passive infrared and ultrasonic) wall switch occupancy sensor
Furnish the Company's model which suits the electrical system parameters and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper DW-100, DW-200, DW-103, DW-203 or

equivalent..

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- .1 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
- .2 Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton programming for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
- .3 One or two RJ-45 port(s) for connection to DLM local network.
- .4 Two-way infrared (IR) transceiver to allow remote programming through and held commissioning tool and control by remote personal controls.
- .5 Device Status LEDs including:
 1. PIR Detection
 2. Ultrasonic detection
 3. Configuration mode
 4. Load binding
- .6 Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
- .7 Manual override of controlled loads.
- .8 Units shall not have any dip switches or potentiometers for field settings.
- .9 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- .10 WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC or equivalent.

2.4 DIGITAL WALL SWITCHES

- .1 Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
 1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Red configuration LED on each switch that blinks to indicate data transmission.

4. Blue Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
- .2 Two RJ-45 ports for connection to DLM local network.
- .3 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- .4 The following switch attributes may be changed or selected using a wireless configuration tool:
 1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
- .5 WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101 or equivalent.

2.5 HANDHELD REMOTE CONTROLS

- .1 Battery-operated handheld switches in 1, 2 and 5 button configurations for remote switching or dimming control. Remote controls shall include the following features:
 1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
 2. Blue LED on each button confirms button press.
 3. Load buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
 4. Inactivity timeout to save battery life.
- .2 A wall mount holster and mounting hardware shall be included with each remote control
- .3 WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105 or equivalent.

2.6 ROOM CONTROLLERS

- .1 Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
 1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 3. Device Status LEDs to indicate:
 - a. Data transmission

- b. Device has power
 - c. Status for each load
 - d. Configuration status
- .2 Quick installation features including:
 - 1. Standard junction box mounting
 - 2. Quick low voltage connections using standard RJ-45 patch cable
- .3 Plenum rated
- .4 Manual override and LED indication for each load
- .5 Dual voltage (120/277 VAC, 60 Hz)
- .6 Zero cross circuitry for each load.
- .7 On/Off Room Controllers shall include:
 - 1. One or two relay configuration
 - 2. Efficient 150 mA switching power supply
 - 3. Three RJ-45 DLM local network ports
 - 4. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - a. One relay configuration only
 - b. Automatic-ON/OFF configuration
 - 5. WattStopper product numbers: LMRC-101, LMRC-102, LMPL-101 or equivalent.
- .8 On/Off/Dimming enhanced Room Controllers shall include:
 - 1. Real time current monitoring
 - 2. One, two or three relay configuration
 - 3. Efficient 250 mA switching power supply
 - 4. Four RJ-45 DLM local network ports.
 - 5. One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
 - 6. Optional Network Bridge for BACnet MS/TP communications (LMRC-3xx).
 - 7. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
 - 8. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - a. One relay configuration only
 - b. Automatic-ON/OFF configuration
 - 9. WattStopper product numbers: LMRC-211, LMRC-212, LMRC-213, LMPL-201, LMRC-311, LMRC-312, LMRC-313 or equivalent.

2.7 DIGITAL PHOTOSENSORS

- .1 Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.
- .2 Digital photosensors include the following features:
 - 1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have

a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.

- a. Sensor light level range shall be from 1-10,000 footcandles (fc).
- b. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
- c. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling after they turn off.
- d. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
- e. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
- f. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
- g. Red configuration LED that blinks to indicate data transmission.
- h. Blue status LED indicates test mode, override mode and load binding.
- i. Recessed switch to turn controlled load(s) ON and OFF.
- j. One RJ-45 port for connection to DLM local network.
- k. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

.3 Closed loop digital photosensors include the following additional features:

1. An internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes setpoints following self-calibration.
4. A sliding setpoint control algorithm for dimming daylight harvesting with a "Day Setpoint" and the "Night Setpoint" to prevent the lights from cycling.
5. WattStopper Product Number: LMLS-400 or equivalent.

.4 Open loop digital photosensors include the following additional features:

1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
3. A proportional control algorithm for dimming daylight harvesting with a "Setpoint" to be maintained during operation.
4. WattStopper Product Number: LMLS-500 or equivalent.

2.8 ROOM NETWORK (DLM Local Network)

.1 The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. Features of the DLM local network include:

1. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
2. Simple replacement of any device in the network with a standard off the shelf unit

- without requiring commissioning, configuration or setup.
- 3. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
- 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.9 CONFIGURATIONS TOOLS

- .1 A configuration tool facilitates optional customization of DLM local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.
- .2 Features and functionality of the wireless configuration tool shall include:
 - 1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 - 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 - 3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
 - 4. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.
 - 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting.
 - 6. Adjust or fine-tune daylighting settings established during auto-commissioning, and input light level data to complete commissioning of open loop daylighting controls.
- .3 WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100 or equivalent.

2.10 EMERGENCY LIGHTING

- .1 Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
 - 1. 120/277 volts, 50/60 Hz., 20 amp ballast rating
 - 2. Push to test button
 - 3. Auxiliary contact for remote test or fire alarm system interface
- .2 WattStopper Product Numbers: ELCU-100, ELCU-200 or equivalent.

2.11 LIGHTING CONTROL PANELS

- .1 Lighting Control Panels
 - 1. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:
 - a. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 – 8 relays, 1 – 24 relays and 6 four-pole contactors, or 1 – 48 relays and 6 four-pole contactors.
 - b. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
 - c. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction

shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:

- i. Removable, plug-in terminal blocks with screwless connections for all low voltage terminations.
- ii. Individual terminal block, override pushbutton, and LED status light for each relay.
- iii. Direct wired switch inputs associated with each relay and group channel shall support two- or three-wire, momentary or maintained contact switches or 24VDC input from occupancy sensors.
- iv. Automatic support for occupancy sensor sequence of operation. Direct wired low voltage inputs automatically reconfigure when connected to a WattStopper occupancy sensor head. Occupancy sensor shall switch lighting on and off during unoccupied periods but shall not turn lighting off during scheduled occupancy periods.
- v. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches and digital occupancy sensors.
- vi. Isolated contacts within each relay shall provide true relay state to the electronics. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems.
- vii. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
- viii. Group, channel, and pattern control of relays shall be provided through a simple keypad interface within the panel. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override pushbuttons and LED displays. Relay group status for each channel shall be provided through bi-color operation of the LED indicators. Solid red indicates that all relays in the group are on, solid green indicates that the group is in a mixed state, and blinking green indicates that the relays have blink warned and are currently timing out.
- ix. Each relay and channel terminal block shall provide a 24V pilot light signal. It shall be possible to configure the system for support for any Class 2 pilot light voltage with the use of an auxiliary power supply.
- x. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

Electrical:

- 1) 20 amp ballast at 277V
- 2) 20 amp ballast at 347V
- 3) 20 amp tungsten at 120V
- 4) 20 amp resistive at 347V
- 5) 1.5 HP motor at 120V
- 6) 14,000 amp short circuit current rating (SCCR) at 347V

Mechanical:

- 1) Individually replaceable, ½" KO mounting with removable Class 2 wire harness.
 - 2) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
 - 3) Dual line and load terminals each support two #14 – #12 solid or stranded conductors.
 - 4) Tested to 300,000 mechanical on/off cycles.
- xi. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.

- xii. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
- xiii. Lighting control panels shall be WattStopper model LILM8, LILM24 or LILM48 as shown on the plans, or equivalent.

.2 BACnet[®] Based Digital Communications

1. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 master/slave token passing-based using the BACnet[®] protocol.
 - a. The panel shall have provision for an individual BACnet device ID. The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
 - b. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k and 76800k bits per second.
 - c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 48. The state of each relay shall be readable and writable by the BAS via the object present value property.
 - d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 48.
 - e. The eight channel groups associated with the panel shall be represented by binary value objects in the instance range of 1 – 8. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the occupied mode. Commanding 0 or NULL shall put the relays into the unoccupied mode.
 - f. Setup and commissioning of the panel shall not require manufacturer-specific software or configuration tools of any kind. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the on-board LCD display and user keypad. Provide BACnet objects for panel setup and control as follows:
 - i. Binary output objects in the instance range of 1 – 48 (one per relay) for on/off control of relays.
 - ii. Binary value objects in the instance range of 1 – 8 (one per channel) for normal hours/after hours schedule control.
 - iii. Binary input objects in the instance range of 1 – 48 (one per relay) for reading true on/off state of the relays.
 - iv. Analog value objects in the instance range of 1 – 48 (one per relay) shall assign relays to channel groups in the range of 1 – 8.
 - v. Binary value objects in the instance range of 101 – 108 (one per channel group) shall assign the channel to follow auto-on or manual-on mode when transitioning to occupied.
 - vi. Analog value objects in the instance range of 101 – 108 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute gracetime period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.
 - vii. Analog value objects in the instance range of 211 – 208 (one per channel) shall assign an after hours time delay value to the channel in the range of 1 – 240 minutes.
 - viii. Multi-state value objects in the instance range of 1 – 8 (one per

channel) shall provide the state of the relays assigned to the channel.
Valid states shall be ALL ON, MIXED, BLINK, and ALL OFF.

- g. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
- h. The BO and BV objects shall support BACnet priority array with a relinquish default of off and after hours respectively.

.3 User Interface

1. Each lighting control panel shall be supplied with an integral user interface consisting of a keypad and associated OLED display screen. The user interface shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following functions as a minimum:
 - a. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
 - b. Enter meaningful names for the panel, relays, and channels.
 - c. View normal hours/after hours status of each channel.
 - d. Override the normal hours/after hours mode for each channel.
 - e. View the 16 priority array slots for each channel and relay.
 - f. Program the schedule response for each channel as:
 - i. Automatic-on or manual-on.
 - ii. Enable/disable blink warn.
 - iii. Enter override time delay as 0 (none) to 240 minutes.

.4 Schedule, Group, And Photocell Control Of Relays

1. The lighting control panel shall support schedule, group, and photocell control functions via the network as configured in the optional Segment Manager controller or building automation system. The lighting control panel shall be fully compatible with building automation systems that are BACnet compliant. See related specification sections for additional information on interfacing the lighting control panel(s) to the building automation system.

.5 Browser-Based Programming And Control

1. The digital segment manager shall be a compact controller capable of hosting the schedule, photocell, and group relay control functions for a network of up to 96 LILM series lighting control panels. The segment manager shall provide the following features:
 - a. Provision for 1 to 3 separate network segments to facilitate efficient network wire routing.
 - b. Compact housing with screw tab mounts for surface installation and integral DIN rail mounting slot for NEMA 1 installation in the LMSM-ENC1 enclosure.
 - c. Web browser-based user interface; shall not require the installation of any lighting control software.
 - d. User interface accessible from most smart phone browsers when Internet connected.
 - e. Login security access control restricting some users to view-only or other limited operations.
 - f. Automatic discovery of the lighting control panels.
 - g. Familiar navigation-tree-based browsing to individual lighting control panels.
 - h. View/override current status of channels and relays.
 - i. Assign relays to channels.
 - j. Set channel operating parameters:

- i. Automatic-on or manual-on operation.
 - ii. Enable/disable blink warn.
 - iii. Override duration time, 0 (none) to 240 minutes.
 - iv. AS-100 automatic wall switch operation mode.
- k. Create and run schedules:
 - i. Normal hours/after hours schedules for channels.
 - ii. On/off schedules for relays.
 - iii. Support for a minimum of 100 unique schedules, each with up to four time events per day.
 - iv. Support annual schedules, holiday schedules and unique date-bound schedules.
- l. Ethernet connectivity for user access via direct-wired connection, LAN/WAN, or Internet connection.
- m. BACnet IP connectivity for connection to building automation systems.
- n. Segment manager shall be WattStopper LMSM-201 with one network segment or LMSM-603 with support for three network segments or equivalent.

2.12 DIGITAL PHOTOCELL FOR OUTDOOR

- .1 Digital photocell for exterior lighting shall be Wattstopper #LMIO-301 or equivalent.

3. EXECUTION

3.1 INSTALLATION

- .1 When using wire for connections other than the DLM local network (Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements
- .2 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- .3 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 - 1. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- .4 Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and day lighting set points.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- .5 Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Consultant of re- commissioning activity.

3.2 FACTORY COMMISSIONING

- .1 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- .2 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- .3 Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION

1. GENERAL

1.1 SUMMARY

- .1 This section of specification is an integral part of the Contract Documents and shall be read accordingly.
- .2 Comply with general conditions, supplementary conditions of the Contract, and section 26 00 00 – Electrical General Requirements.
- .3 Provide labour, materials, and equipment for installation, testing, and commissioning of a complete operating fire alarm system as specified herein, indicated on drawings, add/or required otherwise. The system shall be left ready for continuous and efficient satisfactory operation.

1.2 REFERENCE

- .1 Comply with the requirements of the latest edition of the following:
 - .1 CAN/ULC-S524, Standard for the installation of Fire Alarm Systems.
 - .2 ULC/S525, Audible Signal Appliances for Fire Alarm Systems.
 - .3 CAN/ULC-S526, Visual Signal Appliances for Fire Alarm Systems.
 - .4 CAN/ULC-S527, Control Units for Fire Alarm Systems.
 - .5 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems.
 - .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S531 Smoke Alarms for Fire Alarm Systems.
 - .9 CAN/ULC-S533, Egress Door Security and Releasing Devices.
 - .10 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems
 - .11 CAN/ULC-S537, Standard for the Verification of Fire Alarm System Installations
 - .12 CAN/ULC-S541 – Speakers for Fire Alarm Systems
 - .13 CAN/ULC-S553 - Installation for Smoke Alarms

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 26 00 00 . Shop drawing shall include:
 - .1 Complete system riser diagram showing all devices, control equipment, circuits and wiring.
 - .2 Details of system operating sequence.
 - .3 Details and performance specifications for system control annunciation and peripherals.
 - .4 Details for devices.
- .2 Submit arrangement and wording of annunciators for fire alarm zone indications to local fire department and provide changes as requested. Submit document to local fire department to department's requirement.
- .3 Following completion of verification, and of acceptance of the installation by local fire department, submit the certification of the Fire Alarm system, together with detailed verification record sheets showing location of each device and all verification results.

- .4 Submit the operating and maintenance manual in accordance with section 16010, the manual shall include:
 - .1 Instructions for the operation of the fire alarm system.
 - .2 Instructions for the maintenance of the fire alarm system.
 - .3 Approved shop drawings with all the connections.

1.4 QUALIFICATIONS

- .1 Acceptable Manufacturers:
 - .1 SimplexGrinnel
 - .2 Edwards
 - .3 Notifier
 - .4 Mircomor equivalent.
- .2 Installer: Certified fire alarm installer with service facilities 100km of project.

2. PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 The fire alarm system shall be an OBC, single stage, zoned non-coded, semi-addressable, microprocessor based, electrically supervised system with all components listed by ULC and CSA.
- .2 The fire alarm system shall include, but not limit to:
 - .1 Fire alarm control panel (FACP).
 - .2 Initiating devices: Manual pull station, automatic smoke and heat detectors.
 - .3 Signal devices: audible and visual.
 - .4 Auxiliary devices.
 - .5 Initiating circuits, signal circuits (minimum two circuits) and auxiliary circuits.
 - .6 Power and circuit wiring.
- .3 System shall be electrically supervised in accordance with CAN/ULC S524.
- .4 Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download. To accommodate this capability, the download of a new Panel program will be transferred to a "secondary" configuration memory bank, while the Panel continues to function on the "primary" configuration memory bank.

- .5 History Logs: The system shall provide a means to recall alarms, supervisory and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.
- .6 Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
- .7 Non-interfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
- .8 A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
- .9 FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values. The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations. The FACP shall automatically indicate when an individual sensor needs cleaning.

2.2 SYSTEM OPERATION

- .1 Activation of any alarm initiating devices (sprinkler flow switch, manual pull station, heat detector, smoke detector, etc.) shall initiate the operations to occur as follows:
 - .1 All the audible signal devices sound the alarm tone throughout the building.
All the visual signal devices shall be activated.
 - .2 The zone of initiation device shall be displayed on the control panel.
 - .3 Central station shall be signaled automatically for the notification of fire department.
 - .4 Release door hold open devices.
 - .5 Transmit signals to enable the following functions:
 - .1 Fans shut down
 - .2 Pressurization fans start-up.
 - .3 Mag-locks release
 - .4 Fire doors and/or smoke control doors, to close and/or open.
 - .5 Elevators to commence the fire mode sequence.
 - .6 Independent fire suspension systems to commence the fire mode sequence.
 - .7 Other functions as required on the drawings.
- .2 After one (1) minute of alarm, the system could be manually silenced via the silencing switch on the control panel. A subsequent alarm shall re-activated signals.

- .3 The alarm condition shall be cleared only upon activation of the reset switch on the control panel.
- .4 Activation of supervised sprinkler devices or other auxiliary systems, i.e. supervisory valves, pressure switches, fire pump, generator supervised contacts, etc. shall initiate the following operations:
 - .1 The respective supervisory zone shall be displayed on the control panel.
 - .2 Activate an audible signal (steady tone) on control panel. The signal may be silenced via silencing switch on control panel.
 - .3 Activate a visual signal (indicator) on control panel.
 - .4 Transmit a general trouble signal to central station.
 - .5 The trouble condition shall be cleared only via reset switch.
- .5 Any open circuit, circuit ground fault, short circuit condition, circuit loss of power, loss of main system power, system standby power trouble and removal of any system component shall initiate the following system trouble condition operations:
 - .1 The respective supervisory zone shall be displayed on the control panel.
 - .2 Activate the system trouble indicator on control panel.
 - .3 Activate system trouble audible signal (steady tone) on control panel. The signals may be silenced via silencing switch on control panel.
 - .4 Transmit a general trouble signal to central station.
 - .5 The trouble condition shall be cleared when the cause is rectified.

2.3 FIRE ALARM CONTROL PANEL

- .1 Fire alarm control panel (FACP) shall provide power, annunciation, supervision and control for the system.
- .2 Recessed or semi-recessed sprinkler-proof enclosure with lockable hinged front door.
- .3 Alarm initiating circuits in accordance with the number of zone indicated on the Fire Alarm Schedules plus 20% spare space capacity for future expansion and for the quantity of field devices in accordance with the manufacturer's recommendations.
- .4 Minimum two (2) signal circuits in accordance with the manufacturer's recommendations, with provision for future signal circuits. Signal circuits shall not be loaded more than 80% in order to allow for future adjustment.
- .5 High intensity LEDs for each zone circuit with 20% spare capacity for future zones as indicated. Type labels per the Fire Alarm Schedule and to the requirements of authorities having jurisdiction.
- .6 Common control module with LCD or LED backlit two-line character display of system function with the following additional features:
 - .1 Trouble LED, buzzer, silence switch. 'Signals Silenced' LED.

- .2 'Power-On', 'Disable', 'Supervisory; and 'Alarm' LEDs.
- .3 'Ground Fault' and 'Loss of Normal Power' LED.
- .4 Test pushbutton.
- .5 Alarm reset buttons.
- .7 Individual trouble display for each detection and signal circuit.
- .8 Auxiliary or output point for:
 - .1 Signal to motor controls for fan system shut-down or smoke control operations. Relays shall have contacts rated at 15 amps, pilot duty. Provide control measure to manually operate (turn on and turn off) each motor from FACP.
 - .2 Transmission of signal to off-premises central monitoring station. Actual connection for this function will be the Owner.
 - .3 Signals to elevator controllers.
 - .4 Signals to maglock release and hold open devices.
 - .5 Transmission of signal to security system for F.A. monitoring.
 - .6 Other functions as required on the drawings.
 - .7 20% spare output points for future.
- .9 Operator interface keypad. Provide LCD display with wording to the Consultant's approval in accordance with Fire Alarm Schedule.
- .10 Coded terminal strips for external connections to signal circuits, initiating circuit, multiplex annunciators, etc.
- .11 Receipt of a signal from an alarm initiating device shall cause audible signals to sound for a full period whether or not a previous alarm has been silenced manually.
- .12 The necessary controls to ensure that a fire alarm signal is not initiated during under- voltage or over-voltage conditions caused by changeover from normal to emergency power supply and vice versa.
- .13 Provide the necessary hardware and software required to provide a proper system operation.
- .14 Provide main system power supply to operate the entire fire alarm system and power supply at 24 volts from a 120 VAC 60Hz input. The integral standby power shall consist of 24 volt dc sealed nickel-cadmium batteries or gell-cell batteries, automatic battery charger with power reversal protection, ammeter and voltmeter to monitor charge rate and battery voltage. Standby power requirements shall be in accordance with CAN/ULC-S524, Section 3.2, Power Supply. Battery capacity shall be sufficient to provide 24-hour supervision plus 60 minutes full alarm operation. Battery charger shall be capable of recharging batteries to 80% capacity in 24 hours.

2.4 SYSTEM DEVICES

.1 Manual Pull Stations

- .1 Manual pull stations shall be single stage, extruded aluminum, semi-flush or surface, red, pull activated, wall mounted in 102mm square Red box. At maglock doors, the station shall have a dual contact.
- .2 Where required, provide tamper proof, weatherproof clear shield complete with a battery operated warning horn.

.2 Heat Detectors

- .1 Combination fixed 57°C (135°F) and 8.3°C (15°F)/min rate-of-rise type, in all areas except where normal temperature fluctuations exceed 10°C (18°F)/min.
- .2 Fixed temperature 91°C (195°F) type, provided in areas with normal ambient temperature between 38°C (100°F) and 66°C (150°F).
- .3 Ceiling mounted in 102mm square outlet box.
- .4 Detector in elevator shaft to be complete with auxiliary relays and wired to elevator controller.

.3 Area Smoke Detectors

- .1 Photoelectric type ceiling smoke detector with the following features:
 - .1 Sensitivity read-out;
 - .2 Snap-in base;
 - .3 Visual indication of detector actuation.
- .2 Ceiling mounted in 102mm square outlet box.
- .3 Smoke detectors in elevator machine rooms, elevator lobbies of 1st floor and 2nd floor, and elsewhere indicated shall be provided with auxiliary relays, and wired to elevator controls for supplementary operation of elevators.
- .4 Smoke detectors required for door hold openers and fire automatic doors shall be provided with auxiliary relays, and wired to door hold openers.

.4 Duct-Mounted Smoke Detectors

- .1 Product Description: photoelectric type with the following features:
 - .1 Auxiliary SPDT relay contact for locate fan shutdown;
 - .2 Key-operated normal-reset-test switch.
 - .3 Duct sampling tubes extending width of duct.
 - .4 Visual indication of detector actuation.

- .5 Duct-mounted housing.
 - .6 Powered from fire alarm control panel.
 - .2 Provide remote alarm indication for duct mounted smoke detectors installed in concealed spaces. Ensure that all detectors are accessible for maintenance.
 - .3 Refer to Mechanical Drawings for duct sizes and air velocities to ensure that the proper quantity of detectors is provided to adequately monitor the cross-sectional area of the duct in accordance with manufacturer's recommendations. Coordinate the proper location and installation with Divisions 21, 22 and 23.
 - .4 Where duct-mounted smoke detectors are installed outdoors, provide weather-proof enclosure. Provide heater and power and manufacturer's instruction.
 - .5 Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
 - .6 Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
- .5 Addressable Circuit Interface Modules
- .1 Addressable Circuit Interface Modules: Modules shall be used for monitoring of non-addressable devices and/or circuit, and for control of evacuation indicating appliances and AHU systems.
 - .2 Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signalling line or a separate two-wire pair running from an appropriate power supply as required.
 - .3 There shall be the following types of modules:
 - .1 Type 1: Monitor Circuit Interface Module:
 - a) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
 - b) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
 - .2 Type 2: Line Powered Monitor Circuit Interface Module
 - a) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the

capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.

- b) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

.3 Type 3: Single Address Multi-Point Interface Modules

- a) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
- b) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.
- c) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

.4 Type 4: Line Powered Control Circuit Interface Module

- a) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

.5 Type 5: 4-20 mA Analog Monitor Circuit Interface Module

- a) This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

.6 All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

.6 End-of-Line Devices

- .1 Mount end of line devices in box with last device or separate box wall mounted, adjacent to last device.
- .7 Horns:
 - .1 Temporal horns rated at 98 dba to 91dba at 3m, finished in red and operated on 24V DC. Mounted in 102mm square or single gang outlet box. High and Low field selectable sound output level setting.
- .8 Fire Alarm Strobe
 - .1 Provide surface wall mounted synchronized high strobe lights to indicate alarm condition.
 - .2 The strobe light shall consist of a xenon tube with red lens. 75cd to 110 cd flash intensity.
 - .3 Mounted in 102mm square or single gang outlet box.
- .9 Annunciator
 - .1 Annunciator shall form part of the control panel and contain necessary number of LED lights and LCD to display all alarm, trouble and control zones.
 - .2 The annunciator shall contain a lamp test switch, trouble buzzer, acknowledge push button, signal silencing push button and reset push button.
- .10 Passive Graphic
 - .1 Passive Graphic to be white back grounds with color lines and text. Show all F/A zone areas, stair and elevator shafts, interior walls and doors and sprinkler devices. Size graphic as required. Brushed aluminum trim with tempered glass front. Install passive graphic beside the control panel.

2.5 WIRING

- .1 Install all wiring in conduit.
- .2 Fire alarm system wiring shall be run in separate conduit.
- .3 Provide shielded wiring when recommended by the manufacturer's specifications.
- .4 Wires shall be CSA-FAS Type 105 copper conductor, 105°C rating, not less than 300V Wiring shall be sized not less than requirement of Section 32-100 of the Electrical Safety Code, Class 1 or Class 2 circuits as required, with screw-terminal wiring connections.
- .5 Stranded conductors with more than 7 strands shall be bunched-tinned or terminated in compression connectors.
- .6 Provide watertight fittings for conduits entering the top or sides of surface mounted terminal cabinets, annunciator transponders and control panels.

2.6 SPECIAL ENVIRONMENT

- .1 Devices shall be moisture-proof where located in moisture area. Devices shall be weather-proof where located outside.

- .2 Provide heater and power to heater including breaker and wiring, (break may not be shown on drawing), for devices located in cold area as required by manufacturer.
- .3 Where the devices located in cold and/ or hot area, locate addressable module in warm area, and conventional devices in cold and/ or hot area.
- .4 Provide tamper proof wire guard where indicated on drawings.

2.7 SMOKE ALARMS AND CARBON MONOXIDE DETECTORS

- .1 Smoke alarms, carbon monoxide detectors and their combinations shall not be connected to the fire alarm system.
- .2 Ceiling mounted ionization type smoke alarms shall be activated by the presence of combustion products. The unit shall contain dual ionization chambers (one for fire detection, one for reference), solid state "Power On" indicator, sensitivity test button, electronic for providing 85 dB at 3 meters output, and the unit shall operate from 120 volt ac power circuit. Where more than one (1) smoke alarm is provided in a suite, the operation of one smoke alarm shall operate the alarm of all other smoke alarms within the suite.
- .3 Ceiling mounted carbon monoxide detectors shall operate from a hard-wired 120 volt AC source. The detector's chemical sensor to respond to CO concentrations and when dangerous levels are reached, trigger an internal alarm rated at a minimum of 85 dB at 3 meters. Detector shall be complete with LED light to indicate unit is receiving power and test button. Where more than one detector is provided in a suite, the operation of one detector shall operate the alarm of all other CO detectors within the suite.
- .4 Ceiling mounted combination smoke alarm and carbon monoxide detectors shall be activated by the presence of combustion products and the dangerous levels of CO concentration. The unit shall contain ionization chamber and chemical CO sensor, two visual alarm icons, alarm sound level of minimum 85 dB at 3 meters, "POWER ON" indicator, test/reset button, and the unit shall operate from 120 VAC power circuit. Where more than one unit is provided in a suite, the operation of one unit shall operate the alarm of all other units within the suite.

3. EXECUTION

3.1 INSTALLATION

- .1 Equipment
 - .1 Install all equipment in accordance with CAN/ULC-S524 "Standard for the Installation of Fire Alarm Systems", the manufacturer's instructions, Ontario Building Code, Underwriter's Laboratory of Canada, Electrical Safety Code, these Documents and requirements of the Authority Having Jurisdiction. This shall include appropriate settings for speaker transformer taps.
 - .2 In the event that the information given in the Specification and/or shown on the Drawings is in conflict with the Code and/or the requirement of the Authorities Having Jurisdiction, bring this to the attention of the Consultant, and do not proceed with the work until the matter is clarified.
- .2 Connections to Other Systems

- .1 Sprinkler and Fire Standpipe System Connections
 - .1 Provide wiring and connections to all flow switches, supervised valves and pressure switches supplied by Divisions 21, 22 and 23.
 - .2 Provide wiring and connections to sprinkler and fire standpipe pumps equipped with supervisory contacts provided by Divisions 21, 22 and 23 for 'Loss of Power', 'Phase Reversal' and 'Pump(s) Running' indications.
- .2 Motor Control Connections
 - .1 Provide all wiring and connections from the fire alarm system to motor starters as required for shut-down and/or start-up. Co-ordinate connection and location with Divisions 21, 22 and 23 for proper system operation.
 - .2 Wiring for local fans operation on smoke condition shall be installed by the electrical Subcontractor from duct mounted smoke detectors to the terminal panel adjacent to the motor control panel or the starter.
- .3 Door Device Connections
 - .1 Provide power, wiring, conduit and connections to electrical door hardware, door hold-open devices and door control (Maglocks) devices for proper release operation. Co-ordinate installation with the hardware installer.
- .4 Generator Alarm Connections
 - .1 Provide wiring, conduit and connection to the generators for supervisory status and trouble signals.

3.2 TESTING AND CERTIFICATION

- .1 Arrange with the manufacturer to conduct a complete inspection and test of all installed fire alarm and voice communication equipment including all components such as manual stations, signaling devices, heat detectors, smoke detectors, speakers, fire fighters handsets, controls, etc. Test and verify connections to equipment of other Division such as sprinkler valves, elevators, etc. Co-ordinate with and arrange for staff of other divisions to be present where required.
- .2 Provide staff to test devices and all operational features of the system for witness by the Consultant and Authority having Jurisdiction. Provide 2-way radio communication at each annunciator, control point and other areas in the building as required. All testing must be witnessed by the Owner's representative prior to acceptance.
- .3 Test and verify the total system to ensure satisfactory operation in conformance with latest version of CAN/ULC-S536 and CAN/ULC-S537, "Standard for the Verification of Fire Alarm System Installations".
- .4 Carry out testing, verification and certification as follow:

- .1 System test in conjunction with the manufacturer.
 - .2 Correction of all deficiencies.
 - .3 Submission of test results to t h e Consultant for review including letter of certification from the manufacturer(s).
 - .4 Witness of complete system by the Consultant and/or his representatives.
 - .5 Correction of any deficiencies noted.
 - .6 Acceptance of the system by the Consultant.
 - .7 Witness of system test by the Authority Having Jurisdiction.
 - .8 Correction of any deficiencies requested by the Authority Having Jurisdiction.
 - .9 Submission of manuals with final verification sheets.
- .5 All costs involved in the testing and certification shall be included in the Contract Price.

3.3 TRAINING

- .1 Provide the services of a factory-authorized service representative to demonstrate the system and train the Owner's maintenance personnel as specified below.
 - .1 Train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 hours training.
 - .2 Schedule training with the Owner at least seven days in advance.

END OF SECTION

1.0 GENERAL

1.1 SUMMARY

- 1.1.1 This Section of the Specification is an integral part of the Contract Documents and shall be read accordingly.
- 1.1.2 Comply with General Conditions, Supplementary Conditions of the Contract, and Section 26 00 00 – Electrical General Requirements
- 1.1.3 Comply with section 26 10 00 – Basic Materials & Method.
- 1.1.4 Comply with EIA/TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces.
- 1.1.5 Comply with J-STD-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.2 SCOPE

- 1.2.1 Provide empty raceway systems including conduits, terminal cabinets, plywood backboards, pull boxes, outlets and cover plates for enclosure of wiring.
- 1.2.2 Telecommunication systems include, but not limited to, voice, data, cable TV, P.A., security and access control, emergency alarm, CCTV, CATV, etc.
- 1.2.3 Co-ordinate with system contractors for all the work.
- 1.2.4 Provide P.A. speakers backboxes.

2.0 PRODUCTS

2.1 MATERIALS

- 2.1.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted in the Contract Documents. Provide stainless steel cover plates for the outlet boxes for future use.
- 2.1.2 Conduit size shall be in accordance with systems contractor's requirements and recommended standards.
- 2.1.3 Minimum pull box size shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
27mm	102mm	406mm	76mm	51mm
35mm	152mm	508mm	76mm	76mm
53mm	203mm	914mm	102mm	127mm
78mm	305mm	1219mm	127mm	152mm
103mm	381mm	1524mm	203mm	203mm

- 2.1.4 Plywood backboards shall be minimum 1200 mm x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- 2.1.5 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.
- 2.1.6 Provide grounding at each backboard.

3.0 EXECUTION

3.1 INSTALLATION

- 3.1.1 Vertically mount outlet boxes, unless noted otherwise in the Contract Documents, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

- 3.1.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord (minimum 400LB) continuously from outlet to outlet, through conduit and fasten at each box.
- 3.1.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- 3.1.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease.
- 3.1.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by systems contractors to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.
- 3.1.6 Co-ordinate with P.A. supplier for types and sizes of P.A. speakers backboxes to be provided as required by the electrical Subcontractor and proceed accordingly.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The Security Access Control System must be a fully integrated solution consisting of access control, CCTV and intrusion detection. The Security Access Control System shall be based on Lenel OnGuard 7.4 with the latest models of Mercury hardware. The intrusion solution shall be based on Bosch D9412GV4 intrusion panel and B9xx series keypad. The integration of the access control and intrusion parts of the system shall be achieved via the network for full control of both components via the server as well as on a local level for seamless offline operation. A minimum integration of ARM/DISARM and General alarm shall be guaranteed in the offline mode between the systems.
- .2 The system must be configured to arm using a card swipe and a button press. The system must disarm on the perimeter access granted – door opened event. The system shall not arm until all intrusion points are fault free. All relevant information must be displayed on the Bosch keypad as well as OnGuard interactive map. Integration between access control hardware, OnGuard software and intrusion system must be seamless in both online and offline modes.
- .3 The Contractor shall work with the Region on the technical design of the system, clarification of technical requirements, and provide a full set of technical drawings for approval before proceeding to installation. Technical Shop Drawings shall include, but not be limited to high level riser diagram(s), system riser diagram(s), network diagram(s), termination/wiring diagram(s), device landing schedule(s), intrusion detection points schedule(s), tub/enclosure layout diagram(s), and explanation of the sequence of operation, integration techniques and operational scenarios.
- .4 The installation of all required conduit, cabling and device/panel installation and termination shall be done by a licensed electrical contractor (Installation Subcontractor). The Contractor shall employ the installation services of the Region's approved licensed electrical contractors (pre-qualified Lenel System Installers) listed in section 1.2 below. All necessary cable, conduit, fittings, and other general installation hardware shall be specified by the Contractor and supplied and installed by the Installation Subcontractor. The Contractor shall be fully responsible for the work completed by its Subcontractors, including the Installation Subcontractor, electrical, locksmith and door hardware Subcontractors.
- .5 The Contractor shall be responsible for supplying the system hardware in accordance with the Contract Documents, including Specifications and Drawings provided by the Region.
- .6 The Contractor shall be responsible for providing required on-site installation training for the Installation Subcontractor, if necessary, and supporting them during the installation.
- .7 Where an item is shown on the Drawings and is specified in this Specification Section, such item shall conform to the requirements of this Specification Section.
The Contractor shall provide design drawings identifying all physical security devices at each field location in accordance with the requirements provided by York Region
- .8 The Installation Subcontractor must be, as a minimum, CANASA (Canadian Alarm and Security Association) certified. Additional certifications include CFAA (Canadian Fire Alarm Association) certified, and NFPA (National Fire Protection Association) certified.

- .9 Related documents: Conform to CANASA Canadian Alarm and Security Association installation guidelines.
- .10 Submit to the Electrical Safety Authority (ESA) and any other applicable authority the necessary number of working drawings and specifications for examination and approval prior to commencement of work as required.
- .11 Carry out all changes and alterations required by the authorized inspector of the ESA and any authority having jurisdiction without delay to the progress of the Work and without extra cost.
- .12 The Contractor shall train the Region's personnel to fully operate and perform routine maintenance on the systems and equipment installed.
- .13 The Contractor shall provide all warranty services for facility security system for a period of two (2) years from the date of Total Performance of the Work, and shall provide all necessary material required to replace defective products during this period.

1.2 LENEL SECURITY SYSTEM VALUE ADDED RESELLERS (VAR)

- .1 Security Control System shall be provided by one of the VARs prequalified under Request for Pre-qualification No. PQ-18-50 listed below. The Contractor shall ensure that the VAR provides the services as detailed in this Section:

- .1.1 The following are the pre-qualified Lenel Security System Value Added Resellers:

360 Advanced Security Corporation
Dan Baynton
dan.b@360asc.com
416-798-2228

Convergent Technologies Ltd.
Healey Willan
healey.willan@convergent.com
647-390-5159

Chubb, UTC Fire and Security Canada Inc.
Stephen Yates
stephen.yates@chubbedwards.com
905-629-2600

- .2 Installation and integration of the Lenel security system(s) shall be completed by, one of the installers pre-qualified under Request for Pre-qualification No. PQ-18-222 listed below.

- .3 The following are the pre-qualified Lenel Security System Installers (alphabetical order)

Electro-Works Ltd.
Dondi Keough
Dondi@tcsecure.ca
416-529-7180

OZZ Electric Inc.
Mr. Adrian Masci Manager
amasci@ozzelectric.com
647-628-7304

Symtech Innovations Ltd.
Brent Stewart
Brent.Stewart@symtech.com
416-559-1094

1.3 REFERENCES

- .1 EEMAC TC3 PVC Fittings for use with Rigid PVC Conduit and Tubing.
- .2 CSA C22.2 No. 211.2-06 Rigid PVC (Unplasticized) Conduit.
- .3 CAN/CSA C22.2 No. 18-06, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.

.4 Surveillance System Related References:

1. Canadian ICES-003 (Interference Causing Equipment Standard Policy)
2. Canadian Standards Association (CSA)
3. Conformity for Europe (CE)
4. Consultative Committee for International Radio (CCIR)
5. Electronic Industry Association (EIA)
6. Electrical Testing Laboratories (ETL)
7. Federal Communications Commission (FCC)
8. Joint Photographic Experts Group (JPEG)
9. Moving Picture Experts Group (MPEG)
10. National Television Systems Committee (NTSC)
11. Phase Alternating by Line (PAL)
12. Underwriters Laboratories Inc. (UL)

1.4 SOFTWARE/SYSTEM CONFIGURATION.

- .1 The Security Access Control System installed as part of this Contract shall be added to the existing Lenel OnGuard system. All programming and configuration for the work under this Contract must be consistent with the existing programming to guarantee consistent functionality of the system and all of its components across the Region.
- .2 The Contractor is only responsible for the work related to this Contract and shall NOT adjust or alter the existing configuration for any other facilities within the system without a written authorization from the Region. The Contractor shall NOT alter, modify, delete or interfere in any way with any settings, configuration or variables that may affect the functionality of the existing facilities, systems or their components without prior written authorization from the Region.
- .3 The installed Security Access Control system must be configured to meet all existing Regional standards (Security, Operational, IT). The Contractor shall be responsible for collecting the requirements, developing a custom solution to meet the requirements, and presenting available options in a form of an implementation plan to the Region for approval before implementing the solution.
- .4 All software licensing must be detailed, supplied and installed to operate the security solution. The Contractor shall supply and install the necessary Lenel Bosch integration licenses, card reader licenses and workstation license. It is the Contractor's responsibility to quantify and provide the number of licenses required based on the Drawings and Specifications provided in the Contract Documents. All costs associated with provision of the required licenses shall be included in the Contract Price.
- .5 The Contractor shall work with the Region's IT department to perform application or database server programming and/or configuration. All work requiring access to the database and/or application servers must be coordinated with the Region a minimum of one week in advance.
- .6 All server, network, and other requirements shall be coordinated with the Regional IT Services department and validated by the manufacturer prior to installation. All servers and network switches shall be provided by the Region unless specified otherwise in the Contract Documents.
- .6 The software and/or system deployment and configuration shall be overseen and validated by the Regional representative(s).

- .7 The Contractor shall create graphical map interface for the system, making it same or similar in appearance and functionality to the existing graphical maps. The graphical map interface shall be multilayer hierarchy with the main map represented as a map of York Region with municipality boundaries. The Regional facilities shall be represented by different icons depicting corporate, environmental, transportation, paramedic and other departments. Each facility shall be represented by the architectural floor plan, uploaded from the Region provided AutoCAD drawing, multilayered, if necessary, for areas, floors, buildings. The graphical interface shall represent all field devices and their associated status types, including but not limited to armed, disarmed, normal, forced, held open, locked, unlocked, tamper, on schedule, offline, etc. The Contractor shall use the existing custom dynamic icons to populate the graphical interface or create new if necessary.

1.5 SUBMITTALS

- .1 The Contractor shall submit prior to the start of construction all relevant technical documentation, complete set of technical drawings and specifications.
- .2 The Contractor is required to present adequate documentation covering the entire scope and extent of the completed work prior to Substantial Performance of Work, including but not limited to:
- a) Theory of Operation – system outline and overview
 - b) System Configuration and Administration - Description of details required to prepare the System for implementation, including system planning, layout, functionality and configuration options
 - c) Operation - Submission of operational manuals explaining the system operator's available features, functions, and capabilities
 - d) Administration - Submission of system administration manuals including operational and maintenance requirements and procedures associated with the proposed solution. Description of administrative functions required to supervise and manage the integrated System
 - e) Product Manuals – Submission of complete manufacturer's manuals for all System software and hardware components. Specifications, by make and model, for all devices used must be submitted. The Contractor shall provide a full set of maintenance manuals and operating instructions in electronic format on a USB portable hard drive. This shall include comprehensive descriptive data sheets, brochures, installation, and technical manuals for all systems and equipment forming part of the contract. The manuals shall include operational and schematic diagrams for the System and all related components
 - f) The Contractor shall submit a full schedule of maintenance to be carried out on each system component during the warranty period of 24 months after the date of Total Performance of the Work and for entire lifetime of the system and its components
 - g) As-built drawings – the Contractor shall provide a digital copy and one full hardcopy set of accurate As-built drawings depicting the entire scope of work, including but not limited to network connectivity diagrams, high level riser diagram(s), system riser diagram(s), vertical and horizontal wiring diagrams,

termination/wiring schematic(s), device landing schedule(s), intrusion detection points schedule(s), tub/enclosure layout diagram(s), explanation of the sequence of operation, integration techniques and operational scenarios, addressing charts and other relevant information, product specifications, and cut-sheets, as-built floor plans and detailed commissioning documentation. In addition all technical notes, scripts and other documentation covering the IT portion of the Work specified in the Contract Documents.

1.6 TESTING AND QUALITY ASSURANCE

- .1 The Contractor shall ensure all hardware and software components are functioning as intended within the Region's IT and network environment.
- .2 At the discretion of the Region, final acceptance testing shall be carried out at the following defined levels: per point basis; per system component basis; per software function basis; and per total system basis.
- .3 The Contractor shall test and verify the proper installation and functionality of the system and all of its components including integration to the systems described in this Section, application and database integration as well as online and offline operation to the satisfaction of the Region.
- .4 The Contractor shall inspect all installed devices and equipment for visible damage or tampering which may interfere with the intended system functionality.
- .5 The Contractor shall test all field devices and system components that are configurable or adjustable to ensure proper settings and intended functionality at the location of installation. All configurable settings must be approved by the Region prior to installation. The Contractor shall operate all field devices to verify proper functionality.
- .6 For all failed tests the Contractor shall make all necessary repairs and perform retests. Failure of the test may require the retest of one or more individual tests. Repairs and retests shall be by the Contractor until all tests are passed to the Region's satisfaction without extra cost to the Region.

1.7 TRAINING

- .1 Adequate training shall be provided to the Regional staff including but not limited to system operators, administrators and support staff. A minimum of 4 hours of system training shall be provided to the Regional staff.
- .2 System instruction shall include complete information regarding system operations, management and maintenance. Training sessions must be clearly identified and broken down into significant topics.
- .3 Training documentation shall be developed by the Contractor in adequate quantities to satisfy requirements of the training; and submitted by the Contractor for future reference by the client in printed and electronic formats.
- .4 The Contractor shall also assist the Region in configuring, and/or reconfiguring, and populating, and/or repopulating all System related databases, integrations, configuring and/or reconfiguring all the system parameters to the Region's satisfaction. The Contractor's assistance shall continue until initial configurations and integrations are complete and functional, and/or until all system parameters are working to the Region's

satisfaction. Assistance shall be one technician working side by side with the Region's representative(s) assisting and instructing the Region's representative(s) step by step in configuring system parameters and integration configurations to the systems outlined in the Contract Documents.

- .5 Training shall cover all aspects of all the systems and subsystems under the Scope of the Work included in the Contract Documents.

1.8 NETWORK TCP/IP COORDINATION

- .1 The Region's Project Manager will coordinate for the installation of a network system component with ITS (Information Technology Services) Department and the appropriate BSA (Business System Analyst) at the Site to allow for communications to the database server(s) at Region's Central Monitoring Station to perform final tie in and commissioning.
- .2 If local IT Network infrastructure is not present, Wireless 3G/LTE network equipment shall be used. York Region ITS will supply the pre-configured Wireless Modem and network switch as well as installation specifics.
- .3 The Contractor shall install all required conduits and junction boxes as well as the exterior antenna for the Wireless equipment, in a location determined by ITS to achieve adequate network connectivity.
Network switch is to be located within the Lenel security system cabinet. Both modem and switch shall be powered from Lenel UPS power supplies.

1.9 SHOP DRAWINGS

- .1 Submit shop drawings showing the proposed location of all equipment to be installed under this Contract.
- .2 Shop drawings submission shall include:
 - .1 Schematic
 - .2 Wiring
 - .3 Interconnection Diagrams
- .3 Additional Requirements:
 - .1 For devices containing dip switches, jumpers or programming keypads include:
 - .1 Functional description.
 - .2 Performance data.
 - .3 Physical, electrical and environmental requirements.
 - .4 Location drawing.
 - .5 Equipment descriptive literature.
 - .6 Wiring details.
 - .2 For programmable equipment, communication links and networks, submit bill of materials. Include in bill of materials hardware documentation.
 - .1 For hardware items include and clearly identify: Description, make, model, part number and serial number.
 - .2 For documentation include: Title and publisher for each item.
 - .3 For Programmable Equipment Hardware include:
 - .1 Product description for each item including:

- .1 Wiring and installation instructions.
 - .2 Functional description.
 - .3 Performance data.
 - .4 Physical, electrical and environmental requirements.
 - .5 Adapters and controllers.
 - .2 Equipment layout drawings showing location of hardware, boards, jacks, cables and terminals.
 - .3 Related field tag numbers and wire numbers, module tag assignment, rack module assignment, terminal and terminal strip numbers.
 - .4 Location and identifier and pin assignment of plugs, jacks, and cables.
 - .5 Switch settings and addresses, firmware.
 - .6 Interconnection Diagrams including wiring, cables, jacks between internal and external components, power supplies, processors, communications modules, racks, input/output modules and peripherals. Label terminals, jacks and pins. Show settings for jumpers and switches. Show address for each hardware module and point.
- .4 Review of shop drawings shall be in reference to general design only. Review of the shop drawings shall not in any way relieve the Contractor of responsibility for errors or interference, or from the necessity of furnishing such works and materials as may be required for the completion of the work at any time until formal acceptance.

2 PRODUCTS

2.1 CONTROL PANEL

- .1 Lenel Intelligent System Controllers (To be specified by the Contractor during the design of the security system).
 - LNL-2220 Intelligent Dual Reader Controller (IDRC) provides a single board solution for interfacing one or two doors to an OnGuard® system. On-board Ethernet 10/100Base-T port, 6 MB on-board, non-volatile flash memory, Battery-backed, non-volatile storage of 50,000 events, 16 different formats, 12 or 24 VDC input power, 32 downstream devices.
 - The LNL-3300 Intelligent System Controller (ISC) by Lenel is designed for advanced access control applications. On-board Ethernet 10/100Base-T port, 15 MB on-board, non-volatile flash memory, Battery-backed, non-volatile storage of 50,000 events, 16 different formats, 12 or 24 VDC input power, 64 downstream devices via two individual downstream RS-485 ports.
 - The LNL-4420 is an Advanced Dual Reader Controller by Lenel that provides a single-board solution for interfacing up to 64 doors, plus auxiliary inputs and outputs, to an OnGuard® system.
- .2 Bosch D9412GV4 Control Panel Alarm Panel for intrusion devices: Burg, Commercial Panel 246 individually identified points, 32 areas. ULC listed. To be used in combination with Bosch B426 Conettix Ethernet Communication Module.
- .4 Back up UPS Pro to power all security, access control and wireless network solution. Model to be used is Antigen-presenting cell ("APC") Pro BR 1500G or equivalent. The UPS must reside on an isolated and dedicated AC circuit fed from emergency power panel wherever available.

2.2 KEYPAD

- .1 Bosch B942 Touch Screen Keypad for office corporate sites.

Input/Output module

- .1 LNL-1100: Series 3 Lenel® Input Control Module (ICM) provides the access control system with high-speed acknowledgement of critical alarm points in monitored areas. 16 configurable input control points, 2 output control relays, supports normally open, normally closed, supervised and non-supervised circuits, Grade B, A, and AA line supervision, 12 or 24 VDC input power, Elevator control, support for 128 floors, Advanced Encryption Standard (AES) 128-bit or 256-bit encryption.
- .2 LNL-1200 Series 3: Lenel® Output Control Module (OCM). 16 Form-C 5 A, 30 VDC contacts for load switching, 2 dedicated digital inputs for tamper and power failure status, Elevator control, support for 128 floors, Advanced Encryption Standard (AES) 128-bit or 256-bit encryption.
- .3 Bosch B208 SDI2 8-Input Expansion Module
- .4 Bosch B308 SDI2 8-Output Expansion Module

2.3 WEIGAND INTERFACE UNIT

- .1 LNL-1300 Series 3: Single Reader Interface (SRI) Module. Access control card readers, keypads, or readers with keypads that use standard Wiegand Data1/Data0, Supervised or Unsupervised F2F, or Clock/Data communication are supported, as are those supporting the bidirectional RS-485 Open Supervised Device Protocol (OSDP™). 12 or 24 VDC power supply, Two Form-C relay outputs (5 A door strike and 1 A aux relays), Up to 16 different card formats, Door contact and REX open or closed, supervised or non-supervised, Strike control output
- .2 LNL-1320 Series 3: Dual Reader Interface (DRI) Module: Access control card readers, keypads, or readers with keypads that use standard Wiegand Data1/Data0, Supervised or Unsupervised F2F, or Clock/Data communication are supported, as are those supporting the bidirectional RS-485 Open Supervised Device Protocol (OSDP™). 12 or 24 VDC power supply, Six Form-C 5 A at 28 VDC relay outputs, Up to 16 different formats, Door contact and REX open or closed, supervised or non-supervised, Strike control output, Dedicated tamper and power failure circuits, On-board regulator allows 12 VDC reader support from 24 VDC power source
- .3 LNL-8000: The Star Multiplexer from Lenel is designed to implement star topology on a downstream port of any Lenel® Intelligent System Controller or on any host communication port of any OnGuard® server. Up to eight RS-485 (2-wire) connections or four RS-485 (4-wire) connections can be made downstream of the LNL-8000. Host communications - 38.4 Kbps direct wire (RS-232/RS-485 multi-dropped), 12 VDC input power, Status LEDs for heartbeat, upstream and downstream communication.

2.4 MULTITECHNOLOGY ICLASS READER

- .1 Card Readers: Provide multi-technology iClass / proximity card readers where shown on the Drawings and/or where required by the Contract. Card Readers shall be rated for indoor and outdoor use, have multicolour LED with beeper for operator status indications and will operate on 5-16 VDC. Provide thin line mullion style readers where required to match door frame configuration.
- .2 HID Corporation, Multi-technology card reader RP15/RP40/RPK40.

2.5 PROXIMITY CARD

- .1 Proximity Cards used by the Region are HID Corporation ProxCard II, HU-1326LSSSV
- .2 The Contractor is not required to supply proximity cards to the Region

2.6 DOOR CONTACTS

- .1 Magnetic door contacts.
- .2 GE Security/Interlogix 1078, or equivalent
- .3 Interlogix SR-2207ADL Overhead door contact or equivalent. Overhead door contact to be installed off the ground. Alternative solution might be required based on door type, mounting requirements, and environment.
- .4 Sentrol 2800T Series Magnetic explosion proof door contacts to be used in Class 1, Div.1 and Div.2 classified areas.
- .5 Honeywell LSX Series mechanical explosion proof overhead door contacts to be used in Class 1, Div.1 and Div.2 classified areas.

2.7 BATTERIES

- .1 Gel Cell back-up batteries, 12V, 7 amp-hours.
- .2 Exaltor, UltraTech or equivalent.

2.8 EXIT DEVICE/PANIC BARS

- .1 Push pad exit device, dull chrome finish, UL Listed Panic Hardware FVSR SA163 (N), tested in accordance to ANSI A156.3, 1989, Grade 1.
- .2 Von Duprin 99K-NL Series Exit Devices, or equivalent.

2.9 ELECTRIC DOOR STRIKES

- .1 Heavy duty, stainless steel construction, 3000 lbs. Static strength, UL 1034, ANSI/BHMA Grade 1, .25 Amps @ 24VDC.
- .2 Hess Inc. Series Strikes 1006, or equivalent.

2.10 **ELECTRICAL POWER TRANSFER**

- .1 Transfer of electrical power from door frame to the edge of a swinging door; two (2) 18 AWG wiring, 24VDC, 2A, 16A maximum surge.
- .2 Von Duprin Inc. EPT-2, or equivalent.

2.11 **TRANSFORMERS**

- .1 120V input, 16V output, 40VA, 60 Hz, single phase rating, copper conductors, dry type
- .2 Transformers shall be designed, constructed and rated in accordance with UL, CSA and NEMA standards.
- .3 All transformers to be from the same manufacturer.
- .4 ATC Frost Magnetic Inc., 1640, or equivalent.

2.12 **REQUEST TO EXIT SENSORS**

- .1 Wall mount high impact ABS plastic enclosure, alarm output: form "C" contact, single or double door use, adjustable to 60s, UL Listed.
- .2 Honeywell IS310, or equivalent.

2.13 **PUSH BUTTONS**

- EXIT PUSH BUTTON
- .1 Wall mount brushed stainless steel plate enclosure, momentary switch output, SPDT 10A @ 125/250 VAC, UL Listed.
- .2 Tyco Security Products - Kantech PB-EXIT, or equivalent.
- ARMING PUSH BUTTON
- .3 RCI R991RBPTD9 Wall mount brushed stainless steel plate enclosure, push button with pneumatic time delay, blank red button.

2.14 **MOTION DETECTORS**

- .1 Wall mount motion monitor with temperature compensation, high impact ABS plastic enclosure, alarm output: form "C" contact, 125mA @ 28 VDC, tamper and trouble output contacts, UL Listed.
- .2 Detection Systems DS940Q, Optex DX40 or equivalent.

2.15 **AUDIO ANNUNCIATOR**

- .1 Wall mount, 24VDC, 100dB @ 10', UL Listed.
- .2 Toxalert Inc. HORN/REM, or equivalent.

2.16 **DIGITAL VIDEO MANAGEMENT SYSTEM (DVMS)**

- .1 Lenel Milestone XProtect® Expert Digital Video Management System. The Digital Video Management System (DVMS) shall be designed and developed to the following standards:

- ISO 9001 (2000)
- ISO/IEC 15504 Level 3 or higher
(SPICE 2.0 Software Process Improvement and Capability Determination)
- SEI CMM Level 3 or higher
(American Software Engineering Institute - Capability Maturity Model)

The Digital Video Management System shall include:

- Database Server(s)
- Application Server(s)
- Local recording Networked Camera Server(s) with appropriate software and databases as required
- Operator Workstations
- Network connected cameras and/or network connected video encoders
- Continuous Recording capability for a minimum thirty (30) days at 30 frames per second (note: see more on the attached camera configuration parameters)

- .2 The Digital Video Management System ("DVMS") shall be capable to support unlimited number of cameras.

As a minimum, the system must support all latest Axis network cameras, encoders and camera streamers.

- .3 The following DVMS equipment must be used:

- Camera Streamers / Video Encoders:
 - AXIS Communications
- PTZ Network Cameras:
 - AXIS Communications Q6055-E
- Fixed Indoor Dome Cameras:
 - AXIS Communications P3375-LV
- Fixed Outdoor Dome Cameras:
 - AXIS Communications P3375-LVE
- Fixed 360 Indoor/Outdoor Camera:
 - AXIS Communications P3707-PE

Use the latest generation of the abovementioned equipment.

The DVMS shall support at least industry-standard Motion JPEG, MPEG-4, H.264, and H.265 as well as Axis's Zipstream technology encoding formats.

- .3 The DVMS system shall be fully integrated with the Lenel OnGuard 7.4 or higher. Lenel OnGuard shall be used as the primary user interface.

.4 Network and Video Cabling

A Local Area Network (LAN) shall be provided for communication between the system elements. All interfaces to the LAN shall be a minimum of 1000BaseTX Ethernet. The LAN may use additional technologies within the backbone for greater speed or distance.

Acceptable types are:

- o FDDI (Fiber Distribution Data Interface)
- o 1000BaseSX or 1000BaseLX Gigabit Ethernet
- o Asynchronous Transfer Mode (ATM)
- o 1000BASE-TX

The LAN shall use standard network cables. Acceptable cable types are:

- o Optical Fiber
- o Category 6 or greater Unshielded Twisted Pair (UTP)

The LAN shall be logically and/or physically separate from any existing LAN infrastructure. Interconnection to other LANs shall be through one of the following:

- o A router
- o A Layer 3 capable network switch
- o As an additional VLAN to the existing LAN equipment. Where required to interconnect VLANs, a router or Layer 3 capable switch shall be provided

.5 It is not acceptable for network video cables to be run back to the Camera Server. All communications with the Camera Server shall be via the LAN. Each network camera or video streamer shall have a single network interface to be used for video and Pan/Tilt/Zoom communications.

.6 Supply a complete and working Closed-Circuit Television System (CCTV) System and Digital Video Management System (DVMS).

2.17 **CONDUIT, FASTENINGS AND FITTINGS**

.1 Comply with OESC

.2 Rigid PVC conduit: Conduit, including elbows and fitting, Schedule 40 wall thickness, solvent weld connections, by IPEX Inc., Carlon or equivalent.

.3 Conduit straps for rigid steel and PVC conduit: Malleable iron, hot-dip galvanized, single hole type for conduits up to 50 mm, two-hole type for conduits larger than 50 mm.

.4 Beam clamps: Hot dip galvanized steel designed to clamp onto both sides of the flange. Cat. #S997BC-HG (100-230 mm flange) by Sasco Tube & Roll Forming Inc., Cat. #S999BC-HA (175-430 mm flange) by Sasco Tube & Roll Forming Inc., or type CS91 by Construt Inc. or equivalent.

.5 Rigid PVC conduit connectors: Adapter type with threaded male portion, by IPEX Inc., Carlon or equivalent.

.6 Expansion couplings: With ground straps or clamps. Type XJ by Cooper Crouse-Hinds Canada or equivalent.

.7 Swivel couplings: Threaded, one piece, by Elliot Electrical Manufacturing Co. Running threads are not acceptable or equivalent.

- .8 Conduit spacers: Malleable iron, sized to suite conduit size, by O-Z/Gedney Co., or 1300 Series by Thomas & Betts Ltd or equivalent.
- .9 Pull cords: 6 mm polypropylene or nylon material. Pro-pull rope by Ideal. Industries Inc.
- .10 Bituminous backpaint: In accordance with CAN/CGSB-1.108.

2.18 **WIRING AND MISCELLANEOUS**

- .1 Provide all RS-232, RS-485, Optical Fibre and Ethernet cabling, and Fibre and Ethernet jacks as required for a complete network, if applicable. Direct burial cable for all outdoor applications.
- .2 RS-485 Cables
 - .1 EIA Industrial RS-485.
 - .2 Conductors: Twisted pair, each conductor No. 22 AWG stranded copper.
 - .1 Pairs: 2.
 - .2 Shield: Aluminum-polyester and 90% copper tinned braid.
 - .3 Jacket: Black UV resistant PVC.
 - .4 Electrical Characteristics at 20°C
 - .1 Capacitance: 36.1 pF/m
 - .2 Impedance: 120 ohms
 - .3 Propagation Velocity: 78%
 - .5 Belden Datalene Insulated 3107A.
- .3 Lenel hardware wiring shall follow the below wiring guide:

Purpose	Cable type	Gauge	Cond.	Description	Belden number
RS-485, 4-wire	Non-plenum	24	2P	Overall shield	9842
RS-485, 4-wire	Plenum	24	2P	Overall shield	88102
RS-232	Non-plenum	24	5	Overall shield	9610
	Plenum	24	6	Overall shield	83506
Reader drops	Non-plenum	24	2P	Overall shield	9502
	Non-plenum	22/24	6	Overall shield	5504FE, 9536
	Plenum	22/24	6	Overall shield	6504FE
12 VDC power	Non-plenum	18	2	Overall shield	5300FE, 8760
	Plenum	18	2	Overall shield	6300FE, 88760

.4 CAT6A Cables

- .1 Conform with the following plenum rated Ethernet 1000BASE-TX TIA/EIA 568-B.2-1 Category 6 cable:
 - .1 CSA Certified for trays and risers.
 - .2 Conductors: Unshielded twisted pair, #23 AWG solid copper.
 - .3 Pairs: 4
 - .4 Jacket: Purple Flamearrest, CSA FT4/FT6 rating.
 - .5 Certification/Testing to Category 6 in accordance with the current TIA/ISO Channel Standards.
 - .6 Belden Inc. #2400 or equivalent.

.4 Instrumentation Cables (4-20mA)

- .1 Belden Inc. #8760 or equivalent.
 - .1 #18 AWG.
 - .2 16-stranded copper.
 - .3 Beldfoil aluminium polyester shield.
 - .4 Twisted shielded pair.
 - .5 Bare #20AWG copper drain wire.

.7 Wiring Accessories

- .1 Wire and cable markers: Printable, self-laminating, self-adhesive markers, white background, black lettering on white background, vinyl plastic or polyester film suitable to environment. Wire marker to be sleeved with clear heatshrink tubing.
- .2 Terminal blocks: 600 V, 25 A minimum rating, modular, 35 mm DIN rail mounted, provision for circuit number labelling, individually removable, sized to accommodate conductor size and circuit current. Sak Series by Weidmuller Ltd., UK Series by Phoenix Terminal Blocks Ltd., WK Series by Wieland Electric Inc., ABB Entrelec or equivalent.
- .3 Field wiring terminations: Where screw-type terminal blocks are provided, supply insulated fork tongue terminals. Sta-Kon by Thomas & Betts Ltd., Scotchlok by 3M Canada Inc or equivalent.
- .4 Moisture and waterproofing: In wet locations, with Liquid Tape by Ideal Industries Canada Corp. or equivalent.
- .5 Cables ties: Nylon, one-piece, self-locking type, by Thomas & Betts Ltd., Burndy Inc., Wieland Electric Inc or equivalent or equivalent.
- .6 Electrical insulating tape: Scotch 33 by 3M Canada Inc or equivalent.
- .7 Cable grips: To accommodate type and geometry of cable supported, single weave, variable mesh design, by Thomas and Betts Ltd., Crouse Hinds, Woodhead Canada Ltd or equivalent.

- .8 Cable pulling lubricant: Compatible with cable covering and not to cause damage or corrosion to conduits or ducts. Yellow or clear 77 by Ideal Industries Canada Corp. or equivalent.
- .9 Input 120VAC power to all security related access control panels must be provided at each location identified in the design drawings and must be dedicated and isolated from any other loads.

2.19 **LOCKSMITHING AND DOOR HARDWARE**

- .1 All doors to be equipped as outlined in the associated Security Device Summary document. Where specifics are not available, doors should be equipped with Sergeant, Assa Abloy or Corbin locksets, compatible with future replacement of the cylinder core with a Medeco M3 IC core cylinder.
- .2 Interior exiting through any door (not overhead doors) should involve the use of a push paddle exit device installed at a standard height.

3 EXECUTION

3.1 **INSTALLATION – CONDUITS**

- .1 Connect conduits to electrical boxes and electrical equipment enclosures in wet or sprinkle system equipped areas with watertight conduit connectors.
- .2 Install conduits to conserve headroom in exposed locations and to minimize interference in spaces through which they pass.
- .3 Install conduits 150 mm minimum clear of steam and hot water pipes and 1000 mm minimum clear of heaters.
- .4 Provide rigid galvanized steel conduits, minimum trade size 19 mm for concealed or exposed conduits and 25 mm for conduits embedded in concrete.
- .5 Provide rigid PVC conduit underground or in corrosive areas. Provide 50 mm thick concrete tiles to protect direct buried PVC conduit. Direct burial cable type to be used in all underground applications.
- .6 For conduit systems in or running through hazardous areas, provide conduit, fittings, seals and associated components complying with OESC.
- .7 Install exposed conduits symmetrical with building construction and with accepted bends or pull boxes where conduits change direction.
- .8 Provide expansion fittings in straight conduit runs exceeding 60 m and at building expansion joints.
- .9 Install conduits and fittings surface mounted.
- .10 Install conduits recessed in brick or bare concrete block walls as walls are being erected. Do not cut into walls after walls are in place. Do not install horizontal runs in masonry walls. Do not install conduits in terrazzo or concrete toppings.

- .11 Attach exposed conduits in place with galvanized steel hangers one-hole straps spaced at 1300 mm centres maximum. Group conduits together whenever possible. Use galvanized steel hangers and supports. Perforated straps are not acceptable.
- .12 Provide pipe spacers for exposed conduits on concrete or masonry walls.
- .13 Provide drill-in type expansion bolts and machine screws for supporting hangers and straps.
- .14 Locate conduits penetrating floors, permitting direct vertical connection with minimal bending.
- .15 Provide flexible liquid-tight conduit between rigid conduit system and equipment which may be subject to vibration or adjustment, such as motors or motorized equipment.
- .16 Provide flexible metal conduit between junction boxes and luminaries in office areas and outlets within office partitions.
- .17 For building interior concrete wall and floor penetrations excluding penetrations into wet wells or hazardous chambers, install Schedule 40 galvanized steel pipe conduit sleeves, protruding 50 mm through floors and flush with wall surfaces prior to pouring concrete. Size sleeve for free passage of conduit. Seal all penetrations for fire separation in accordance with the OBC.
- .18 Size conduits according to Inspection Authority (ESA) requirements.
- .19 Route conduits to avoid beams, columns and other obstructions.
- .20 To prevent corrosion of concrete embedded conduits, prior to concrete placement, apply 40 microns minimum of bituminous backpaint to conduit exterior surface at concrete entry points (150 mm inside and 100 mm outside the concrete).
- .21 Embedded conduits: Ensure that the maximum outside diameter of concrete embedded conduit is 1/3 of the structural slab thickness measured at thinnest point. Ensure minimum space between each conduit running parallel is 3 times the O.D. of largest conduit. Do not run conduits running parallel to beam axes, directly above beams. Offset conduits running parallel to beams by a minimum of 300 mm minimum from face of beam to outside wall of conduit. Cross conduits at right angles wherever possible. Run conduits in space between layers of reinforcing steel without deforming reinforcing steel pattern.
- .22 Cut PVC jacket conduit thread removing plastic jacket. Coat exposed metal with zinc rich primer. Tighten conduit utilizing strap wrenches. Coat damaged conduit surfaces and exposed threads as recommended by conduit manufacturer.
- .23 Coat damaged surfaces and exposed threads of corrosion resistant conduit as recommended by conduit manufacturer.
- .24 Ream cut conduits to remove burrs; paint completed galvanized steel joints and field cut threads with zinc rich primer paint.
- .25 Clean conduit run with an accepted cleaner equipped with a mandrel.

- .26 Provide watertight, steel capped bushings on ends.
- .27 Install expansion fittings on dry side of plastic water stops where required.
- .28 Where conduits pass through a waterproof membrane, provide an oversized sleeve before membrane is installed. Use cold mastic between sleeves and conduits.
- .29 Do not commence surface conduit installation Work until masonry ceiling, wall and floor finishes are completed. Finish surface mounted conduit installation Work prior to painting.
- .30 Touch up and repair coated conduits and fittings including any exposed threads with compound material supplied by conduit manufacturer.
- .31 For flush mounted panelboards, provide two 25 mm empty conduits (minimum) up to ceiling space and where applicable, two 25 mm empty conduits (minimum) down through floor into ceiling or basement space below.
- .32 Provide pull cords in conduits with 1000 mm of slack at each end.

3.2 INSTALLATION – WIRES AND CABLES

- .1 Provide wires of number and size (including corresponding raceways) required, with space conductors as indicated in the Drawings. Provide adequate wiring for actual equipment installed.
- .2 Provide wire and cable according to the drawings and security system requirements.
- .3 Pull cable into ducts, conduits and cable trays in accordance with cable manufacturer's recommendations. Use patented cable grips suitable for cable type, or pulling eyes fastened directly onto cable conductors.
- .4 Limit pulling tension and minimum bending radii to those recommended by manufacturer.
- .5 Prevent damage to cable jackets by utilizing adequate lubricant when pulling cables through ducts and conduits.
- .6 Support cables in manholes and utility tunnels on cable trays or cable racks.
- .7 Arrange cables in parallel rows on cable trays. Maintain cable spacing by fastening cables, with Velcro, a minimum of every 2000 mm minimum on straight horizontal runs and to each rung at bends, including two rungs of adjoining straight sections. Fasten cables on vertical tray runs every 1000 mm.
- .8 Connect cables to electrical boxes and equipment enclosures located in outdoor, wet or sprinkled areas with watertight cable connectors.
- .9 Provide cable grips for vertical and catenary cable suspension installations to reduce cable tension at connectors and at cable bends.
- .10 Install through wiring in junctions and pull boxes having no connection within the box. Leave a minimum of 150 mm of slack inside box.

- .11 Facilitate making of joints and connections by leaving sufficient slack in each conductor at panelboards, outlet boxes and other devices.
- .12 Do not connect more than three lighting circuits for three phase panels and two lighting circuits for single phase panels to a common neutral.
- .13 Use #10 AWG minimum for home runs to lighting panels exceeding 25 m.
- .14 Install instrumentation/system signal wires in separate raceways from power and control wiring.
- .15 Provide mechanical protection for cables within 1500 mm of the floor in buildings and within 2000 mm above grade outdoors.
- .16 Identify each cable by attaching a cable marker at each end, in all intermediate manholes, junction boxes and pull boxes.
- .17 Provide cable grips on vertical and horizontal cable suspensions.
- .18 Install cables to conserve headroom in exposed locations and to minimize the amount of interference in spaces through which they pass.
- .19 Do not install horizontal runs in hollow masonry walls.
- .20 Passage through any structural member or precast slab must be approved by the Consultant.
- .21 Where exposed, install raceways and cables parallel with building lines and group neatly.
- .22 Maintain the integrity of all fire separations by sealing around all cables where they pass through any fire barriers. Generally this includes all floors ceilings and concrete and masonry walls.
- .23 As far as is practicable, all feeder wiring shall be continuous from origin to panel termination without running splices in intermediate pull boxes or splicing chambers. Sufficient slack shall be left at the termination point to make proper connections to the equipment.
- .24 Do not embed armoured cables in concrete.

3.3 INSTALLATION – LENEL ONGUARD SYSTEM AND SECURITY DEVICES

- .1 Supply, install, test, and commission Lenel OnGuard system components, communication equipment, and associated equipment to ensure the functionality of complete security system and network. Report all construction defects which will affect the progress of the Work to the Region and the Consultant.
- .2 The Drawings have been developed on a conceptual basis. The Contractor is responsible for providing/verifying the quantities and part numbers contained in the following table, and for all additional components, cables, etc. required to complete the Work as defined in the Specifications and on the Drawings. Break down the Bill of Materials by room number.. The following table lists typical parts for the security system design. This list is to be used as a reference only. The detailed design to be done by the Contractor shall verify part numbers and quantities required.

Part#	Description
Access Control	
LNL-2220	Intelligent Dual Reader Controller
LNL-3300	Intelligent System Controller
LNL-4420	Advanced Dual Reader Controller
LNL-1300	Single Reader Interface Module
LNL-1320	Dual Reader Interface Module
LNL-1100	Input Control Module
LNL-1200	Output Control Module
RP15/RP40/RPK40	HID Corporation, Multi technology card reader to suit application
1078 or equivalent	Magnetic Door Contact
SR-2207ADL	Overhead Door Contact
LSXA3K1	Explosion Proof Mechanical Door Contact /w accessories to suit application
2800T	Sentrol 2800T Series Magnetic explosion proof door contacts
CK-IS310	REX Motion
2966906 PHOENIX	SPST Relay 12VDC with base or equivalent railmount
2912497 PHOENIX	SPDT Relay 12VDC with base or equivalent railmount
IM-1270	12V/7AH Backup Battery
LSP MCLASS	Life Safety Power MCLASS FlexPower Power Supply with backplate, no wire management. Enclosure by Hoffman
Hoffman NEMA 2 Enclosure	Hoffman enclosure to suit application and to fit corresponding LiSP backplate
Hoffman NAME 3 Enclosure	Hoffman enclosure to suit application and to fit corresponding LiSP backplate
Hoffman Nema 4 Enclosure	Hoffman enclosure to suit application and to fit corresponding LiSP backplate
R991RBPTD9	Arming Button, w/delay RED Blank
Hes 1006 KD	Hes 1006 KD 630 Electric Strike (provided by Locksmith)
Hes 9600	ES 9600 The surface mounted, windstorm rated solution for rim exit devices (Provided by Locksmith)
Intrusion	
D9412GV4	Bosch D9412GV4 Control Panel Alarm Panel
B208 SDI2	Bosch B208 SDI2 8-Input Expansion Module
B308 SDI2	Bosch B308 SDI2 8-Output Expansion Module
B942	Bosch B942 Touch Screen Keypad
B930 ATM	Bosch B930 ATM Style-Alpha Numeric Keypad (SD12)
B56	B56 Keypad Surface Mount Box
B426	Bosch B426 Conettix Ethernet Communication Module
FG-1625F or equivalent	Glass Break Detector
DS940Q, Optex DX40 or equivalent	Motion Detector

- .3 A minimum of 20% of alarm inputs and 20% of relay outputs to remain as spare. Unless otherwise noted in the Contract Drawings the Lenel security system inputs and outputs shall be 80% full, leaving 20% spare capacity.
- .4 The Lenel Controllers and Bosch hardware and additional nodes, if required during the detailed design, to be housed in NEMA 2, NEMA 3, or NEMA 4 rated Hoffman Enclosures or equivalent to suit application. Enclosures to be wall mounted and located as shown on the drawings. Equipment location and other mounting locations may be re-located with prior approval from the Region.
- .5 Life Safety Power MCLASS FlexPower Power Supply with backplate and power distribution modules to be used for the system design. Hoffman Enclosures or equivalent to be used to suit application. Enclosure and Power Supply solution to be presented to the Region for approval.
- .6 All Control Panels, where applicable, to be equipped with battery backup supply. Control Panel batteries to consist of 12V, 7AH.
- .7 Lenel and Bosch Security Systems and all other equipment to be installed according to the manufacturer's recommendations.
- .8 The Security System Device Summary shown on drawing E10.0 is to be the primary document used when designing the system.

PLEASE REFER TO THE MARKED DRAWINGS AND THE SECURITY DEVICE SUMMARY DOCUMENT FOR THE SPECIFIC SECURITY AND LOCKSMITHING REQUIREMENTS.

- .9 The Contractor shall supply all necessary wiring, termination equipment/devices and other necessary equipment not specified in the Contract Documents but which is necessary to implement a fully functional Lenel OnGuard security system and mechanical/electromechanical key lock system. Details for lock placement, function and keying can be found in the associated Security Device Summary drawing E10.0
- .10 All wires shall be CSA approved and have a flame test value equal to, or greater than, that required by the local building or fire code where it is being used, including the OBC.
- .11 End of line supervision shall be used on all installations. End of line resistors shall be installed at the detection device and not the control panel.
- .12 All devices should be installed with a continuous, splice free cable run.
- .13 If splices are required, the splices shall be made in OESC approved junction boxes. Splice box locations shall be marked on the wiring diagram.
- .14 Wire lists shall be permanently affixed inside the control panel.
- .15 Security wiring should not run in parallel within 12" of 110 V AC or higher voltage electrical wiring or conduit.
- .16 All applicable local, provincial or federal codes shall be followed.

- .17 The location of equipment shown on Drawings may be revised by the Consultant during construction, and the Contractor shall not be entitled to any additional costs for the relocation of equipment provide that the new the location is within 6 meters of original location.
- .18 Install transformers complete with mounting brackets and hardware in positions in accordance with the manufacturer's instructions.
- .19 The Contractor shall provide all necessary lugs and mounting equipment which is not already provided with transformers.
- .20 The facility to communicate with Lenel OnGuard database server at Region Headquarters via TCP/IP. Activation of switch/hub ports on networking equipment maintained by Region's Information Technology Services Group ("ITS") to be co-ordinated by the Region. Contractor to provide one (1) week prior notification to the ITS for activation of network ports.
- .21 IP addresses to be provided by Region upon request.
- .22 Network switch is to be located within the security system cabinet. Both modem and switch should be powered from UPS power supplies.
- .23 All replaced or extra equipment to be delivered to the Region upon project completion of this Contract to be used for spare parts.
- .24 Comply with all applicable ordinances when installing access control systems.
- .25 All manufacturers' requirements and electrical code requirements for grounding and bonding, including the requirements of the OESC and OBC, shall be followed.
- .26 Magnetic door contacts to be installed on all exterior access doors and interior doors, as identified within the Device Summary Chart on Drawing E10.0.
- .27 Electric door strikes to be installed on all doors as identified within the Device Summary on Drawing E10.0. Door key locks to allow key override of door strikes in all cases.

3.4 INSTALLATION – LENEL ONGUARD ENTERPRISE SOFTWARE INTEGRATION

- .1 Integrate the facility into the Region's existing Lenel OnGuard Enterprise software.
- .2 The Contractor shall co-ordinate the Work with the Region to incorporate facility into the Lenel OnGuard system.
- .3 This work shall be completed a minimum of 15 Working Days prior to the date of Substantial Performance of the Work. The Contractor to coordinate with the Region's Security and Life Safety Coordinator at 1-877-464-9675 ext. 76900.

3.5 OPERATION - GENERAL

- .1 Operation of the Lenel OnGuard security system to function similarly to existing Lenel OnGuard systems installed at Region Water and Wastewater and corporate facilities. The Contractor shall confirm all security system functions and operation with the Region of York Security and Life Safety Coordinator at 1-877-464-9675 ext.76900 prior to any programming.
- .2 Overview: A general overview of the operation of the system is as follows:
 - .1 The system shall allow for the monitoring of intrusion detection alarms inside the system alarm monitoring module, in addition to giving command and control of supported intrusion detection devices. Once alarms are brought in to the system they shall be stored in the system audit trail.
 - .2 All system events not designated as alarm conditions shall be stored in the system audit trail.
 - .3 Each door may be programmed to generate "Door Forced" and "Door Held Open" alarms. These alarms shall have the ability to have a user-definable time delay. Request to exit ("RTE") motion sensors to be installed on interior of all perimeter exit doors which are equipped with door contacts to prevent false forced entry caused by egress of personnel. RTEs to be configured to shunt forced entry only; RTEs shall not to be configured to release the electric strike mechanisms in place.
 - .4 The system shall upload/download information to the control panels automatically while the control panels are in communication with the host server application. A data download may also be initiated manually. This may consist of either controller database information or alarms and events.
- .3 Authentication to Lenel OnGuard System shall be via programmed Door Groups, Time Zones and Access Groups.
- .4 Main entry doors to be assigned Access Group "A".
- .5 HID Reader and combination HID Reader and Arming Button to function as a method of arming and disarming security system respectively. The system shall only Arm if there are no troubles in the system.
- .6 Upon presentation of proximity card identified as Region staff, the system shall activate electric door strike on a corresponding door, allowing those doors to be opened.
- .7 Upon authorized entry to facility (Assess Granted, Door opened) the system shall automatically disarm the system. "Security System Disarmed" input shall be signalled to field controller. Access granted without the door opening shall not disarm the system.
- .8 Prior to exiting facility, personnel will arm the security system by present their card to the interior "Arming" card reader and pushing "Confirm" pushbutton (Arming Button). This sequence of events will arm the security system. "Security System Armed" input shall be signalled to field controller. The action of breaking the door contact shall not to arm the security system. The system shall only Arm if there are no troubles in the system.

- .9 Upon manual key entry to armed facility, "Intrusion Alarm" input shall be signalled to field controller.
- .10 Upon illegal forced entry to facility, "Intrusion Alarm" input signalled to field controller. Control Panel maintains "Security System Armed" input signal to field controller.

3.6 FIELD QUALITY CONTROL

- .1 Cable and Wire – 1000 Volt and Below
 - .1 Conduct insulation resistance measurements using a "Megger" (500 V instrument for circuit up to 350 V system, 1000 V instrument for 351-600 V systems).
 - .2 Record test results in a log book and submit to the Consultant for reference. Replace or repair circuits which do not meet inspection Authority requirements. With equipment disconnected, measure insulation resistance of the following circuits:
 - .1 Power and lighting feeders: Phase-to-phase, phase-to-ground.
 - .2 Control circuits: To ground only.
 - .3 Do not perform "Megger" tests on equipment containing solid-state components.
 - .4 Disconnect power factor correction capacitors from system prior to testing.
- .2 Instrumentation Wiring
 - .1 Check continuity of each conductor using ohmmeter or DC buzzer. Megger or 120 volt filament lamp testing is not acceptable.
 - .3 Carry out functional tests with the Region's Representative to confirm field wiring, interlocks, and device functionality.
 - .4 Depending upon magnitude and complexity, divide security system into logical sections, energize one section at a time and check out operation of section.
 - .5 Upon completion of sectional tests, undertake group testing.
 - .6 Check out complete system for operational sequencing.
 - .7 For local testing, each device/sensor should be tested and marked off one by one until all devices/sensors are tested. Each sensor shall be verified to the zone.
 - .8 Submit to the Consultant one copy of all test results.
 - .9 Provide a written list of all passwords, keywords, serial numbers and/or configurations that are encountered during the installation of the operating system and application software. This information to be provided in writing to the York Region Security and Life Safety Coordinator at 1-877-464-9675 ext.76900.
 - .10 Assign all warranties, licenses and product registration to the Regional Municipality of York.

- .11 Turn over to the York Region Security and Life Safety Coordinator 1-877-464-9675 ext.76900 all installation software, user manuals, accessory cables, calibration units and any other material accompanying the installed equipment.

3.7 WIRING IDENTIFICATION

- .1 Identify all wiring including fibre optic cabling, with wire markers.
- .2 Colour code power, feeder and branch conductors at both ends with coloured plastic tapes. Tapes are not required where conductors are identified by jacket colour. Maintain phase and colour sequence throughout.
- .3 Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance as identified by Region of York standards.
- .4 Identify all controller wiring at terminal blocks and connection points with the controller terminal (I/O) address numbers

3.8 SITE TESTING

- .1 Following installation of Lenel OnGuard System at the facility, Site testing shall be performed by the Contractor. Testing to be co-ordinated with the Region.
- .2 Record test results in a log book and submit to the Consultant for reference. Replace or repair circuits which do not meet inspection Authority requirements.
- .3 The Facility to be tested to confirm operation of the System
- .4 The Region's representative to be present for all testing. The Region's representative to confirm that testing has been satisfactorily completed and that system is ready for operational use as intended.
- .5 All facility exterior access doors to be tested for valid entry and intrusion entry by presentation of test proximity card(s) to reader. The corresponding inputs to SCADA system to be confirmed. The system to be tested with both valid and invalid proximity cards in online and offline operation modes.
- .6 All applicable doors to be tested for valid entry and intrusion entry. The corresponding inputs to SCADA system to be confirmed.
- .7 Key override to facility through main entry door to be tested for by manually opening door with mechanical key. Corresponding inputs to SCADA system to be confirmed.
- .8 Security system arming/disarming to be tested and verified.
- .9 All event and alarm conditions to be verified and logged to Lenel OnGuard database. To be verified by running a respective report.
- .10 Local testing to be performed at the facility. Following successful demonstration of local testing, operational testing to be performed utilizing Region's existing Lenel OnGuard Server.
- .11 Following successful integration with Lenel OnGuard Server, shift programming of the facility, if applicable, to be coordinated through the Region's Security and Life Safety Coordinator 1-877-464-9675 ext.76900.

END OF SECTION



EMS Shore Cord Assembly Instructions

These instructions are for the assembly of the EMS Shore Cord. They are to be followed to ensure we maintain the standard for our stock and installs.

Prepared By:
Tim Hywarren
Sr. Building Operator
Property Services Branch

Parts List

- To make complete assemblies from Power supply line to EMS Vehicle plug the following parts to be provided and installed by the electrical contractor:

Leviton Products:

Part#	Description	Qty.
69591-W3	3' cord set Wetguard Plug and connector	1
25W47 L5-15P	2 Pole, 3 wire Wetguard , Twist lock	1
25W47 L5-15R	2 Pole, 3 wire Wetguard , Twist lock	1

Hubbel Products:

HBL6018	Weatherproof Long Boot	1
HBL5269C	2 Pole, 3 wire Grounding	1

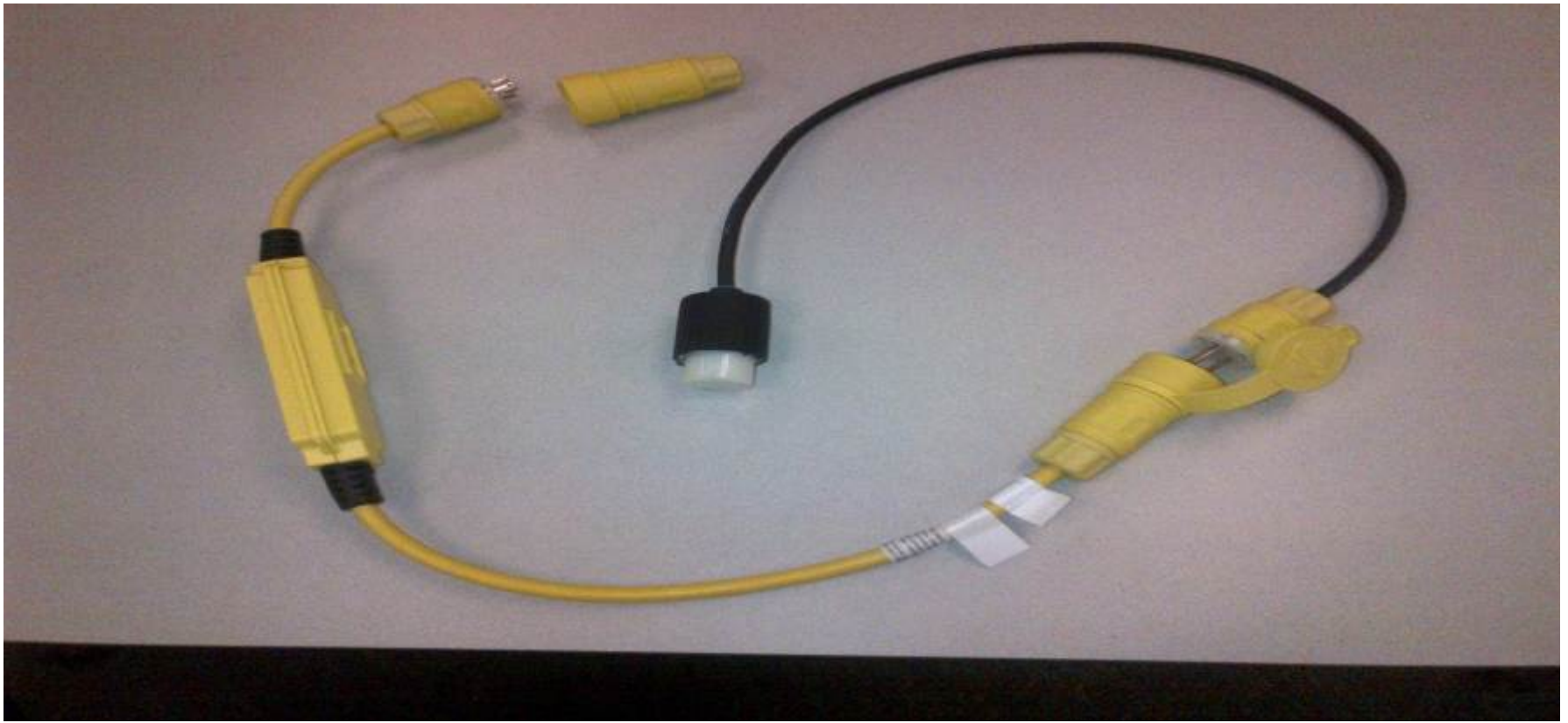
In House

35" 14/3 cabtire length	Qty	1
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Basic Configuration is:

[Twist lock] [Twist lock] [GFCI Assembly 6951-w3] [Whip aka Breakaway]

Pwr line – 24w47 female plug--24w47 male plug-- GFCI—14w47 female plug—14w47 male plug— Hubbel Boot



Supply Power

The supply line should have the following:

- Hanging from the ceiling with a strain relief on the cab tire
- The bottom of the 24w47 female Twist-Lock Wetguard plug at a height of **86"above the floor**



GFI Assembly



1. This is what it comes like from Manufacturer. It has a straight blade wetgaurd plug which needs to be replaced with a Twist Lock wetgaurd.



2. Disassemble the plugs end and remove only the straight blade portion. Then take a new Twistlock out of pkg and install it. The bases are interchangeable.



3. Once the new Twist Lock has been installed use a permanent marker to place inspection marks above the connections points to verify correct wire placement



4. Completed End

Whip End (Prep)

- Prior to making the Whip end some prep work needs to be done

Cabtire 14/3 cut to 35" length



Boot Top needs to be cut. Only the Top section needs to be removed. Use a Cable cutter to get best results



Whip Assembly



1. Remove 1" of cab tire casing & strip wires at each end



2. Install Wetgaord end, Mark the connection points w/ marker



3. Put the prepped boot on wire



4. Disassemble the Hubbell end



5. Slide the casing on wire length



6. Install Hubbell Plug, Mark Connection points w/ marker



7. Slide Hubbell boot over plug pulling it over plug end under it is seated firmly at the back of boot.

Whip Assembly (Boot Mods)



1. Boot needs to be cut back to expose the Hubbell Plug End

2. It is 2" front the cord end of the boots shoulder

3. For best clean cut results use a PVC tube/pipe cutter and have the edge up against the raised shoulder of the plug end of the booth.

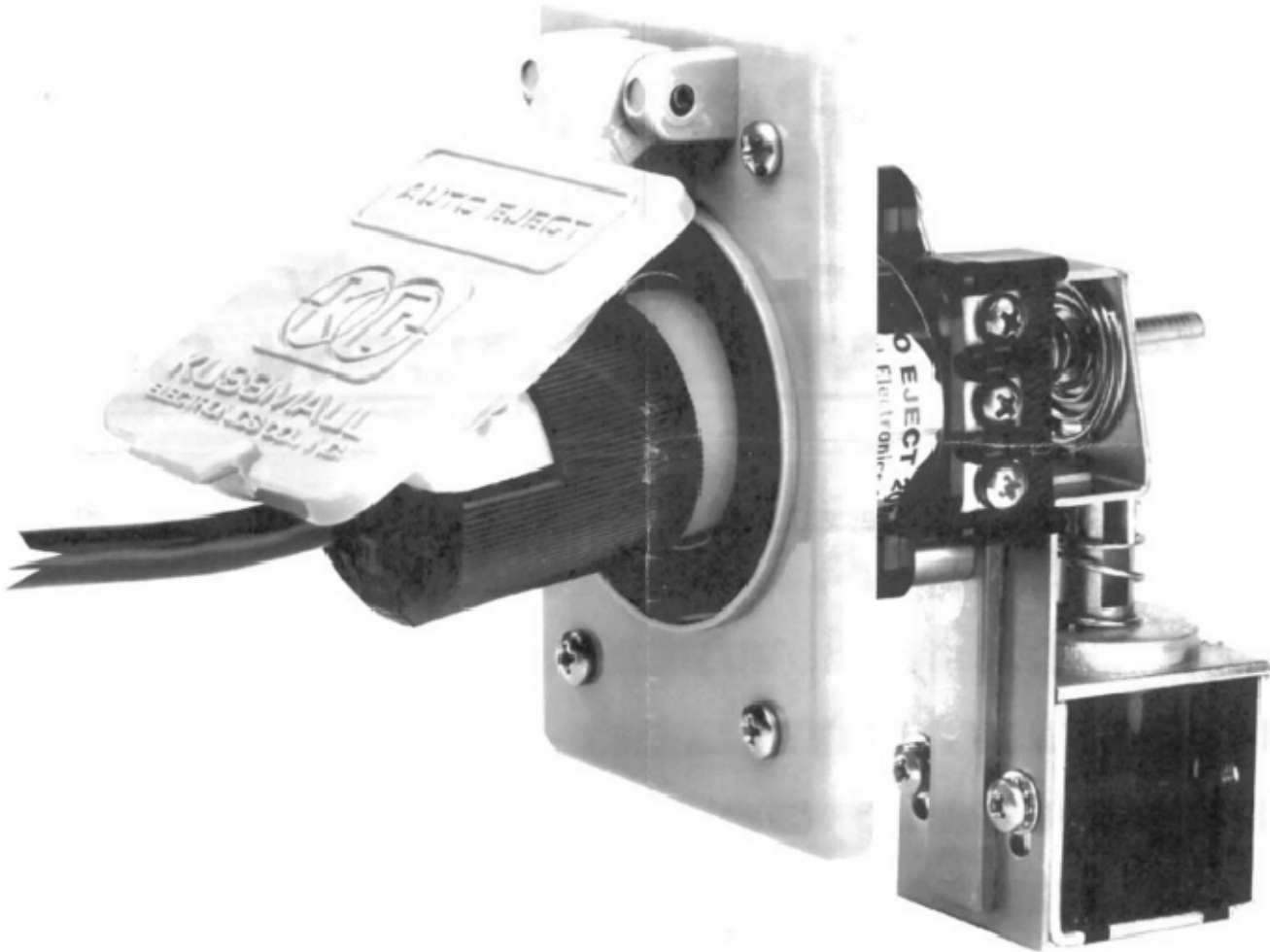
4. Using silicone seal around the cord and plug. This will help prevent water from entering the boot.



INSTRUCTION MANUAL

AUTO EJECT WP

AUTOMATIC SHORE LINE DISCONNECT



2 YEAR WARRANTY

170 Cherry Avenue
West Sayville, NY 11796
www.kussmaul.com

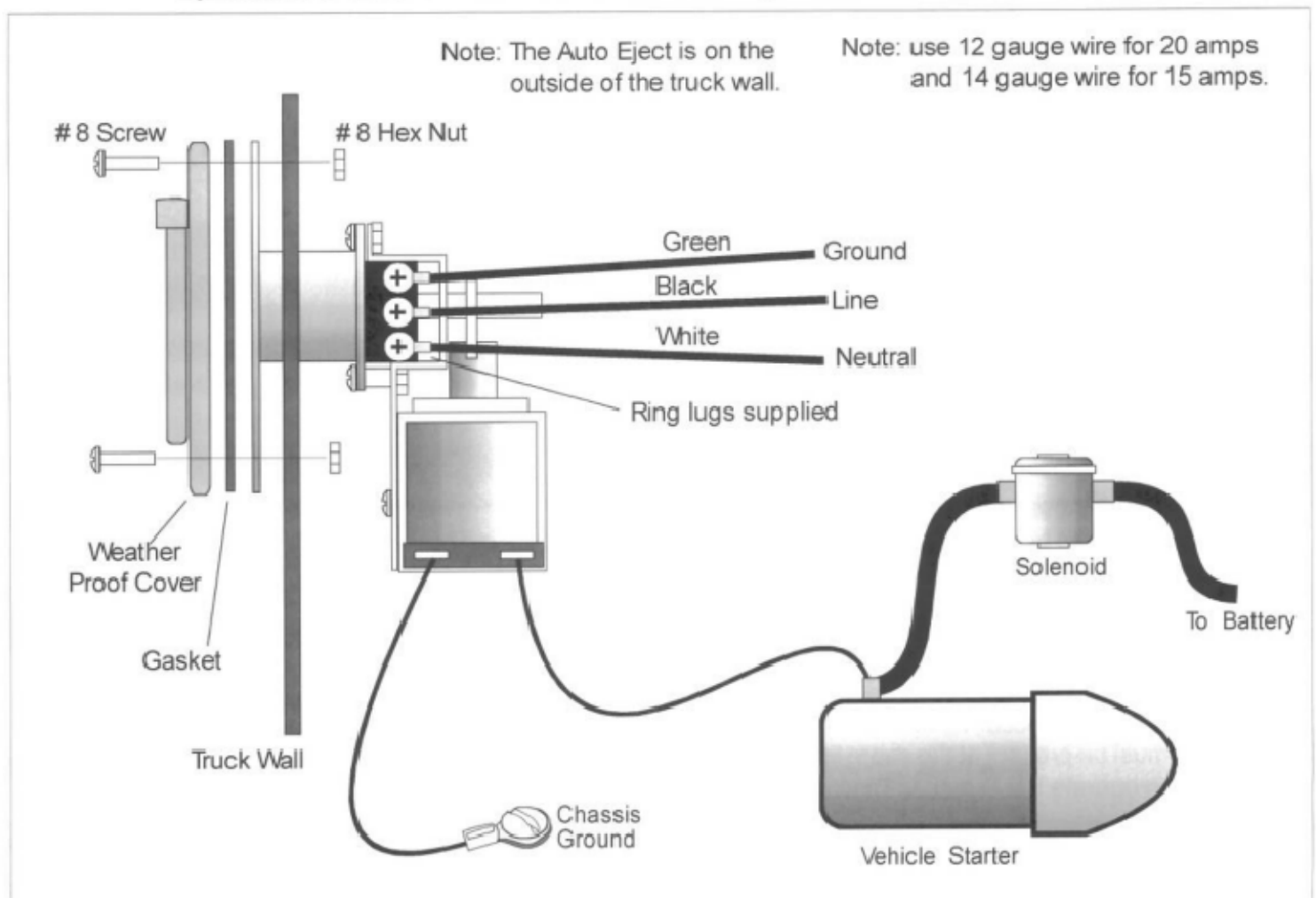
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ELECTRONICS
ENERGIZED AND READY, WHEN SECONDS COUNT

Ph: 800-346-0314
Fax: 631-567-5826
sales@kussmaul.com

INSTALLATION INSTRUCTIONS

1. Locate a convenient place on the vehicle to mount the AUTO EJECT. A minimum clearance of 4" behind the mounting panel is required as well as 3 3/4" below the center line to clear the ejection mechanism.
2. Place the template in position and center punch in 7 places.
- 3a. Drill 2 holes, 1/2" diameter. IMPORTANT THESE HOLES MUST BE DRILLED FIRST.
- 3b. Drill 4 mounting holes, 3/16" diameter and one, 2 1/4" clearance hole for the AUTO EJECT.
4. Connect one terminal of the solenoid on the AUTO EJECT to the vehicle ground and the other solenoid terminal to the vehicle's starter. USE #16 GAUGE WIRE OR HEAVIER.
5. Crimp the ring lugs on the wire and connect the Green, Black, and White power wires to the accessories on the vehicle.
6. Test installation by installing mating connector into the AUTO EJECT. Energizing the starter should energize the solenoid and eject the connector.
7. Keep connector and contacts of the AUTO EJECT clean. Clean contacts with WD-40 solvent as required. Lubricate contacts monthly with "vaseline" to insure free operation.

NOTE: USE ONLY CORD CONNECTOR SUPPLIED WITH THE AUTO EJECT
All connectors are not identical, using a substitute may result in unreliable operation or failure of the AUTO EJECT to operate.



INSTALLATION RECORD & WARRANTY

Date Installed _____

Installed By _____

Vehicle Identification _____

Vehicle Owner _____

2 YEAR WARRANTY

All Auto Ejects manufactured by Kussmaul Electronics Company Inc. are warranted to be free of defects of material or workmanship. Liability is limited to repairing or replacing at our factory, without charge, any material or defects which become apparent in normal use within 2 years from the date the equipment was shipped. Equipment is to be returned, shipping charges prepaid and will be returned, after repair, shipping charges paid.

This warranty does not include normal wear and tear, pitting of the electrical contacts, malfunction due to contamination of the mechanism, or solenoid overheating due to improper installation.

Kussmaul Electronics Company, Inc. shall have no liability for damages of any kind to associated equipment arising from the installation and /or use of the Kussmaul Electronics Company, Inc. products. The purchaser, by the acceptance of the equipment, assumes all liability for any damages which may result from its installation, use or misuse, by the purchaser, his or its employees or others.

1. EMS SHORE CORD ASSEMBLY INSTRUCTIONS

1.1 PARTS LIST

To make complete assemblies from Power supply line to Emergency Medical Services Vehicle plug, the Contractor shall ensure that the following parts are provided and installed by the electrical Subcontractor:

Leviton Products:

Part#	Description	Qty.
69591-W3	3' cord set Wetguard Plug and connector	1
25W47 L5-15P	2 Pole, 3 wire Wetguard , Twist lock	1
25W47 L5-15R	2 Pole, 3 wire Wetguard , Twist lock	1

Hubbel Products:

HBL6018	Weatherproof Long Boot	1
HBL5269C	2 Pole, 3 wire Grounding	1

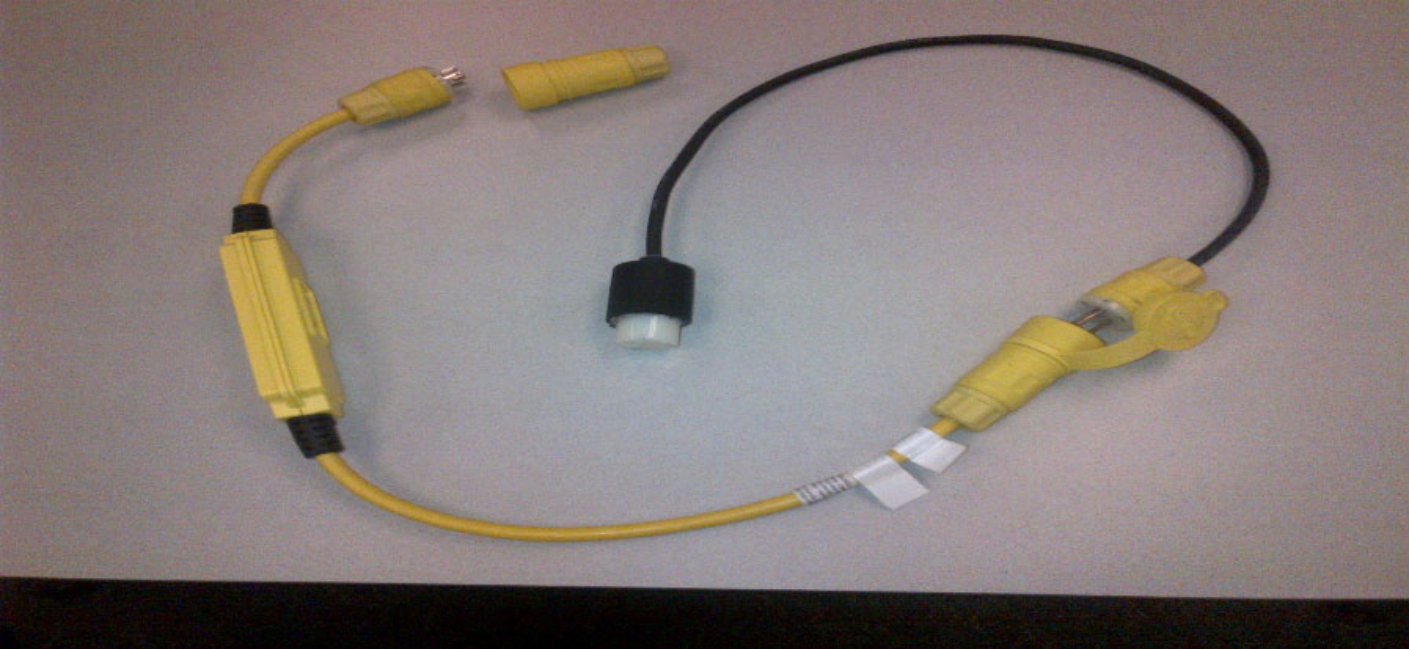
Or equivalent

Owner will provide
35" 14/3 cabtire length Qty 1

Or equivalent

1.2 Basic Configuration is:

[Twist lock] [Twist lock] [GFCI Assembly 6951-w3] [Whip aka Breakaway]
Power line – 24w47 female plug--24w47 male plug-- GFCI—14w47 female plug—14w47 male plug— Hubbel Boot



1.3 The Supply Line Shall Have The Following:

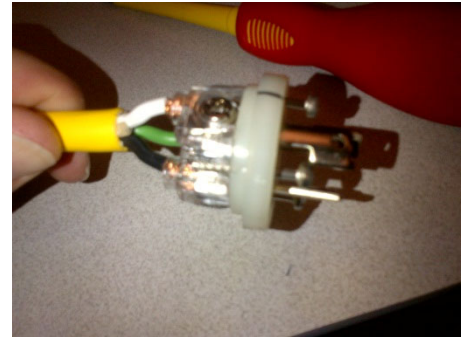
- Hanging from the ceiling with a strain relief on the cab tire
- The bottom of the 24w47 female Twist-Lock Wetguard plug at a height of 86" above the floor.



1.4 GFI Assembly:

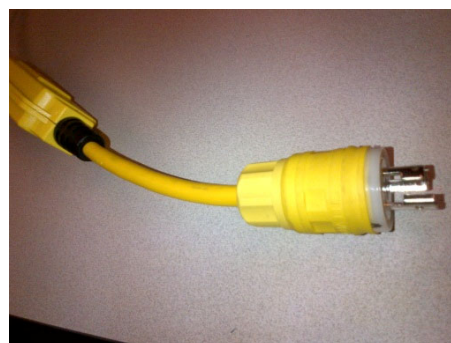


1. This is what it comes like from manufacturer. It has a straight blade wetgaud plug which needs to be replaced with a Twist Lock wetgaud.



2. Disassemble the plugs end and remove only the straight blade portion. Then take a new Twistlock out of package and install it. The bases are interchangeable.

3. Once the new Twist Lock has been installed use a permanent marker to place inspection marks above the connections points to verify correct wire placement



4. Completed End

1.5 Whip End (Preparation):

- Prior to making the Whip end some preparation work needs to be done

Cable 14/3 cut to
35" length



Boot Top needs to be cut. Only the Top section needs to be removed. Use a Cable cutter to get best results





1. Remove 1" of cab tire casing & strip wires at each end



2. Install Wetgaord end, Mark the connection points w/ marker



3. Put the prepped boot on wire



4. Disassemble the Hubbell e



5. Slide the casing on wire length



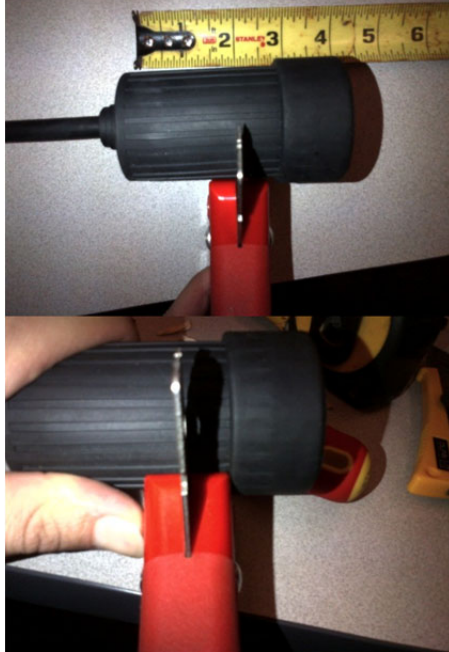
6. Install Hubbell Plug, Mark Connection points w/ marker



7. Slide Hubbell boot over plug pulling it over plug end under it is seated firmly at the back of boot.



1. Boot needs to be cut back to expose the Hubbell Plug End



2. It is 2" front the cord end of the boots shoulder

3. For best clean cut results use a PVC tube/pipe cutter and have the edge up against the raised shoulder of the plug end of the booth.



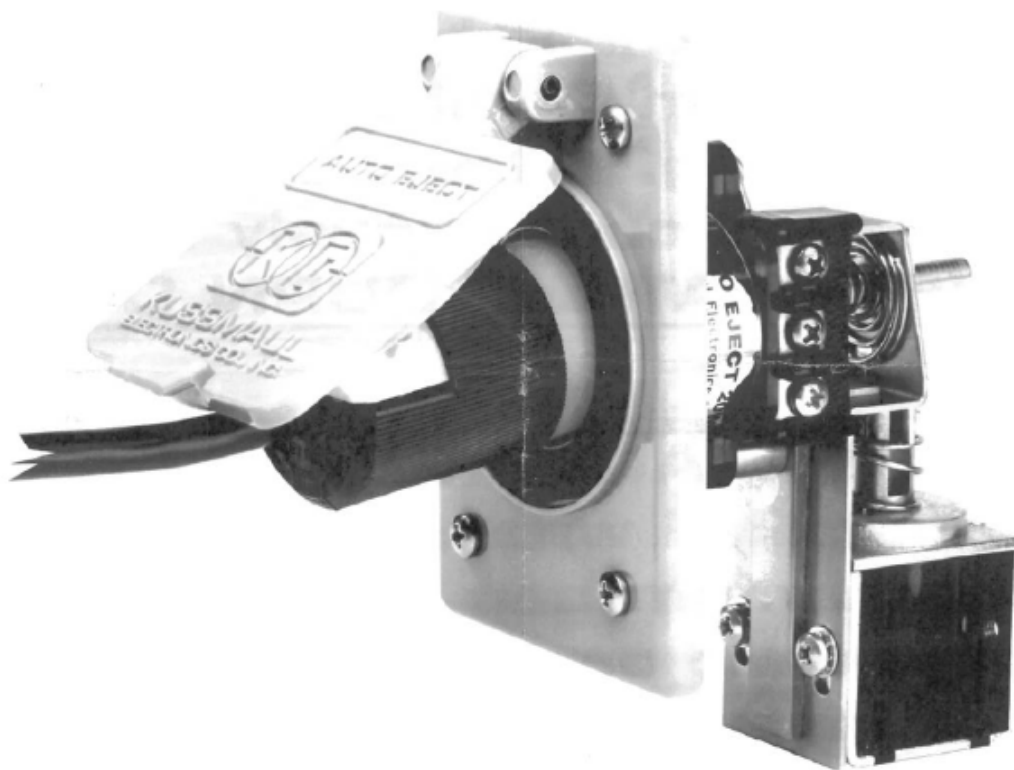
4. Using silicone seal around the cord and plug. This will help prevent water from entering the boot.



FILE: D91-18wp rev d
Rev: D, DATE: 1-19-12

INSTRUCTION MANUAL

AUTO EJECT WP AUTOMATIC SHORE LINE DISCONNECT



2 YEAR WARRANTY

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West Sayville, NY 11796
www.kussmaul.com

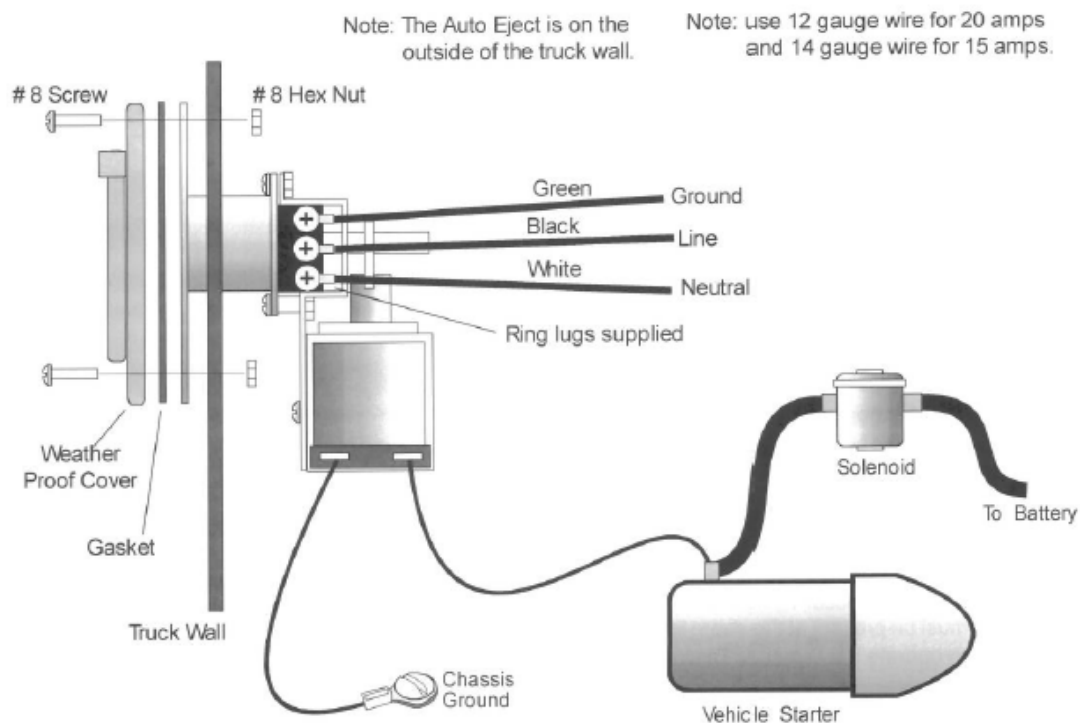
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INSTALLATION INSTRUCTIONS

1. Locate a convenient place on the vehicle to mount the AUTO EJECT. A minimum clearance of 4" behind the mounting panel is required as well as 3 3/4" below the center line to clear the ejection mechanism.
2. Place the template in position and center punch in 7 places.
- 3a. Drill 2 holes, 1/2" diameter. IMPORTANT THESE HOLES MUST BE DRILLED FIRST.
- 3b. Drill 4 mounting holes, 3/16" diameter and one, 2 1/4" clearance hole for the AUTO EJECT.
4. Connect one terminal of the solenoid on the AUTO EJECT to the vehicle ground and the other solenoid terminal to the vehicle's starter. USE #16 GAUGE WIRE OR HEAVIER.
5. Crimp the ring lugs on the wire and connect the Green, Black, and White power wires to the accessories on the vehicle.
6. Test installation by installing mating connector into the AUTO EJECT. Energizing the starter should energize the solenoid and eject the connector.
7. Keep connector and contacts of the AUTO EJECT clean. Clean contacts with WD-40 solvent as required. Lubricate contacts monthly with "vaseline" to insure free operation.

NOTE: USE ONLY CORD CONNECTOR SUPPLIED WITH THE AUTO EJECT
All connectors are not identical, using a substitute may result in unreliable operation or failure of the AUTO EJECT to operate.



END OF SECTION