



MUNICIPALITY OF  
**West Elgin**

## **THE MUNICIPALITY OF WEST ELGIN**

**CONTRACT DOCUMENTS FOR TENDER  
CONTRACT NO. WE-2024-01**

**RODNEY WATER POLLUTION CONTROL PLANT UPGRADES**

**CLOSING DATE: 2:00:00 PM ON 2024-07-31**

BIDS MUST BE RECEIVED BY IN A SEALED OPAQUE ENVELOPE OR PACKAGE CLEARLY MARKED WITH THE NAME AND ADDRESS OF THE RESPONDER, TITLE OF FILE AND FILE NUMBER. COMPLETED BIDS CAN BE **MAILED OR HAND DELIVERED** (IN PERSON OR BY COURIER) TO THE ADDRESS NOTED BELOW. RESPONDENTS ARE SOLELY RESPONSIBLE FOR ENSURING BIDS ARE RECEIVED BY THE TREASURER PRIOR TO THE CLOSING DATE AND TIME. FAILURE TO SUBMIT THE BID AS REQUESTED WILL RESULT IN IT BEING DISQUALIFIED.

**ATTN: MAGDA BADURA, TREASURER  
MUNICIPALITY OF WEST ELGIN  
22413 Hoskins Line, Box 490  
Rodney, ON  
N0L 2C0**



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**DATA SHEET FOR TENDERERS**

Contract Name:	Rodney WPCP Upgrades
Tender Closing Date:	2:00 pm - 2024-07-31
Owner:	The Municipality of West Elgin
Address:	22413 Hoskins Line, Box 490 Rodney, ON, N0L 2C0
Bid Deposit (amount):	\$50,000.00
Open for Acceptance:	120 days from Tender Closing
Bonding:	
Performance	50% of contract price, excluding H.S.T.
Labour and Material	50% of contract price, excluding H.S.T.
Maintenance Term:	12 months from Substantial Performance
Tentative Commencement Date:	October 2024
Completion Date:	February 2026
Liquidated Damages:	Office Supervision and Field Inspection, and Contract Administration Costs incurred by the Municipality, in addition to \$1,000.00 per working day
Date of <b>Mandatory</b> Pre-Tender Meeting:	2024-07-16 at 10:00 am : Rodney WPCP located at 22590 Pioneer Line, Rodney, ON

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**TENDERER'S CHECK LIST**

1. Have you attended the Mandatory Pre-Tender meeting?
2. Have you complied with the "Requirements at Time of Tendering" - Clause 9, Information for Tenderers?
3. Have you submitted the following:
  - (a) Bid Deposit as specified.
  - (b) Form of Tender - original signature in ink
  - (c) Letter of Agreement to Bond / Letter of Guarantee
4. Have you acknowledged the number of Addenda received, in the appropriate space provided on FT-1, included the information contained therein in your Total Contract Price?

**FAILURE TO COMPLY WITH THE REQUIREMENTS AT TIME OF TENDERING SHALL RESULT IN THE TENDER BEING REJECTED. THE TENDER MAY ALSO BE REJECTED IN ACCORDANCE WITH CLAUSE 12 -INFORMATION FOR TENDERERS – INFORMAL OR UNBALANCED TENDERS.**



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# SECTION 1 – FORM OF TENDER



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**FORM OF TENDER**

Tenderer's business name \_\_\_\_\_

Type of business: Proprietorship  Corporation  Partnership  (place checkmark in appropriate box)

Business address \_\_\_\_\_

H.S.T. Number \_\_\_\_\_

**Clause No.**

1. The Tenderer has carefully examined the locality and site of the proposed works, as well as the Contract Documents related to the works, including the Tender, The OPS General Conditions of Contract, Supplementary Conditions, Special Provisions, Ontario Provincial Standards for Roads and Public Works, Volumes 1 - 4 inclusive and Volumes 7 and 8, Form of Tender, Articles of Agreement, Contract Drawings, Specifications, and Addenda No. \_\_\_\_\_ to \_\_\_\_\_ inclusive\*, relating to the said Contract(s).

2. The Tenderer hereby accepts and agrees that the items referred to in (1.) above form part of the Contract(s)

3. The Tenderer hereby submits their Tender and offers to enter into a Contract(s) to construct all that is set out in the Contract Documents on the Terms and Conditions and under the provisions set out or called for in the Contract Documents for the Lump Sum Price of \_\_\_\_\_ excluding HST, being made up as shown in the Schedule of Items and Prices - Form of Tender.

*\* The Tenderer will insert here the number of the Addenda received by him during the tendering period and taken into account by him in preparing his Tender **FAILURE TO ACKNOWLEDGE ALL ISSUED ADDENDA SHALL RESULT IN THE TENDER BEING REJECTED.***

4. Enclosed with the Tender is a bid deposit in the amount of \_\_\_\_\_ .

5. The Tenderer proposes \_\_\_\_\_  
(name of Bonding Company)

which is willing to become bound with the Tenderer in accordance with Clause 20 - Information for Tenderers.



6. If awarded the Contract, the Tenderer agrees to substantially complete the work within **the schedule outlined Data Sheet for Tenderers**. The Tenderer agrees to execute the contract and to provide the documents required in Clause 13 of the Information for Tenderers within 7 days after being notified in writing to do so by the Municipality. In the event of default or failure on the Tenderer's part, to execute the contract, the Tenderer agrees that the Municipality shall be at liberty to retain the money deposited by the Tenderer to the use of the Municipality and to accept the next lowest or any other tender, or to advertise for new tenders, or to carry out the works in any other way it may deem best and the Tenderer further agrees to pay to the Municipality the difference between the amount of this tender and any greater sum which the Municipality may expend or incur by reason of such default or failure, or by reason of such action on the part of the Municipality, including the cost of advertisement for new tenders and to indemnify and save harmless the Municipality and its officers and servants from all loss, damage, cost, charges, and expenses which it or they may suffer or be put to by reason of any such default or failure.

7. The Tenderer declares that:

- (a) No person, firm or corporation other than the Tenderer has any interest in this Tender or in the proposed Contract for which this Tender is made.
- (b) This Tender is made without any connection, knowledge, comparison of figures or arrangements with any other person or persons making a Tender for the same work and is in all respects fair and without collusion or fraud.
- (c) No appointed officer or employee of the Municipality of West Elgin is, will be, or has become interested, directly or indirectly, as a contracting party, partner, shareholder, surety or otherwise in the Tender or in the proposed contract or in any portion of the profits thereof, or of any supplies to be used therein, or in any of the moneys to be derived therefrom.
- (d) The several matters stated in the Form of Tender are in all respects true.

8. Tenderer acknowledges that a review of the documents listed in the Information for Tenderers has been undertaken.

Dated at \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

Tenderer's Business Name: \_\_\_\_\_

Person authorized to bind tenderer:

\_\_\_\_\_ : \_\_\_\_\_  
(print name) (signature)

Person's position with tenderer:

\_\_\_\_\_

Witness:

\_\_\_\_\_ : \_\_\_\_\_  
(print name) (signature)



**SCHEDULE OF ITEMS AND PRICES**

ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
Division 1: General Requirements						
1.01	N/A	Bonding and Insurance	1	LS	\$	\$
1.02	01000	Mobilization and Demobilization	1	LS	\$	\$
1.03	01050	Pre and Post Construction Surveys	1	LS	\$	\$
1.04	01500	Temporary Facilities and Controls	1	LS	\$	\$
1.05	01510	Temporary Scaffolding	1	LS	\$	\$
1.06	01561	Environmental Protection and Control	1	LS	\$	\$
1.07	01580	Project Sign Boards	1	LS	\$	\$
1.08	01650	Commissioning of the Work	1	LS	\$	\$
1.09	01700	Contract Closeout	1	LS	\$	\$
1.10	01040, 01500	Traffic Control	1	LS	\$	\$
1.11		All other Division 1 Items	1	LS	\$	\$
Division 1: General Requirements					Subtotal	\$
Division 2: Site Work						
2.01	02000	General Requirements	1	LS	\$	\$
2.02	02050	Removal of Screen System, Enclosure, and Associated Equipment	1	LS	\$	\$
2.03	02050	Removal of Secondary Clarifier Mechanism, Cover, and Associated Equipment	1	LS	\$	\$
2.04	02050	Removal of Alum Tank, Piping, and Associated Appurtenances	1	LS	\$	\$





**THE MUNICIPALITY OF WEST ELGIN  
TENDER DOCUMENTS**

**RODNEY WPCP UPGRADES  
INFORMATION FOR TENDERERS**

ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
2.05	02050	Removal of Mechanical Surface Aerators	1	LS	\$	\$
2.06	02050	Removal of Baffles in Aeration Tanks	1	LS	\$	\$
2.07	02050	Removal of Decant Piping and Associated Appurtenances	1	LS	\$	\$
2.08	02050	Openings for Doors, Entry Walls, Equipment, Louvres, Piping, etc.	1	LS	\$	\$
2.09	02100	Removal of Topsoil and Grass	1	LS	\$	\$
2.10	02100	Removal of Sludge and Debris from Clarifier	1	LS	\$	\$
2.11	02100	Removal of Sludge and Debris from Aeration Tanks	1	LS	\$	\$
2.12	02220, 02221	Backfill and Excavation	1	LS	\$	\$
2.13	02480	Landscaping	1	LS	\$	\$
2.14	02600	Yard Piping – Decant System	1	LS	\$	\$
2.15	02600	Yard Piping – Effluent Piping	1	LS	\$	\$
2.16		All other Division 2 Items	1	LS	\$	\$
<b>Division 2: Site Works</b>					<b>Subtotal</b>	<b>\$</b>
<b>Division 3: Concrete</b>						
3.01	03000	General Requirements	1	LS	\$	\$
3.02	03300	Cast-in-Place Concrete (housekeeping pads, repairs, piers, etc.)	1	LS	\$	\$
3.03	03300	Concrete Wall Height Extensions	1	LS	\$	\$
3.04	03300	Cellular Grout Infills	1	LS	\$	\$
3.05	03300	Concrete Infills, concrete cutting and finishing	1	LS	\$	\$



ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
3.06		All other Division 3 Items	1	LS	\$	\$
Division 3: Concrete					Subtotal	\$
Division 4: Masonry						
4.01	04000	General Requirements	1	LS	\$	\$
4.02	04050, 04100, 04200	Concrete Masonry Unit – 190 mm	1	LS	\$	\$
4.03	04050, 04100, 04200	Concrete Masonry, Concrete Wall repairs	1	LS	\$	\$
4.04		All other Division 4 Items	1	LS	\$	\$
Division 4: Masonry					Subtotal	\$
Division 5: Metals						
5.01	05000	General Requirements	1	LS	\$	\$
5.02	05120	Structural Steel (lintels, scum troughs, etc.)	1	LS	\$	\$
5.03	05310	Composite Steel Deck	1	LS	\$	\$
5.04	05512, 05516, 05521	Guardrails, Ladders, Aluminum Stairs	1	LS	\$	\$
5.05	05331	Grating	1	LS	\$	\$
5.06	05561	Galvanized Checkered Plate	1	LS	\$	\$
5.07		Building Enclosure	1	LS	\$	\$
5.08		All other Division 5 items	1	LS	\$	\$
Division 5: Metals					Subtotal	\$



ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
Division 6: Wood, Plastics & Composites						
6.01	06000	General Requirements	1	LS	\$	\$
6.02	06101	Rough Carpentry – Headworks Building	1	LS	\$	\$
6.03	06200	Finish Carpentry – Headworks Building	1	LS	\$	\$
6.04	06200	Finish Carpentry – Control Building	1	LS	\$	\$
6.05	06470	Plastic Laminate Finish – Headworks Building	1	LS	\$	\$
6.06		All Other Division 6 Items	1	LS	\$	\$
Division 6: Wood, Plastics & Composites					Subtotal	\$
Division 7: Thermal & Moisture Protection						
7.01	07000	General Requirements	1	LS	\$	\$
7.02	07195	Air Vapour Barrier	1	LS	\$	\$
7.03	07200	Building Insulation	1	LS	\$	\$
7.04	07535	SBS Modified Bituminous Membrane Roofing	1	LS	\$	\$
7.05	07620	Metal Flashing and Trim – Walls	1	LS	\$	\$
7.06	07840	Firestopping	1	LS	\$	\$
7.07	07920	Sealants	1	LS	\$	\$
7.08		All other Division 7 Items	1	LS	\$	\$
Division 7: Thermal & Moisture Protection					Subtotal	\$
Division 8 – Doors and Windows						
8.01	08000	General Requirements	1	LS	\$	\$



ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
8.02	08110, 08710	Hollow Metal Doors – Double Exterior (hardware inclusive)	1	LS	\$	\$
8.03		All other Division 8 Items	1	LS	\$	\$
Division 8: Doors and Windows					Subtotal	\$
Division 9: Finishes						
9.01	09000	General Requirements	1	LS	\$	\$
9.02	09790	Chemical Resistant Wall and Floor Treatment	1	LS	\$	\$
9.03	09900	Painting Protective Coating – Walls	1	LS	\$	\$
9.04	09900	Painting Protective Coating – Doors	1	LS	\$	\$
9.05		All other Division 9 Items	1	LS	\$	\$
Division 9: Finishes					Subtotal	\$
Division 10: Specialties						
10.01	10000	General Requirements	1	LS	\$	\$
10.02	10210	Architectural Louvres	1	LS	\$	\$
10.03		All other Division 10 Items	1	LS	\$	\$
Division 10: Specialties					Subtotal	\$
Division 11: Equipment						
11.01	11000	General Requirements	1	LS	\$	\$
11.02	11005	Electric Motors	1	LS	\$	\$
11.03	11007	Electric Actuator	1	LS	\$	\$



ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
11.04	11246	Alum Chemical FRP Tank – Field Erected and Associated Piping and Appurtenances	1	LS	\$	\$
11.05	11315	Submersible Pump, piping, valves and associated accessories	1	LS	\$	\$
11.06	11332	Spiral Screen System, Piping, Valves, Davit, Control Panel and Associated Equipment	1	LS	\$	\$
11.07	11350	Circular Clarifier Mechanism, RAS Piping, and Associated Appurtenances	1	LS	\$	\$
11.08	11370	Positive Displacement Blowers (3) with acoustic enclosure, VFDs, and associated equipment	1	LS	\$	\$
11.09	11376	Aeration Diffusers and Associated piping, Supports, and appurtenances	1	LS	\$	\$
11.10	11995	FRP Enclosure, doors, louvres, and associated equipment	1	LS	\$	\$
11.11		All other Division 11 Items	1	LS	\$	\$
Division 11: Equipment					Subtotal	\$
Division 13: Controls and Instrumentation						
13.01	13000	General Requirements	1	LS	\$	\$
13.02	13322, 13323	ROD2 PLC Panel Modifications	1	LS	\$	\$
13.03	13324	ROD2 PLC Re-Programming	1	LS	\$	\$
13.04	13329	SCADA System Program Modifications	1	LS	\$	\$
13.05	13341	Pressure Gauge	1	LS	\$	\$
13.05	13343	Hydrostatic Pressure Transmitter	1	LS	\$	\$
13.06	13343	Pressure Transmitter	1	LS	\$	\$



ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
13.07	13362	Float Switch	1	LS	\$	\$
13.08	13381	Dissolved Oxygen Analyzer	1	LS	\$	\$
13.09		All other Division 13 Items	1	LS	\$	\$
Division 13: Controls and Instrumentation					Subtotal	\$
Division 15: Mechanical						
15.01	15000	General Requirements	1	LS	\$	\$
15.02	15060	Pipe and Fittings	1	LS	\$	\$
15.03	15063	Copper Pipe	1	LS	\$	\$
15.04	15065	PVC Schedule Pipe	1	LS	\$	\$
15.05	15065	PVC Chemical Pipe – Alum Pipe	1	LS	\$	\$
15.06	15066	Stainless Steel – Effluent Water Piping	1	LS	\$	\$
15.07	15066	Stainless Steel Pipe - Aeration Piping	1	LS	\$	\$
15.08	15073	Refrigerant Copper Tubing and Fittings	1	LS	\$	\$
15.09	15100	Process and Service Valves – Ball Valves	1	LS	\$	\$
15.10	15100	Process and Service Valves – Check Valves	1	LS	\$	\$
15.11	15100	Process and Service Valves – Butterfly Valves	1	LS	\$	\$
15.12	15100	Process and Service Valves – Globe Valves	1	LS	\$	\$
15.13	15100	Process and Service Valves – Gate Valve	1	LS	\$	\$
15.14	15260	Pipe Insulation	1	LS	\$	\$
15.15	15270	Duct Insulation	1	LS	\$	\$



ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
15.16	15304	Portable Fire Extinguisher	1	LS	\$	\$
15.17	15400	Plumbing and Drainage	1	LS	\$	\$
15.18	15424	Domestic Water Heater	1	LS	\$	\$
15.19	15450	Plumbing Fixtures	1	LS	\$	\$
15.20	15670	Ductless Split HVAC Systems	1	LS	\$	\$
15.21	15801	Ductwork Low Pressure to 500 Pa	1	LS	\$	\$
15.22	15820	Duct Accessories	1	LS	\$	\$
15.23	15825	Balancing dampers	1	LS	\$	\$
15.24	15830	Electric Heating Devices	1	LS	\$	\$
15.25	15860	Fans and Intake Hoods	1	LS	\$	\$
15.26	15900	Building System Control	1	LS	\$	\$
15.27	15990	Air Balancing	1	LS	\$	\$
15.28		All other Division 15 Items	1	LS	\$	\$
Division 15: Mechanical					Subtotal	\$
Division 16: Electrical						
16.01	16000	General Requirements	1	LS	\$	\$
16.02	16106, 16107	Installation of cables in Trenches, Direct Buried Underground Cable Duct	1	LS	\$	\$
16.03	16111	Conduit, Conduit Fastenings, Conduit Fittings	1	LS	\$	\$
16.04	16122	Wires and Cables 0-1000V	1	LS	\$	\$



**THE MUNICIPALITY OF WEST ELGIN  
TENDER DOCUMENTS**

**RODNEY WPCP UPGRADES  
INFORMATION FOR TENDERERS**

ITEM	SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
16.05	16131, 16151, 16191	Junction and Pull Boxes, Wiring and Box Connectors, Fastenings and Supports	1	LS	\$	\$
16.06	16141	Wiring Devices	1	LS	\$	\$
16.07	16440	Disconnect Switches	1	LS	\$	\$
16.08	16450	Grounding Secondary	1	LS	\$	\$
16.09	16461	Dry Type Transformers	1	LS	\$	\$
16.10	16471	Panelboards Breaker Type	1	LS	\$	\$
16.11	16477	Molded Case Breakers	1	LS	\$	\$
16.12	16505, 16536	Lighting Equipment, Emergency Lighting	1	LS	\$	\$
16.13	16811, 16485	Motor Starters, Contractors	1	LS	\$	\$
16.14	16816	AC Variable Frequency Drives	1	LS	\$	\$
16.15	16825	Control Devices	1	LS	\$	\$
16.16	16850	Heat Tracing System	1	LS	\$	\$
16.17		All other Division 16 Items	1	LS	\$	\$
Division 16: Electrical					Subtotal	\$
Contingency						
17.01		Contingency	1	LS	\$400,000	\$400,000
Contingency					Subtotal	\$400,000
<b>TOTAL</b>						<b>\$</b>

**Note: All prices are stated in Canadian funds. Prices are inclusive of customs, duty and freight.**

HST Registration Number: \_\_\_\_\_.





## S U M M A R Y

A – Division 1: General Requirements Subtotal	\$	_____
A – Division 2: General Requirements Subtotal	\$	_____
A – Division 3: General Requirements Subtotal	\$	_____
A – Division 4: General Requirements Subtotal	\$	_____
A – Division 5: General Requirements Subtotal	\$	_____
A – Division 6: General Requirements Subtotal	\$	_____
A – Division 7: General Requirements Subtotal	\$	_____
A – Division 8: General Requirements Subtotal	\$	_____
A – Division 9: General Requirements Subtotal	\$	_____
A – Division 10: General Requirements Subtotal	\$	_____
A – Division 11: General Requirements Subtotal	\$	_____
A – Division 13: General Requirements Subtotal	\$	_____
A – Division 15: General Requirements Subtotal	\$	_____
A – Division 16: General Requirements Subtotal	\$	_____
<b>A – Subtotal of Divisional Specifications</b>	\$	_____
 B - Contingency Allowance	\$	<b>400,000.00</b>
 <b>SUB-TOTAL – Base Price (A + B)</b>	\$	=====
 Applicable H.S.T	\$	_____
 <b>TOTAL CONTRACT PRICE (CDN) ([A + B] + HST)</b>	\$	=====



# SECTION 2 – INFORMATION FOR TENDERERS



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**1. GENERAL**

SEALED TENDERS will be received by the Treasurer, 22413 Hoskins Line, Box 490, Rodney, ON, N0L 2C0 for the completion of

**Project: Rodney Water Pollution Control Plant Upgrades**

**Tender Number: 215817**

Tenders shall be submitted in an envelope provided by the Contractor not later than 2:00:00 pm (local time)

On 2024-07-31

Conditions relating to tendering as prescribed in the Tender Documents must be complied with. The lowest or any Tender shall not necessarily be accepted.

All index and reference numbers in the Tender Documents are given for the convenience of the Contractor and such must be taken only as a general guide to the items referred. It must not be assumed that such numbering is the only reference to each item, but the Tender Documents must be read in detail for each item.

Tenders received by the Treasurer later than the specified closing time will be returned unopened to the Tenderer.

**2. CONTRACT ADMINISTRATOR**

Name R.V. Anderson Associates Limited

Address 557 Southdale Road East, Suite 200, London, ON N6E 1A2

Contact Person Chris Paslawski

Email Address cpaslawski@rvanderson.com

Telephone Number 519-681-9916 ext. 5049



### 3. TENDERERS MAY OBTAIN INTERPRETATION OF TENDER DOCUMENTS

- a) Each bidder must review all tender documents and promptly report and request clarification of any discrepancy, deficiency, ambiguity, error, inconsistency, or omission contained therein 2 working days prior to tender closing not including Saturdays, Sundays and Statutory Holidays. Any such request must be submitted to the Contract Administrator in writing, prior to **2024-07-29**. **Directing inquiries to other than the Contract Administrator may result in your submission being rejected.**
- b) Where a request results in a change or a clarification to the tender, the Contract Administrator will prepare and issue an Addendum to this tender which will be posted on the Municipality's website. **With the exception of an Addendum delaying the closing or cancelling of this Tender**, NO Addendum will be issued within the twenty-four (24) hours prior to closing - not including Saturdays, Sundays and Statutory Holidays. Bidders that have submitted bids prior to the date and time cut-off for Addenda issuance are solely responsible to monitor the link provided by R.V. Anderson Associates Limited for further Addendum and are therefore also solely responsible for submitting complete new bids acknowledging any said Addendum prior to the closing date and time of the bid solicitation.

***FAILURE TO ACKNOWLEDGE ALL ISSUED ADDENDA SHALL RESULT IN THE TENDER BEING REJECTED.***

The Municipality will not be responsible for any verbal instruction given to the Contractor during the tendering period.

### 4. PRICES SUBMITTED

The tender price or prices quoted in the Tender shall be in full compensation for all labour, equipment and materials and utility and transportation services necessary to perform and complete all work under the Contract, including all miscellaneous work, whether specifically included in the Tender Documents or not. It is the intention of the Drawings and Specifications to provide finished work. Any items omitted therefrom which are clearly necessary for the completion of the work shall be considered part of the work, though not directly specified in the Tender Documents.

### 5. ALLOWANCE FOR CERTAIN ITEMS

No provision has been made in the Form of Tender to allow for certain items. A partial list of such items may include the Contractor's site offices; stores and conveniences; maintenance of flow and traffic, barricades, signs, flag person, etc.; insurance; watchman, permits and approvals (other than those to be paid for by the Municipality); items required by the Drawings or Specifications but which have been omitted from the Schedule of Items and Prices and other items required by the Contract, but not specifically related to or covered by the other items in the Schedule of Items and Prices. Payment for such items shall be in accordance with paragraph 02) of Ontario Provincial Standards General Conditions of Contract Clause GC8.02.01 PRICE FOR WORK.

### 6. INSURANCE

Prior to the commencement of any work, the Contractor must furnish to the Municipality, at the Contractor's expense, certificate(s) of insurance satisfactory to the Municipality, as set forth below. In the event that the certificate(s) of insurance is/are not satisfactory, the Municipality may require the Contractor to provide a certified copy of the policy. The Contractor shall further provide that evidence of the continuance of said insurance is filed at each policy renewal date for the duration of the Contract.

All insurance policies of the Contractor shall be underwritten by an insurer licensed to conduct business in the



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Province of Ontario and shall include a waiver of subrogation against the Municipality of West Elgin, its and their respective successors, assigns, elected officials, directors, officers, agents, and employees.

The insurance certificates shall also list R.V. Anderson Associates Limited as an additional insured on the policy.

The certificate(s) for the coverage and amounts listed below to be provided:

- (a) \$1 million – Automobile Policy
- (b) \$2 million – Commercial General Liability
- (c) \$2 million – Environmental Liability / Contractor Pollution Liability (CPL)
- (d) Project Cost – Builder’s Risk

The Commercial General Liability policy shall contain:

- A “Cross Liability” clause or endorsement;
- An endorsement certifying that the Municipality of West Elgin and R.V. Anderson Associates Limited are added as additional insured;
- An endorsement to the effect that the policy or policies will not be altered, cancelled, or allowed to lapse without thirty days prior written notice to the Municipality of West Elgin;
- Non-owned automobile coverage with a limit of at least \$1 million, including contractual non-owned coverage;
- Products and complete operations coverage.

The Environmental Liability/Contractor Pollution Liability (CPL) shall include Sudden and Accidental coverage; and Gradual Release coverage (if applicable to the work). The gradual release coverage shall continue for an additional twelve (12) months following substantial completion of the contract.

The Environmental Liability/Contractor Pollution Liability policy shall cover the work and services described in this agreement including coverage for loss or claims arising from contamination to third party property or bodily injury during transit.

The Contractor shall maintain and pay for a Builder’s All Risk Policy satisfactory to the Municipality in the joint names of the Municipality of West Elgin and the Contractor, in the amount of 100 percent of the total value of the Contract. All monies paid under such insurance shall be received by the Municipality, which shall pay as much of it as may be required for the purpose of replacing, rebuilding, or repairing the work and all such material which has been damaged or destroyed according to the appropriate Manager or Consultants certificate and the balance, if any, shall be paid to the Contractor on completion. Such replacing, rebuilding, repairing and completion shall be carried out in every way subject to the terms and conditions of the Contract. The Builder’s All Risks Policy shall remain in the custody of the Municipality and shall be kept in force by the Contractor until the work has been completed and accepted in writing by the Municipality.



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**7. DECLARATION - WORKERS' COMPENSATION/CORPORATION TAX ACT (WD-1)**

At the time of execution of the Contract and prior to receiving payment for substantial and total performance of the work, the successful Tenderer shall submit a Declaration stating that he has paid all assessments or compensations payable and has otherwise complied with all the requirements of the Workplace Safety and Insurance Board, and that the successful Tenderer has paid all taxes and/or penalties imposed on it by the Corporation Tax Act of the Province of Ontario.

**8. WORKPLACE SAFETY AND INSURANCE BOARD**

At the time of execution of the Contract, the successful Tenderer shall furnish the Corporation with a Certificate of Clearance from the Workplace Safety and Insurance Board. The successful Tenderer shall further maintain that good standing throughout the contract period.

In addition, the successful Tenderer will also be required to produce a Certificate of Clearance from the Workplace Safety and Insurance Board throughout the Contract, including all payment certificates. If the Tenderer fails to pay the required assessment or compensation, the Municipality may pay such assessments or compensation to the Workplace Safety and Insurance Board and deduct such amounts from the Contractor.

**9. REQUIREMENTS AT TIME OF TENDERING**

Failure of the Tenderer to comply with any of the following shall result in the Tender being rejected

- (a) The Tenderer shall submit an **original** signed in ink bid deposit with their Tender.
- (b) The Tenderer shall submit the Form of Tender issued by the Contract Administrator.
- (c) The Tenderer's business name shall be inserted in at least one of the two spaces provided in the Form of Tender.
- (d) The original signature in ink of the person authorized to bind the Tenderer shall be inserted in the space provided in the Form of Tender. No photocopies, facsimiles, or digital signatures will be accepted.
- (e) An original Letter of Guarantee from a recognized Financial Institution or Letter of Agreement/Letter of Guarantee from a bonding agency licensed to operate in the Province of Ontario must be included with the bid confirming that if the bidder is successful, the necessary guarantee will be issued as spelled out in Clause 13.

Letters of Agreement submitted must bear an original signature of the issuer and the bidder. PHOTOCOPIES, DIGITAL SIGNATURES OR FAXED COPIES OF LETTERS OF AGREEMENT/LETTERS OF GUARANTEE WILL RESULT IN THE BID BEING REJECTED.

- (f) The Tenderer shall not apply any conditions whatsoever to the Total Contract Price.



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**10. TENDER OPEN FOR ACCEPTANCE**

The Tenderer shall keep his Tender open for acceptance and irrevocable until 60 days have elapsed from the closing date of the Tender, or a formal contract is executed based on a Tender other than this one.

**11. NOTIFICATION OF CONTRACT AWARD**

The awarding of the Contract, based on this Tender, shall constitute and be an acceptance of this Tender, and the Municipality shall notify the successful tenderer of the contract award.

**12. INFORMAL OR UNBALANCED TENDERS**

In addition to those errors in the Tender that shall result in the Tender being rejected, as indicated in Clause 9 "REQUIREMENTS AT TIME OF TENDERING", Tenders which are incomplete, illegible or obscure, or that contain additions not called for, erasures, alterations, errors or irregularities of any kind, or contain prices which appear to be unbalanced as to be likely to adversely affect the Municipality, may be rejected as informal.

All blanks must be legibly and properly filled in. Should any uncertainty arise as to the proper manner of doing so, the required information will, upon request, be given by the Contract Administrator.

Tenderers who have submitted Tenders which have been rejected by the Municipality because of informalities will be notified of the reasons for rejection. When checking Tenders, the following procedures shall be used:

- (a) If the amount tendered for a unit price item does not agree with the extension of the estimated quantity and the tendered unit price, or if the extension has not been made, the unit price shall govern and the total price shall be corrected accordingly.
- (b) If both the unit price and the total price are left blank, then both shall be considered as zero.
- (c) If the unit price is left blank but a total price is shown for the item, the unit price shall be established by dividing the total price by the estimated quantity.
- (d) If the total price is left blank for a lump sum item, it shall be considered as zero.
- (e) If the Tender contains an error in addition and/or subtraction and/or transcription, the error shall be corrected and the corrected total contract price shall govern.

**13. REQUIREMENTS AT TIME OF EXECUTION**

Subject to an award of the Contract by the Municipality, the Tenderer is required to submit the following documentation in a form satisfactory to the Municipality for execution within seven (7) days after being notified in writing to do so by the Municipality.

- (a) Executed Bonds
  - i) The Municipality of West Elgin, Performance Bond
  - ii) The Municipality of West Elgin, Labour and Material
- (b) Executed Agreement
  - i) The Municipality of West Elgin, Form of Agreement
- (c) Insurance
  - i) The Municipality of West Elgin, Certificate of Insurance





- (d) Declaration
  - i) Workers' Compensation
  - ii) Corporation Tax Act
- (e) Workplace Safety and Insurance Board - Certificate of Clearance
- (f) Ontario RSO 1990 C.10 Occupational Health and Safety Act & Regulations
- (g) Verification of Registration as Contractor (with Ministry Of Labour)  
Note: only required once for the Owner's files
- i) Confined Space Policy

#### **14. WITHDRAWAL OF TENDERS**

A Tenderer who has submitted a Tender may submit a further Tender at any time up to the official closing time. The last Tender received shall supersede and invalidate all Tenders previously submitted by that Tenderer for this Contract.

A Tenderer may withdraw his Tender at any time up to the official closing time by letter bearing the signature of any person authorized by the Tenderer.

All withdrawn or superseded Tenders will be returned unopened.

#### **15. ABILITY AND EXPERIENCE OF TENDERERS**

No Tender will be considered from any Tenderer unless known to be skilled and regularly engaged in work of a character similar to that covered by the Drawings and Specifications. In order to aid the Municipality in determining the ability of any Tenderer, the Tenderer shall, within 48 hours after being requested in writing by the Contract Administrator, furnish evidence satisfactory to the Municipality of the Tenderer's experience and familiarity with work of the character specified and his financial ability to prosecute the proposed work properly to completion within the specified time. The evidence requested may, without being limited thereto, include the following:

- (a) The Tenderer's performance record with listing of work of a similar character and proportions which he has constructed, giving the name of the owner, date built and construction cost.
- (b) A tabulation of other work now under contract, giving the location, type, size, required date of completion and the percent of completion to date of each job.
- (c) An itemized list of the Tenderer's equipment available for use on the proposed Contract.
- (d) A listing of the major parts of the work which are proposed to be sublet.
- (e) The Tenderer's latest financial statement.
- (f) Evidence that the Tenderer is licensed to do business in the Province of Ontario, in the case of a corporation organized under the laws of any other Province or Country.



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**16. EXCLUSION OF TENDERERS IN LITIGATION**

The Municipality may, in its absolute discretion, reject a Tender or Proposal submitted by the Tenderer if the Tenderer, or any officer or managing director of the Tenderer is or has been engaged, either directly or indirectly through another corporation, in a legal action against the Municipality, its elected or appointed officers and employees in relation to:

- i. Any other contract or services; or
- ii. Any matter arising from the Municipality's exercise of its powers, duties, or functions.

In determining whether or not to reject a quotation, tender or proposal under this clause, the Municipality will consider whether the litigation is likely to affect the Tenderers ability to work with the Municipality, its consultants and representatives, and whether the Municipality's experience with the Tenderer indicates that the Municipality is likely to incur increased staff and legal costs in the administration of the contract if it is awarded to the Tenderer.

**17. SINGLE TENDER**

A single tender may be opened, and the Municipality reserves the right to accept or reject it.

**18. BID DEPOSIT WITH TENDER**

Tenders must be accompanied by an original bid deposit in the form of a sealed and signed Bid Bond, irrevocable Letter of Credit, Certified Cheque, or Canadian Currency (PHOTOCOPIES OR FAXED COPIES OF BID BONDS WILL RESULT IN THE BID BEING REJECTED).

Bid bonds submitted as a security shall be in accordance with the standards of the Canadian Construction Association and shall be from the same guarantee surety company supplying the Performance and Labour and Material Bonds for this Contract. Should the Tenderer withdraw his tender before 60 days have elapsed from the closing date of the Tender, or a formal Contract is executed, based on a tender other than this one, or fail to comply with any or all the requirements at the time of execution, the Municipality shall be at liberty to retain the money deposited by the Tenderer to the use of the said Municipality as liquidated damages, and to accept any other Tender or advertise for new Tenders, or carry out the work in any other way as the said Municipality may in its sole discretion deem best; the Tenderer also agrees to pay to the said Municipality the difference between the price or prices set out in this Tender and any greater sum or sums which the said Municipality may expend or for which it may become liable by reason of such default or failure, including the cost of any advertisement for new Tenders, and fully to indemnify and save harmless the said Municipality and/or its officers, agents, or servants from all loss, damage, liability, cost charges, or expense whatever which it, they or any of them may suffer, incur or be put to by reason of any such default or failure.

Bid deposits will be returned to Tenderers upon award of the Tender by the Municipality's Council except for that of the successful Tenderer and the next lowest Tenderer who will have their bid deposits returned upon execution of the Contract Document by the Municipality.

**19. BONDS**

The Tenderer shall, on or before the execution of the Contract, produce and file with the Treasurer, the following bonds:

(a) a bond in the amount of 50% of the total contract price, excluding H.S.T., guaranteeing the full and faithful performance of the work, including maintenance of the works for the stipulated period and the obligation to indemnify and save harmless the said Municipality, as in the Form of Contract.

(b) a bond in the amount of 50% of the total contract price, excluding H.S.T., guaranteeing payment for



labour and materials.

## **20. PRECONSTRUCTION REQUIREMENTS**

The following documents are required for review and or approval prior to any construction related activities:

- Construction Schedule; submitted to Construction Administration at least 14 days prior to preconstruction meeting
- List of sub-contractors; (Including Health & Safety Acknowledgements);
- Site access plan;
- Workplan for long lead time items;
- Clarifier and Headworks bypass plan; and
- MECP, ESA, and any other applicable permits required for the completion of the work.

## **21. BYPASS AND GROUND WATER MONITORING REQUIREMENTS**

Ground water monitoring including dewatering wet wells and level transmitters are required prior to the works in the clarifier and aeration tanks. Replacing the clarifier mechanism requires the clarifier to be taken offline. A temporary bypass will be required for the duration of the work. The lagoon has been dredged to allow for three-months of plant bypass flow.

A temporary bypass will also be required for the replacement of the headworks building. The clarifier and headworks upgrades are to be completed within the three-month bypass period.

## **22. HARMONIZED SALES TAX**

Harmonized Sales Tax applies to all goods and services purchased by the Municipality of West Elgin. H.S.T. is calculated, at the applicable tax rate, on these purchases and is payable by the Municipality at the time payment is made for the purchase.

Tenderers will be required to register for purposes of the tax, collect the tax on their taxable supplies to the Municipality of West Elgin and remit as required by legislation. Tenderers must supply the Municipality of West Elgin with their H.S.T. registration number.

The total contract price shall be inclusive of all government sales taxes, including H.S.T., custom duties and excise taxes applicable with respect to the contract, and shall be paid by the Tenderer unless otherwise provided by statute. The estimated amount of Harmonized Sales Tax must be disclosed separately on the Form of Tender.



# SECTION 3 – SPECIAL PROVISIONS



## 1. Ontario Provincial Standards and Specifications (OPSS)

The Ontario Provincial Standards General Conditions of Contract (OPS-GC), the Ontario Provincial Standard Specifications (OPSS) and the Ontario Provincial Standard Drawings (OPSD) shall form an integral part of these tender and contract documents.

In the OPS General Conditions of Contract Form, wherever the words “Ministry of Transportation” appear, they shall be taken to mean “The Municipality of West Elgin.”

These standard documents are not physically included with these documents for tendering purposes. Copies of the OPS documents are available at:

[www.raqsa.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage](http://www.raqsa.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage)

## 2. Substantial Completion

The Contractor is advised that the project is subject to a grant from the Ontario Communities Infrastructure Fund (OCIF). In order to meet the funding and the Municipalities objectives, the following milestones shall be met by the Contractor:

- **Substantial Completion: December 2025**
- **Final Completion: February 2026**

Should the Contractor fail to meet either of these milestones, the Contractor agrees to pay the Municipality Liquidated Damages in accordance with the Liquidated Damages clause in this Special Provisions document.

In the Bid price, each Bidder shall be deemed to have made due allowance for the publication of a copy of the certificate of substantial performance of the Contract in the Daily Commercial News or a commercial publication within seven days of receipt of the said certificate, if applicable, in order to facilitate the release of any holdbacks under the substantial performance certificate, if applicable.

## 3. Contractor's Schedule

The Successful Bidder shall be required, within a period of **seven (7)** calendar days after receiving notice that it is the Successful Bidder, to submit to the Engineer for approval a detailed schedule with sufficient information to demonstrate completion of all aspects of the works required under the Contract within the completion date requirements of the Contract and the above constraints. Include in the schedule the work of any sub-contractor, submission dates for required approval agency permits and estimated agency review time, estimated testing timelines, and the project completion date.

Time shall be of the essence of all Contracts. Work shall not commence until the Contractor has received authorization from the Engineer. The Contractor may be required, at the discretion of the Engineer, to postpone or halt work until conditions become acceptable.

Contractor to use additional work forces and equipment or revise methods of operation when the progress of work is not sufficient to meet the Construction Schedule at no additional cost to the City.

All schedules must indicate contingency and alternative dates and times in the event of postponement of any activity for any reason. Submission of a schedule does not relieve the Contractor from their responsibility for the completion of the Work in the time required by the Contract.



Except in emergency situations or as may be required by the Engineer, the Contractor shall not carry out operations on Saturdays, Sundays or any Statutory Holiday without permission in writing from the Municipality of West Elgin.

The Contractor is advised the site is in close proximity to near-by residents; it is highly unlikely work will be approved outside of regular working hours.

#### 4. Contractor's Superintendence

The Contractor shall provide a competent representative to be constantly on site during all working hours and ongoing throughout the execution of the works required by the Contract. The Contractor's representative shall, at all times, be in full control and be responsible for all activities and all phases of work including those portions of the works performed by sub-contractors.

#### 5. Maintenance Period

The Contractor guarantees that the said work shall, for a period of twelve (12) months from the date of substantial completion, remain in such condition as will meet with the approval of the Municipality. The Municipality will arrange for a final inspection of the works at that time. The Contractor will be required by the Municipality to make good in a permanent manner, satisfactory to the Municipality, any imperfections due to materials or workmanship used in the works.

The decision of the Municipality is to be final as to the nature and cause of such imperfection and the necessity for removing same.

Should the Contractor fail to comply with the direction of the Municipality, the latter may, after giving the Contractor twelve (12) hours' written notice, perform the necessary work and the cost may be deducted by the Municipality from monies owing to the Contractor, or to recover the cost from the Contractor.

Notwithstanding the expiration of the maintenance period, the Contractor shall not be relieved of correcting any defects or faults of which notice has been given to the Contractor prior to the expiration of the maintenance period.

#### 6. Contractor Responsibilities

Prior to any work or service being provided to or on Municipality property, Contractors must provide the Municipality with all documentation as requested and as applicable to the scope of the work.

The Successful Bidder shall give all necessary notices, obtain all necessary permits, pay all fees and furnish all necessary certificates as evidence that all work, as installed, conforms with the laws of all governing authorities before the final Certificate of Payment is issued by the Municipality. All changes and alterations required by an authorized inspector of any authority having jurisdiction shall be carried out without charge to the Municipality.

The Contractor shall notify the Engineer before any application for a license or permit is made in order that the Engineer may be represented if the Engineer so elects when such application is made.

The Contractor shall conform to and enforce strict compliance with the Occupational Health and Safety Act (OHSA) including the Contractor's obligations as an "Employer" under Section 25 and 26 thereof and with all regulations under the OHSA including, without limitation:

- a. Regulation 860 RSO 1990 (workplace hazardous materials information system, WHMIS)
- b. Regulation 851/91 Industrial Establishments



- c. Regulation 213/91 RSO 1990 Construction Projects
- d. Highway Traffic Act

It is understood that the Contractor, by executing the Contract, unequivocally acknowledges that it is the “constructor” within the meaning of the OHS Act and amendments thereto, as applicable to the scope of work outlined in the Bid Document and Contract, with complete control for health and safety matters over all persons who may be present at the site, whether such persons are members of the Contractor’s own forces, employees of the Municipality, utility companies or other sub-contractors or are third parties present at the site.

**The Municipality of West Elgin shall not be the Constructor. The Contractor hereby confirms that it has assumed such responsibility as the constructor for all purposes.**

The Contractor shall provide and maintain the necessary first aid items and equipment as called for under the First Aid Regulations of the Workplace Safety and Insurance Act and OHS Act.

#### 7. Liquidated Damages

It is agreed by the parties to the Contract the contract shall be Substantially Completed by **December 2025** and Final Completion shall be achieved by **February 2026**. If these stipulated milestones are not met, then damages will be sustained by the Municipality, and that it is and will be impracticable and extremely difficult to ascertain and determine the actual damages which the Municipality will sustain in the event of and by reason of such delay, and the parties hereto agree that the Contractor will pay to the Municipality the sum of

\$ \_\_\_\_\_ 1,000.00 \_\_\_\_\_

for each and every calendar day delay in finishing the work beyond the Substantial Completion date noted in the Special Provisions. It is also agreed that this amount is an estimate of the actual damages to the Municipality that will accrue for failure to have the work completed before the required completion date.

#### 8. Payment Holdback

A Maintenance Holdback of two and one-half percent (2.5%) of the total estimated value of the work completed to date will be retained, in addition to the Statutory Holdback of ten percent (10%) from each progress payment certificate.

The Maintenance Holdback will be released twelve (12) months from the date of Substantial Performance provided that all warranty and maintenance related issues have been completed to the satisfaction of the Engineer.

Upon written notice of a warranty or maintenance issue, the contractor will have five (5) days to remedy or provide an acceptable schedule for a remedy. If a remedy or acceptable schedule is not complete in five (5) days, the Municipality may complete the remedy and deduct the cost from the Maintenance hold back.

#### 9. Responsibility of Facility Operators

Operators will not be responsible for cleaning any structures that may be required for this work. It is the responsibility of the Contractor to clean each tank/structure to a condition suitable to complete the work. Disposal of all material shall be the responsibility of the Contractor.

#### 10. Confined Space Safety



Contractor agrees that any additional safety related costs associated with confined space entry, if required, have been included in the Total Contract Price for which no additional compensation is allowed/permitted.

The project may require confined space entry. The Contractor shall submit its company policies and procedures for confined space entry at the time of execution of documents.

#### **11. Site Cleanup and Restoration**

The contractor is responsible for leaving the site in a clean fashion that is, at minimum, restored to preconstruction condition. If any fencing, roadways, or other items that are to be left in place, are damaged or disturbed they must be restored to, at minimum, their preconstruction condition. Final restoration and cleaning shall be completed to the satisfaction of the Engineer.

#### **12. Driveway Maintenance**

Contractor to ensure all driveways to the Rodney Water Pollution Control Plant (WPCP) are clear of all debris at all times. Contractor is responsible for maintaining and cleaning of the driveway to ensure clean and hazard-free environment within the Rodney WPCP site as required or directed by the Engineer.

#### **13. Environmental Protection and Control**

In addition to all requirements stated in Specifications Section 01561, Contractor is ensure adequate dust control measures are implemented for a period of three (3) months after completion of all site restoration. The Contractor is advised the access driveway of the facility borders a nearby resident. Environmental protection and dust control shall be implemented for the duration of the project and maintained daily.

All excavated slopes shall be covered and protected until surface restoration is complete.

#### **14. Contractor Lay-down Area**

The Contractor shall confine the laydown area within the boundaries of the facilities at the Rodney WPCP. The Contractor shall be responsible for protection of equipment and securing the area at all times, and ensuring there are no hazards left on site during the off-hours. Laydown area shall be kept off the grass, and on the gravel or asphalt areas only.

#### **15. Rights of the Municipality**

The Municipality of West Elgin reserves the right, in its sole discretion, to:

- Make public the names of any or all the bidders;
- Assess a bidder's bid on the basis of
  - Information provided by references
  - The Bidder's past performance on previous Contracts awarded by the municipality; or
  - Other relevant information that arises during this Tender process.
- Waive minor informalities and accept Bids which substantially comply with the requirements of this Bid Request, but the Municipality shall not allow any blank space in any Bid to be filled in after the Submission Deadline;
- Verify with a third party any information set out in the bid;
- Check references other than those provided by the Bidder;
- Disqualify any Bidder whose Bid contains misrepresentations and any other in accurate or misleading information;
- Disqualify any Bidder or any Bid who has engaged in conduct prohibited by this Tender;
- Cancel this Bid at any time prior to the execution of the Contract by the Municipality for any reason





whatsoever;

- If this Bid is cancelled, the Municipality may issue a new Bid Request for the same or similar deliverables, but the Municipality is not required or obliged to do so;
- Accept any Bid in whole or in part; or
- Reject any or all bids.

**16. Application of Municipal Freedom of Information and Protection of Privacy Act**

The Bidder acknowledges that the Contract and all information related to the Contract and Deliverables is subject to the *Municipal Freedom of Information and Protection of Privacy Act*, R.S.O. 1990, C. M-56.

**17. Provisional Items & Allowances**

Allowances:

The Tenderer shall not enter a new price or alter the price in the Tender for any Allowance. Allowances shall be used as directed by the Engineer. The Tenderer agrees that no mark-up on any allowances is permitted. The Tenderer agrees that allowances shall only include costs borne by the respective firm or sub-contractor completing the work, and the Contractor is not entitled to any portion of the Allowance, unless the work is being carried by the Contractor.



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## **18. Clarifier and Headworks Workplan**

The Contractor is responsible for submitting a schedule and workplan prior to mobilization. The schedule and workplan shall incorporate the following considerations, at a minimum.

The Contractor is advised the Rodney WPCP is a fully operational, continuously functioning facility. Maintaining its function is the highest priority at all times. The Municipality and Operator are under a covenant agreement to protect the environment in the operation of these facilities. The Contractor's activities must not impede this ability for the Municipality and Operator.

The Engineer, Municipality, and Operator will act in good faith to support the Contractor in coordination and scheduling the work in an efficient and effective manner. Such support and assistance shall not relieve the Contractor of responsibility for their own schedule or directing of activities. The Contractor shall not use this assistance or support as basis for a claim to arise.

Any changes in plant operations required by the Contractor in order to carry out the work shall be made in writing to the Engineer, Municipality, and Operator, at least one (1) week in advance of the time the change is required. Coordinate with the Engineer, Operators, and other divisions to ensure minimum downtime. Contractor is advised the facility Operators, the Municipality, or the Engineer has the right to stop work at anytime for any reason.

The Contractor is responsible for ensuring continuity of operation at the Rodney WPCPs during and upon completion of the work stated in the tender and associated documents. Ground water monitoring including dewatering wet wells and level transmitters are required prior to the works in the clarifier and aeration tanks. The replacement of the clarifier mechanism will require the clarifier to be taken offline. The flows will need to be bypassed prior to discharge to the environment as a standby treatment method for the plant is not available. The lagoon has been recently dredged to allow for three-months of incoming flow storage. The clarifier shutdown is not to exceed the three-month period. The Contractor will be required for any additional storage, or treatment alternatives that exceeds the three-month storage period. The additional treatment alternative shall be included in the Total Contract Price and accounted for in Tender Item 1, Item 1.04. No additional costs will be granted for failure to plan the work within the allocated shut-down period.

The upgrades to the headworks system will also require the inlet channel to be taken offline. A full plant bypass will also be required. The headworks system upgrades must be completed within the three-month bypass period for the clarifier work. The lagoon has enough storage for one time storage of three-month period.

The Contractor must submit a workplan that includes the proposed shutdowns of the clarifier and headworks system. The workplan is to include dates, at minimum, for removal of equipment, delivery of new equipment, installation of new equipment, start-up of new equipment, and end of plant bypass. The final sequence of work must be reviewed and agreed upon by the Engineer and the Municipality.

The "Best Practices" for the Contractor in maintaining an efficient schedule will include preparing and submitting a realistic and detailed proposed Workplan in advance of activities which could impact Operations or affect the allowable timeline for plant bypass, clarifier replacement, headworks installation, etc.



# SECTION 4 – FORM OF AGREEMENT



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**THIS AGREEMENT** made on the \_\_\_\_\_ day of \_\_\_\_\_ 20 \_\_\_\_\_.

BETWEEN

**THE MUNICIPALITY OF WEST ELGIN**

(hereinafter called the "Municipality")

**OF THE FIRST PART**

- and -

(hereinafter called the "Contractor")

**OF THE SECOND PART**

**WITNESSETH**

That the Municipality and the Contractor in consideration of the fulfilment of their respective promises and obligations herein set forth, covenant and agree with each other as follows:

**ARTICLE 1**

(a) A general description of the work is:

The removal and disposal of sludge from the Rodney Lagoon Cell at the Rodney WWTP; Tender Number: 215817

(b) The Contractor shall, except as otherwise specifically provided, at his own expense, provide all and every kind of labour, machinery, plant, structures, roads, ways, materials, appliances, articles and things necessary for the due execution of all the work set out in this Contract and shall forthwith according to the instruction of the Contract Administrator commence the works and diligently execute the respective portions thereof, and deliver the works complete in every particular to the Municipality within the time specified in Subsection GC3.06 EXTENSION OF CONTRACT TIME and Clause 7 FORM OF TENDER.

**ARTICLE 2**

In the event that the Tender provides for and contains a Contingency Allowance, it is understood and agreed that such Contingency Allowance is merely for the convenience of accounting by the Municipality, and the Contractor is not entitled to payment thereof except for extra or additional work carried out by them in accordance with the Contract and only to the extent of such extra or additional work.



### ARTICLE 3

In case of any inconsistency or conflict between the provisions of this Agreement and the Plans or Specifications or General Conditions or Tender or any other document or writing, the provisions of such documents shall take precedence and govern in the following order, as outlined in the Ontario Provincial Standards General Conditions of Contract GC 2.02.

### ARTICLE 4

The Contractor shall not assign the Contract, either in whole or in part, without the written consent of the Corporation, as set out in Subsection GC 3.09 – Ontario Provincial Standards – General Conditions of Contract.

### ARTICLE 5

The Municipality covenants with the Contractor that the Contractor having in all respects complied with the provisions of this Contract, will be paid for and in respect of all the work at the tendered unit prices after measurement approved by the Engineer, the total which is presently estimated at **xxxxxxx Dollars (\$xxxxxxx including H.S.T.)**, together with such additional sum for extra or additional work at the unit rates stipulated in the written orders of the Engineer and Municipality authorizing the extra or additional work; such payment, however, shall be subject to Article 2 hereof and subject to such additions and deductions as may be properly made under the terms hereof, and further subject to the provisions that the Municipality may make payments on account monthly or otherwise as may be provided in the General Conditions.

### ARTICLE 6

Where any notice, direction or other communication required to be or may be given or made by one of the parties hereto to the other or to the Contract Administrator or to his agent, it shall be deemed sufficiently given or made if mailed or delivered in writing to such party or to the Engineer at the following address:

The Municipality

The Municipality of West Elgin  
22413 Hoskins Line, Box 490  
Rodney, ON N0L 2C0

The Contractor

Contract Administrator/Engineer

R.V. Anderson Associates Ltd.  
557 Southdale Road E, Suite 200  
London, ON N6E 1A2

### ARTICLE 7

A copy of each of the Tender, Special Provisions, Addenda to inclusive is hereto annexed and together with the plans, detailed drawings, Ontario Provincial Standards for Roads and Public Works, Volumes 1 - 4 inclusive and Volumes 7 and 8, all as listed in the Information for Tenderers are made part of this Contract, as fully to all intents and purposes as though recited in full herein.

### ARTICLE 8

No implied Contract of any kind whatsoever by or on behalf of the Municipality shall arise or be implied from anything in this Contract contained nor from any position or situation of the parties at any time, it being clearly understood that the express covenants and agreements herein contained made by the Municipality shall be the only covenants and agreements upon which any rights against the Municipality may be founded.

### ARTICLE 9

The Contractor declares that in tendering for the works and in entering into this Contract he has either



investigated for himself the character of the work and all local conditions that might affect his tender or his acceptance of the work, or that hereby assume all risk of conditions arising or developing in the course of the work which might or could make the work, or any items thereof, more expensive in character, or more onerous to fulfil, than was contemplated or known when the tender was made or the Contract signed. The Contractor also declares that he did not rely upon information furnished by any methods whatsoever, by the Municipality or its officers or employees, being aware that any information from such sources was and is approximate and speculative only and was not in any manner warranted or guaranteed by the Municipality.

**ARTICLE 10**

In compliance with the current regulations made under the Retail Sales Tax, Ontario, for the purpose of the purchase of materials to be in the works which are the subject matter of this Contract, the Contractor is hereby appointed as a special purchasing agent for the Municipality which will be provided to the Contractor.

**ARTICLE 11**

This Contract shall apply to and be binding on the parties hereto and their successors, administrators, executors and assigns and each of them.

**IN WITNESS WHEREOF** the parties have hereunto set their hands and seals the day and year first above written or cause their corporate seals to be affixed, attested by the signature of their proper officers, as the case may be.

.....)  
*Witness as to signature of contractor*  
)  
)  
Address.....)  
)  
)  
.....)  
)  
)  
Occupation.....)

.....  
Contractor

.....

THE MUNICIPALITY OF WEST ELGIN

.....  
Mayor

.....  
Clerk

# DIVISION 1

## GENERAL REQUIREMENTS

## INDEX

SECTIONS

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END OF INDEX DIVISION 1



PART 1 - GENERAL

## 1.01 Reference:

- A. These Specifications form an integral part of the Contract Documents.
- B. Refer to all other parts of the Contract Documents to determine their effect on the work of each section of these Specifications.
- C. The General Conditions, Supplementary General Conditions, Special Provisions, Information for Tenderers, Form of Tender, Articles of Agreement, in addition to any and all Addenda shall be read in conjunction with and shall apply to and govern every Specification.
- D. The requirements of this Section and Division 1 apply to and govern the work under all other divisions.

## 1.02 Related Work:

- A. References - Section 01090
- B. Removals and Demolition - Section 02050

## 1.03 WHMIS Submittals:

- A. Prior to the commencement of work, provide to the Engineer a list of those products which are controlled under WHMIS legislation and that are expected to be used in the performance of the work. Provide related Material Safety Data Sheets in accordance with the specified procedure for Submittals for information. Properly label all containers used in the application of products controlled under WHMIS product legislation.
- B. Notify the Engineer of changes to the list in writing and provide the relevant Material Safety Data Sheets.

## 1.04 Metric Conversion:

- A. Be responsible for conversion of dimensions from metric units to imperial units and vice versa, as necessary

PART 2 - PRODUCTS

There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 Mobilization and Demobilization:

- A. Supply and erect signs, barricades, flashers, delineators, and provide flag persons, and such other protection as may be required to protect the public during construction.

- B. Provide temporary orange construction fence with laminated caution tape wired to T-bar posts spaced at 1.8 m on centre to define Contractor's working area.
- C. Provide security protection for Contractor's office, plant, and stored materials.
- D. Move onto site and set up Contractor's office, storage facilities, and plant including sanitary facilities, temporary fencing, hydro and telephone.
- E. Provide necessary access to the project including haul roads as required and restoration of surfaces to original condition after haul roads are removed.
- F. Move off site and remove Contractor's office, storage facilities and plant, and leave site clean and tidy.
- G. Ensure that the price entered in the Form of Tender for this item is consistent with the costs involved but does not, in any event, exceed ten percent (10%) of the tendered price.
- H. The following governs payment for Mobilization/Demobilization where it is not defined separately in the Form of Tender:
  - 1. 60% to be paid upon commencement of construction and the provision of all temporary facilities.
  - 2. 40% to be paid after Substantial Performance and full demobilization.

### 3.02 Examination:

- A. Examine the site and any work on which the work of each Division depends. Check all dimensions, and if any discrepancies or defects are found, notify the Engineer.
- B. Confirm dimensions prior to commencing work and ensure that they are agreed upon by the affected trades and the Engineer.
- C. A Designated Substances Survey Report is included in the Tender Documents. Thoroughly examine the site and confirm the location of designated substances and, in particular, asbestos, before commencing work.
- D. Inform workers and sub-trades of the locations of designated substances on site before commencing work.
- E. Commencement of the work implies acceptance by the Contractor of dimensions, conditions and surfaces.

### 3.03 Work to Conform:

- A. Ensure that all work conforms with the Contract during its progress and upon its completion, true to the lines, levels and grades shown on the Contract Documents. Ensure that the work is built in a thoroughly substantial and workmanlike manner, in accordance with the Contract Documents, subject to such modifications and additions as may be deemed necessary by the Engineer. No payment will be made for any work in

excess of the requirements of the Contract Documents unless ordered in writing by the Engineer.

- B. Conform to applicable codes and standards including, but not limited to, those listed in Section 01090.

### 3.04 Maintenance of Documents on Site:

- A. Maintain at the job site, one copy of each of following:

1. Contract Documents complete with Addenda.
2. Reviewed shop drawings.
3. Change orders.
4. Other modifications to the Contract.
5. Field test records.
6. MOL notices.
7. Safety inspection reports.
8. Copies of permits and approvals.

- B. Maintain documents in a clean, dry, legible condition.

- C. Make documents available at all times for review by the Engineer.

- D. Maintain on site, one copy of each workmanship standard called for in the Specifications.

### 3.05 Maintain As-Built Drawings as follows:

1. Provide two sets of full-size white prints for As-Built drawing purposes.
2. Maintain As-Built drawings on site and record all deviations from the Contract Documents. Record all changes in the work caused by site conditions, originated by the Owner, the Engineer, the Contractor or a Sub-contractor and by addenda, supplemental drawings, site instructions, supplementary instructions, field orders, change orders, correspondence and directions of regulatory authorities.
3. Record the following information:
  - a) Depths of various elements of foundations in relation to the established survey datum.
  - b) Horizontal and vertical location of underground utilities and appurtenances and provide reference to permanent surface features.

- c) Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure. Do not conceal critical work until its location has been recorded.
  - d) Changes of dimension and detail.
  - e) Location of access panels for valves, controls, cleanouts, etc.
- 4. Make available to the Engineer the up to date As-Built drawings identifying changes as described above for review as requested.
  - 5. Submit As-Built drawings for monthly review.
  - 6. Complete the As-Built drawings and submit them to the Engineer and Owner prior to the request for Substantial Performance. Modify the As-Built drawings if necessary and submit the final As-Built drawings to the Engineer and Owner prior to the issuance of the Completion Certificate.

### 3.06 Access to Site:

- A. Unless stated otherwise, reasonable access to the site will be permitted from start of construction until Substantial Performance of the Contract.
- B. After Substantial Performance of the Contract, do not enter the facility without prior written authorization from the Owner and restrict activities to the work duly authorized by the Owner, including modifications and rectification of deficiencies. For completion of additional work other than the authorized work, obtain written approval from the Owner prior to proceeding with such additional work.
- C. The Engineer will authorize access to the construction site. Construct and maintain temporary roads required for the work in a proper and safe fashion.
- D. Maintain proper and safe access to the existing facility at all times. Ensure that personnel employed by the Owner at the existing facility have full access at all times to all areas required by the normal operation of the facility.
- E. Repair promptly any damage to the existing access road, to the satisfaction of the Engineer.
- F. Provide and maintain access route at all times for Emergency and Owner's vehicles.
- G. Be responsible for snow removal within the work area.

### 3.07 Access to Work:

- A. The Owner or persons authorized by the Engineer may at any time and for any purpose enter upon the work and premises used by the Contractor. Provide proper and safe facilities for access. Others, such as regulatory and permitting agencies, may also, when authorized by the Engineer, enter upon the work and premises used by the Contractor for purposes that may be required by their agencies.

- B. Provide proper facilities by means of walkways, ladders or otherwise, to secure convenient safe access to all parts of the work as may be required by the Engineer.
- C. Place materials so that free access may be maintained at any time to all parts of the work and facilities.

### 3.08 Work Areas:

- A. Work areas are defined on the Drawings or designated by the Engineer. Confine operations to the designated areas.

### 3.09 Use of Premises by Contractor:

- A. Be advised that the Contractor and subcontractors shall have reasonable, but not unrestricted use of the premises. Confine activities to the areas designated on the Contract Drawings and to the satisfaction of the Engineer. No claims for additional costs will be entertained by the Owner resulting from restrictions of movements on, or occupation of, the premises.
- B. Do not enter upon or occupy with workers, tools, or materials of any nature, lands other than the property of the Owner or within working easements as shown on the Contract Drawings, without the written permission of the proper parties. Provide a certified copy of each such consent to the Engineer. Assume liabilities and additional costs for rentals or damages arising from occupation of private lands.

### 3.10 Protection of Construction and Equipment:

- A. Protect new construction from damage. Do not overload any part of a structure, falsework, formwork or scaffolding. Rebuild to the satisfaction of the Engineer damaged portions of the work.
- B. Take precautions to protect structures and equipment until completion.
- C. Protect equipment supplied and/or installed, under this contract, from damage, dust, dirt, etc., to the satisfaction of the Engineer. If required, supply temporary housing for equipment or items supplied.
- D. Comply with instructions of the Engineer concerning storage of equipment and materials.
- E. Assume full responsibility for storage and protection of materials and equipment delivered to site.

### 3.11 Protection of Existing Facilities and Personnel:

- A. Do not endanger in any way the personnel, equipment, plant and existing structures of the Owner. Exercise caution to keep the existing facilities free from damage due to the Contractor's work. If the measures observed by the Contractor are not considered sufficient, the Engineer may order additional precautions to be taken.

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### 3.12 Protection of Existing Utilities:

- A. Be responsible for locating all existing utilities through “daylighting” method. The locations of utilities shown on the Drawings are approximate.
- B. Contact the Engineer and the utility companies for any information not shown on the Drawings with regard to the location of underground utilities. Exercise the necessary care in construction operations and take other precautions as necessary to safeguard the utilities from damage. Bear the cost of repairing damaged utilities.
- C. Provide support for the existing utilities/services as required at crossings or in proximity to new installations.

### 3.13 Protection of Survey Markers:

- A. Preserve survey property pins and bars while the work is in progress. Have an Ontario Land Surveyor replace property pins and bars damaged or removed by construction activities, to the satisfaction of the Engineer, at no cost to the Owner.

### 3.14 Protection of Adjacent Property:

- A. Do not cause damage to adjacent property, public or private, or to sidewalks, roadways, curbs, gutters, manholes, underground structures, boulevards, grass plots, sodding, trees, shrubs or other structures, works or things on or near the line, or in the vicinity of the works or elsewhere. Repair damage, in the manner directed by, and to the satisfaction of, the Engineer.

### 3.15 Protection Against Flotation:

- A. Control groundwater level and surface water to prevent damage to pipes or structures due to water uplift pressure during construction and until the completed works are accepted.

### 3.16 Metric Material and Equipment:

- A. Where metric and imperial material and equipment are to be installed under the same contract, be satisfied that mating of metric and non-metric material and equipment is possible. Provide transition couplings, adapters, etc.

### 3.17 Photographs and Video:

- A. The Owner and the Engineer reserve the right to take photographs and video of the work at any time.
- B. Provide, to the Engineer on a data key, photographs showing progress of the work on a monthly basis.

### 3.18 Plant, Equipment and Materials provided for the Work:

- A. Ensure that construction plant, temporary facilities and materials, when brought to the site, are exclusively intended for the permanent construction and completion of the work.

Do not remove same or any part thereof, except from one part of the site to another, without the consent of the Engineer, in writing.

- B. Observance of the above item does not necessarily imply approval by the Engineer, as the Engineer may reject such items at any time.

### 3.19 Owner's Interest in Existing Equipment and Materials:

- A. Provide the Owner with the first right of refusal for the existing equipment or material that is removed from the existing works. Refer to Section 02050 for additional requirements.

### 3.20 Changes to Suit Preferred Construction Method:

- A. Should the method of construction preferred by the Contractor for part or all of the works necessitate re-design, alterations, additions or changes to the structures or any part of the works, provide such changes, re-design, alterations and/or additions, as necessary and in accordance with the Contract requirements and to the satisfaction of the Engineer at no additional cost to the Owner.
- B. Formally propose deviations from the Contract Documents for review by the Engineer. Clearly indicate the change in value of the works caused by the deviation.

### 3.21 Interpretation of Drawings and Specifications:

- A. In case of discrepancy between the Contract Drawings, Specifications or any other part of the Contract Documents, the order of precedence listed in the Contract Documents governs this Contract. In case of discrepancy within one of the Contract Documents of the same type, the more onerous and stringent requirement shall govern.
- B. The Contract Drawings and Specifications are complementary to each other and what is called for by either is as binding as if called for by both. It is the intention to provide for a finished project, complete in all essentials, notwithstanding that not every item involved may be particularly mentioned or shown.
- C. Notify the Engineer as soon as possible if any unintentional error or omission should become known. Engineer will review and propose a solution and the Contractor shall be compensated in accordance with the General Conditions.
- D. The location of un-dimensioned fixtures, apparatus, outlets, conduits, piping, etc., shown on the Contract Drawings or specified are approximate. Finalize the actual locations as directed by the Engineer and as required to suit conditions at the time of installation and as is reasonable.
- E. Locate equipment, fixtures, piping, conduits, etc. that are un-dimensioned to create the minimum interference with pedestrian access, machinery traffic, and headroom.
- F. The Contract Drawings and Specifications are prepared using SI (metric) units; however, some Contract Drawings and Specifications may use imperial units. Be responsible for the accuracy of conversions between Imperial units and SI units.

- G. Read the Drawings as a complete package even though the Contract Drawings have been divided into disciplines such as: General, Architectural, Structural, Process, Mechanical, Electrical, Instrumentation and other disciplines. Details applicable to one section may appear on Drawings pertaining to another section or sections.
- H. Read the Specifications as a complete package even though the Specifications have been divided into Divisions. Specifications relating to one division may appear in another division or divisions. Coordinate the work of the sub-trades to meet the requirements of the Contract.

### 3.22 Geotechnical Investigations:

- A. A geotechnical investigation of the project site has not been completed and previous geotechnical investigations are not available. The ground water level and soil conditions are not available.
- B. Be satisfied as to the soil conditions and perform test excavations and/or borehole drilling as required, to satisfy the requirements. Protect existing facilities and underground utilities as specified.

### 3.23 Additional Drawings:

- A. The Engineer may furnish additional drawings to assist in the proper execution of the work. These drawings will be issued for clarification only and will not become the basis for extra payment. Such drawings have the same meaning and intent as if they were included with the Contract Documents.
- B. The Engineer may provide, at any time, drawings pertaining to additional or extra work. These drawings will be clearly identified as relating to work for extra payment.

### 3.24 Explosives:

- A. Do not use explosives on this project.
- B. Do not use powder-activated tools on any part of the work unless written approval for their specific use is obtained from the Engineer. Ensure that workers using powder-activated tools are properly trained in their use.

### 3.25 Work Done in Cold Weather:

- A. Protect structures, piping, sewers, and equipment that may be exposed to frost during the construction period until the project is completed and accepted. Include such protective measures in the contract price and correct any damage sustained, to the satisfaction of the Engineer.
- B. Submit to the Engineer in writing, before construction begins and by October 1st, of each year of construction, an outline of specific frost protection measures to be implemented on this project. Be responsible for the proper implementation of frost protection measures and damages arising from freezing regardless of the review by the Engineer of the frost protection measures.



- C. In instances where the Engineer may permit or order work to be done when the minimum ambient temperature is at, about, or below 4°C, heat all material used. Provide sufficient temporary protection in the form of false work and tarpaulins, or other temporary structures to adequately enclose the portion of the work under construction. Supply sufficient temporary heat necessary to maintain the temperature throughout the work at or above 10°C during the construction and for a minimum of four (4) days after completion of the enclosed portion of the work.

### 3.26 Patent and License Fees:

- A. Be responsible for execution and payment of all applicable patent, copyright or license fees and royalties relating to equipment or processes incorporated into the works, unless specified otherwise.
- B. Save the Owner and Engineer harmless from damages and costs, which may arise from patent infringements.

### 3.27 Professional Engineer:

- A. Where the drawings and specifications identify the requirement for a Professional Engineer, provide the services of an Engineering Practitioner licensed in the province where the Project is located.

### 3.28 Loose Items:

- A. For the purpose of this Contract, loose items are items supplied under this Contract which are not directly incorporated into the works, such as furniture, spare parts, lubricants, portable pumps, etc.
- B. Be responsible for the care and security of loose items until the date of Substantial Performance, at which time the Owner will confirm receipt in writing for the loose items. Should the Owner wish to assume any loose items prior to the date of Substantial Performance, obtain a written receipt from the Owner listing the items. Replace prior to Final Acceptance any spare parts used during Warranty Period for the purpose of correcting defects in the supplied equipment. Official receipt of spare parts to take place just prior to the Final Acceptance.
- C. Prepare a summary list of loose items and spare parts updated on a monthly basis. Submit the list for review by the Engineer.

### 3.29 Assistance:

- A. Provide reasonable help to the Owner's representatives in checking the setting out of the work. Provide ready access to work.

END OF SECTION 01000

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work of this Section.

## 1.02 Work Covered by Contract Documents:

- A. The work required to be done under this Contract includes the supply of material, labour, equipment, permits, site offices, and other requirements, necessary for the complete construction of the works shown on the Contract Drawings and as specified herein including a guarantee of workmanship and materials for a period of one year after the issuance of the Certificate of Substantial Performance.
- B. The following is a general, but not necessarily complete, description of the work to be constructed under the Contract. The list below is not intended to specify the order of construction/execution:
  - 1. Remove and dispose offsite the existing Headworks building including influent screen system, enclosure and associated accessories. Install a new Headworks building including a new screening system inside a new FRP enclosure complete with HVAC, plumbing, and structural upgrades to a new concrete base slab. Modify existing concrete inlet channel to suit new screening system.
  - 2. Install a groundwater monitoring system including a dewatering well with level transmitter to continuously monitor ground water levels in the aeration tanks and clarifier areas.
  - 3. Drain aeration tanks and dispose offsite. Remove the existing mechanical aerators and provide wash water to clean the tanks and dispose of wash water offsite. Install new fine bubble aeration systems in two (2) existing aeration tanks including new air blowers, air piping, valves and associated accessories.
  - 4. Remove and dispose offsite one (1) existing outdoor Alum storage tank, and associated accessories. Modify existing containment curb..
  - 5. Remove the existing lime chemical system, including pumps, piping, mixers, storage tanks, and associated accessories. Modify the existing Lime Chemical Room to Alum Chemical Room with associated upgrades including a field-erect a FRP Alum storage tank, concrete containment curb, containment access ladder, relocation of existing alum feed pumps, piping, emergency eyewash, hot water tank and other associated accessories.
  - 6. Remove the existing clarifier mechanism with FRP cover and dispose offsite. Drain the clarifier tank and dispose offsite. Provide wash water to clean the tank and dispose of wash water offsite. Install a new clarifier mechanism of similar type without cover.
  - 7. Upgrades and modification to the existing Control Building B to provide a blower room separate from the existing RAS/WAS pump room and chemical room.

Upgrades and modification include a partition fire-rated wall, HVAC, plumbing and a tempered emergency eye wash and shower station as required.

8. Replacement of the existing WAS/RAS pumps motors, and drain piping, along with installation of a new sump pump in a modified sump.
9. Replacement of the existing decant pump discharge piping and connection to existing above grade flexible hose.
10. Associated electrical and instrumentation upgrades for the new equipment. Replacement of existing electrical and controls that do not meet hazardous classification.
11. Restoration, grading and landscaping as required.

#### 1.03 Work by Others:

- A. The following contracts may be proceeding on the site at the same time as this Contract:
  1. General operation and maintenance of the facility
- B. Jointly plan and coordinate work with other contracts and utility companies awarded by the Owner that may be in progress on the site of this Contract.
- C. Obtain acceptance in writing from the Engineer for all arrangements made with other Contractor(s).
- D. The Engineer shall determine co-ordination and execution of work in the event that Contractor(s) are unable to reach satisfactory working agreements.
- E. Coordinate with utility companies before proceeding with the work under this Contract.

#### 1.04 Change in the Work, Extra Work, and Additional Work:

- A. For work completed by the Contractor's own forces, the value of the change shall be determined based on a breakdown of actual costs for the work and acceptance of the quotation by the Owner. The Contractor may charge a maximum markup of 5% as a combined percentage fee for overhead and profit on the aggregate of the work performed.
- B. For work completed by the sub-contractor, the subcontractor may charge a maximum markup of 5% as a combined percentage fee for overhead and profit and the Contractor may apply their markup on the sub-contractor's work based on the following breakdown:
  1. 20% of the first \$3,500; plus
  2. 15% of the amount from \$3,500 to \$12,000; plus
  3. 5% of the amount in excess of \$12,000.
- C. The percentage fee markups referred to above are intended to cover all profit general expenses and overhead costs incurred by the Contractor in relation to the change

including, but not limited to, head office and head office personnel costs, estimating, supervision, coordination, administration, general cleanup, small tools, As-Built Drawings, Warranty, insurance and job safety costs.

- D. An adjustment to the Contract Time will be considered only when the Contractor demonstrates to the Owner and the Engineer that a change in the Work affects the critical path of the Work. Any costs associated with the adjustment to the Contract Time shall be identified by the Contractor in their quotation.

1.05 Definitions:

- A. Provide: Furnish and install, complete and in place, ready for intended use.

PART 2 - PRODUCTS

- A. No products in this Section

PART 3 - EXECUTION

- A. There are no Execution items in this Section.

END OF SECTION 01010

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

PART 2 - PRODUCTS

- A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 General:

- A. Base the tender price upon providing the materials and equipment specified on the Contract Drawings or in the Specifications, which define the standard of quality required.
- B. Do not base the tender price upon a presumed acceptance by the Engineer or Owner of a substitute item of supply.
- C. Where products are named specifically by brand name or other specific details, base the tender prices on supply and installation of the products named in the Contract Documents.
- D. The naming of a manufacturer is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying materials and equipment as specified.
- E. No substitutions or alternatives are allowed for pre-selected equipment.

## 3.02 Alternatives:

- A. Where more than one manufacturer or supplier's name or product is listed in the Specifications, note that the design, as specified and shown on the Drawings, has been based on the first named supplier, manufacturer or product listed.
- B. If a product from a manufacturer or supplier other than the first named is provided, assume liabilities and costs for the following:
  - 1. The performance and proper fit and matching of such equipment or material to surrounding pipe, equipment or material of the building, electrical, mechanical and controls or any other sub-trades, and
  - 2. Engineering and construction costs that may subsequently arise as a result of the acceptance of the product from other than the first named manufacturer or supplier.

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### 3.03 Substitutions:

- A. In all cases where a substitution is proposed other than from one of the named manufacturer's or supplier's products, provide written justification to the Engineer indicating the reasons for the substitution (eg. significant delay in delivery, strikes, unavailability, improved quality or field service, significant contract cost reduction). Provide sufficient descriptive and technical information for the Engineer to thoroughly compare articles or groups of articles with those specified. Failure to comply with this requirement to the Engineer's satisfaction may result in rejection of the request due to insufficient information or time to evaluate it.
- B. Submit requests for substitutions on the Substitution Request Form appended to the end of this Section. Requests for substitutions submitted in other ways will not be considered.
- C. Should the equipment or materials proposed by the Contractor be accepted, provide required changes to the Contract to suit the accepted substitution at no additional cost to the Owner.
- D. Do not permit subcontractors to make applications and submissions related to substitutions directly to the Engineer. Such applications and submissions must be made by the Contractor. Applications and submissions relating to alternatives and substitutions made by subcontractors will not be considered.
- E. When making requests for substitutions, allowance in the schedule has been made for the Engineer and the Owner to fully consider the proposed substitution and to provide a response. Be aware of the response times as specified in Section 01300 and make allowances for them. No claims for costs or time will be entertained due to the time required for the consideration of substitution requests as long as the response times falls within the allowable response time as specified.
- F. No claims for costs or time will be entertained relating to the rejection or acceptance of a proposed substitution.

Substitution Request Form

Substitute Description:			Sub Request #:	
OWNER:		Date Sent	Date Received	Initials
PROJECT:	Contractor → Engineer			
CONTRACTOR:	Engineer → Contractor			
Specification Title:		Description:		
Specification #:	Page/para:	Drawing #s:		

Proposed Substitution:				
Manufacturer:		Address:		Phone:
Trade Name:			Model #:	
Installer		Address:		Phone:
History: <input type="checkbox"/> New Product <input type="checkbox"/> 2-5 Years Old <input type="checkbox"/> 5-10 Years Old <input type="checkbox"/> > 10 Years Old				
Details:				
<input type="checkbox"/> Attached point-by-point comparative data. <input type="checkbox"/> Attached complete dimensional information and technical data, including laboratory tests, if applicable. <input type="checkbox"/> Attached complete information on changes to drawings and specifications which proposed substitution will require for proper installation.				

Similar project which for product was used	
Project:	Consultant:
Address:	Owner:
	Date Installed:
Proposed substitution affects other parts of work: <input type="checkbox"/> No <input type="checkbox"/> Yes; explain:	

Savings to Owner for accepting substitution: \$
Proposed substitution changes contract time: <input type="checkbox"/> No <input type="checkbox"/> Yes; <input type="checkbox"/> Add <input type="checkbox"/> Deduct: _____ days.
If yes, indicate reason:
Proposed substitution affects the dimensions shown on drawings: <input type="checkbox"/> No <input type="checkbox"/> Yes;
If yes, indicate reason:
Supporting Data Attached: <input type="checkbox"/> Drawings <input type="checkbox"/> Product Data <input type="checkbox"/> Samples <input type="checkbox"/> Tests <input type="checkbox"/> Reports <input type="checkbox"/> Other, specify:

The Undersigned certifies: <ul style="list-style-type: none"> <li>• Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product, or liability is assumed for equivalent performance.</li> <li>• Same warranty will be furnished for proposed substitution as for specified product.</li> <li>• Same maintenance service and source of replacement parts, as applicable, is available.</li> <li>• Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule other than specified herein.</li> <li>• Cost data as stated above is complete and accurate. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.</li> <li>• Proposed substitution does not affect dimensions and functional clearances other than specified herein.</li> <li>• Costs will be carried by the Contractor for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.</li> <li>• Coordination, installation, and changes in the work as necessary for accepted substitution will be complete in all respects.</li> </ul>	
Submitted by:	
Contractor Signature:	<i>Signature Required.</i>
Address:	
Telephone:	
Attachments:	
RVA's REVIEW AND ACTION	
<input type="checkbox"/> Substitution reviewed <input type="checkbox"/> Substitution reviewed as noted <input type="checkbox"/> Substitution rejected – Use specified materials. <input type="checkbox"/> Resubmit as noted – Additional information required.	RVA's estimated budget for additional design, inspection, contract administration and as-built drawings.  \$ _____
Signed by:	Date:
Additional Comments: <input type="checkbox"/> Contractor <input type="checkbox"/> Subcontractor <input type="checkbox"/> Supplier <input type="checkbox"/> Manufacturer <input type="checkbox"/> RVA <input type="checkbox"/> Other:	

END OF SECTION 01030



PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

PART 2 - PRODUCTS

- A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 Supervision:

- A. Maintain on the site at all times a general superintendent who is fully qualified to properly direct the progress of this Contract continuously, including the co-ordination and work of subcontractors. During periods when work on this project is not being carried out, maintain protective fencing or competent security personnel on the site to guard the site and works and the properties and possessions thereon of the Contractor and their subcontractors as well as those of the Owner.

## 3.02 Sub-Trades:

- A. The various Divisions of these Specifications have not necessarily been segregated into sub-trades or sub-contracts. Define the scope of work required of each sub-trade and apportion it, with special attention directed toward items or materials that are to be built into concrete, masonry, etc.
- B. Coordinate architectural, structural, mechanical, electrical and control work for the equipment being installed.
- C. No extra payment will be considered based on differences of interpretation of the Contract Documents, or lack of direction in the Specifications as to which trade should provide certain items or materials.
- D. Should alternative equipment proposed by the Contractor be accepted, provide required changes to electrical equipment, wiring or raceways associated with that equipment and bear the extra expense for such changes to equipment layout, electrical and control equipment or wiring system.

## 3.03 Access:

- A. At all times, maintain vehicular access along public roads used by construction vehicles.
- B. At all times, maintain vehicular access to the facility.
- C. Submit a traffic control plan in accordance with Ontario Ministry of Transportation requirements.
- D. Maintain public roads in acceptable condition to the satisfaction of the Engineer/Owner. Clean roadway and provide dust suppression daily or more frequently as required.

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### 3.04 Co-ordination of Construction with Operation of Existing Facilities:

- A. Give facility operations precedence over construction activities.
- B. Maintain the conveyance of sewage at all times.
- C. For the facilities on the site, coordinate construction activity under this Contract with the Owner.
- D. Upon award of the Contract, submit a list of services requiring shutdown, anticipated shutdown times and maximum duration.
- E. Provide 14 days written notice to the Engineer where a temporary shut-down of any portion of existing works is necessary to facilitate construction. Have the proposed timing of such construction reviewed by the Engineer prior to initiation of the work related to the shutdown.
- F. Obtain acceptance from the Engineer for all proposed partial shut-downs required for equipment, piping, instrumentation and electrical installations and/or removal at least 3 weeks in advance by the Engineer. Obtain written approval of all schedules by the Engineer. Ensure all schedules indicate contingency and alternate date and times in the event of postponement for any reason, or breakdown of temporary by-pass equipment during the shutdown. Allow for redundancy in implementing contingency plans.
- G. Provide a detailed schedule indicating each phase of the shutdown and startup of each portion of the existing works.
- H. Provide written procedures for each shutdown and startup activity.
- I. Coordinate with the Engineer connections of all utilities.
- J. Take every precaution to avoid interfering with facility operation and maintenance. In the event of conflict between construction operations and facility operations, facility operations have priority. Reschedule construction operations, if required, without change to the Contract Price.
- K. In the event of unpredictable circumstances and emergencies, the Owner reserves the right to cancel scheduled work that would impact the facility's capability in meeting the MECP requirements or create operational constraints.

### 3.05 Concealment of Pipes and Conduits:

- A. Unless specifically noted otherwise on the Drawings, completely conceal pipes, ducts and other such services within the construction of floors, walls, ceiling or soffits of the building. Leave electrical conduits exposed within unfinished areas.
- B. If doubt arises as to the means of concealment or the intent of the Contract Documents in this connection, request clarification from the Engineer before proceeding with the work. Furring to conceal services on walls or ceilings will be allowed only where indicated on the Drawings or reviewed by the Engineer.

- C. Have the mechanical subcontractors lay out their work well in advance of erection of walls, ceilings, furring, etc., so that provision may be made for proper concealment where required. Have such work tested, inspected and pipe covering applied, where applicable, before being concealed.
- D. Install pipes, ducts, and conduits, etc. that are to be furred in neatly and close to building structures so that furring can be kept as small as possible. Replace services or other work that are not installed as required, to the satisfaction of the Engineer.
- E. Run exposed ducts, piping and conduit neatly along ceilings, walls or beams with hangers at right angles to walls and ceilings. Provide struts to support conduits. Do not secure conduits directly to walls.

### 3.06 Cutting, Drilling, Fitting and Patching:

- A. Complete the necessary cutting, fitting and patching to ensure that the various parts of the work fit properly. Complete cutting, fitting and patching as may be required to connect the work with that of any other Contractor as indicated on the Contract Documents.
- B. Do not negatively impact existing work by cutting, digging, blasting or any other construction operation.
- C. Do not cut load-bearing members without the review by the Engineer.
- D. Be responsible for costs occasioned by ill-timed work.
- E. Prior to coring or drilling into existing concrete, in order to avoid damage to any encased piping, conduits, and other concealed items in the vicinity, ensure that:
  - 1. The locations and the extent of cutting required are coordinated with the trade(s) involved and are accurately and carefully marked out.
  - 2. The walls or slabs are scanned with ground penetrating radar (GPR) prior to drilling holes or coring openings to determine the location of existing services concealed in and/or behind the construction to be drilled.
  - 3. Shop drawings applicable to the affected area have been reviewed.

### 3.07 Location of Fixtures:

- A. The location of un-dimensioned fixtures, apparatus, outlets, conduits, piping, etc., identified on the Contract Documents or as specified are approximate. Finalize the actual locations as reviewed by the Engineer and as required to suit conditions at the time of installation and as is reasonable.
- B. Inform the Engineer of the impending installation and review with him the location details before installation.

3.08 Roughing In:

- A. Be responsible for obtaining manufacturer's literature, for correct roughing-in and hook-up of equipment, fixtures, appliances, and other items.

END OF SECTION 01040

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

PART 2 - PRODUCTS

- A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 Survey Information:

- A. All elevations indicated on Contract Documents are referred to the datum of Geodetic Survey of Canada and to a benchmark established at or near the site of work unless otherwise specified.
- B. Verify and report to the Engineer discrepancies with respect to grades and elevations.

## 3.02 Construction Layout:

- A. Be responsible for laying out the work, based on the benchmark and reference lines shown on the Drawings or established by the Engineer.
- B. Be responsible for the accuracy of levels and layout during the construction period and of the finished work.

## 3.03 Vertical and Horizontal Control:

- A. Erect stakes, sight lines and batterboards so that they will not be disturbed during excavation. Protect and preserve reference points during construction.
- B. The Engineer may check the layout and point out discrepancies. There is no obligation upon the Engineer to check the Contractor's work. Be responsible for the accuracy of lines and elevations, regardless of the Engineer's action or lack of action in checking same.
- C. Report immediately any discrepancies to the Engineer.

## 3.04 Field Measurements and Tests:

- A. Measure field dimensions required for the proper execution of the work. Carry out field measurements of critical items such as piping specials required to fit into confined spaces and between equipment before fabrication and show on the shop drawings.
- B. Field verify the locations, dimensions and elevations of existing structures and existing services that are to be connected to or that affect lines to be installed or structures to be connected.

### 3.05 Pre-Construction Condition Survey:

- A. Prior to construction, undertake an inspection of buildings and infrastructure involved in or within 50 metres of the proposed work. Have the pre-construction inspection documented in writing, in photographs and videos as appropriate, noting existing damage, surface finish conditions of structures and cracks.
- B. Provide to the Engineer, in accordance with the specified procedure for Submittals, copies of a report documenting the preconstruction inspection, including photographs, no later than two (2) weeks after the inspection.
- C. Ensure that the inspection report is sufficiently detailed that existing damage, cracks and surface finish conditions are described in the text of the report. Cross-reference the text in the survey report to specific photographic images noting the features depicted in each image. Do not submit only a set of photographic images without a clear text description.
- D. Indicate the location of each photograph on a copy of the Drawings so that the subject of each photograph may be located accurately by others later.

### 3.06 Post- Construction Survey:

- A. Following construction and prior to substantial performance, undertake an inspection of buildings and infrastructure involved in or in the vicinity of the proposed work. Have the post-construction inspection documented in writing, in photographs and videos as appropriate, noting damage, surface finish conditions of structures and cracks.
- B. At a minimum, ensure that the buildings and infrastructure inspected during the Pre-Construction Survey are included within the scope of the Post-Construction Survey.
- C. Provide to the Engineer, in accordance with the specified procedure for Submittals, copies of a post-construction inspection report documenting the pre-construction inspection, including photographs, no later than two (2) weeks after the inspection.
- D. Ensure that the inspection report is sufficiently detailed that existing damage, cracks and surface finish conditions are described in the text of the report. Cross-reference the text in the survey report to specific photographic images noting the features depicted in each image. Do not submit only a set of photographic images without a clear text description.
- E. Indicate the location of each photograph on a copy of the Drawings so that the subject of each photograph may be located accurately by others later.
- F. Be responsible for repairing damage to buildings and infrastructure caused by the work.
- G. Coordinate the locations of the photographs to coincide with the photographic images obtained during the Pre-Construction Condition Survey so that an assessment may be made of damage resulting from construction activities.

END OF SECTION 01050

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Related Work:

- A. References - Section 01090

## 1.03 Codes and Standards:

- A. Ensure that the Work confirms to the Standards listed in Section 01090. Canadian standards take precedence over American standards in the case of duplication or conflict.
- B. Perform work in accordance with the requirements contained in the latest editions of applicable statutes and codes including but not limited to:
  - 1. Occupational Health and Safety Act (OHSA) and Regulations
  - 2. Ontario Building Code (OBC)
  - 3. Plumbing Code
  - 4. Ontario Electrical Safety Code (OESC)
  - 5. Codes or Standards by the National Fire Protection Association (NFPA)
  - 6. Workplace Hazardous Materials Information System (WHMIS)
  - 7. Codes and Standards by the Canadian Gas Association (CGA)
- C. Assume the designation and responsibilities of Constructor pursuant to the Ontario Health and Safety Act and regulations. It is not intended that the Owner will assume the role of Constructor under any circumstances.
- D. Bear the increases in costs that may result if the Owner becomes designated as the "Constructor" as a result of the Contractor's acts or lack thereof.

## 1.04 Statutory Regulations:

- A. The construction of the Works and the operations connected therewith are subject to the approval, inspection, by-laws, and regulations of municipal, provincial and federal authorities and organizations concerned with roads, streets, railways, telephones, electrical supplies, gas supplies and other public services or utilities having jurisdiction in respect to any aspect of this Contract.
- B. Construct habitable structures to comply with the Ontario Building Code.

PART 2 - PRODUCTS

- A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 Approvals and Permits:

- A. Apply for, obtain and pay for permits required for the project, including but not limited to:

1. Mud tracking permit
2. Plumbing permit
3. Electrical Safety Authority
4. Other permits as may be required.

Note: The Engineer will be responsible for obtaining the Building Permit and Certificates of Approval from the MECP where applicable.

- B. The Owner will provide a clean set of Drawings and Specifications for each application.
- C. Arrange for inspections as required by applicable Codes or by authorities having jurisdiction over the Works.
- D. Provide to the Engineer, on a monthly basis, a report of inspection.

END OF SECTION 01060



PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Quality Assurance:

- A. Application: When a standard is specified by reference, comply with the requirements and recommendations stated in that standard, except when modified by the Contract Documents or other applicable codes that establish stricter standards.
- B. Publication Date: Whenever in these specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply.

## 1.03 Abbreviations:

- A. The following is a general, but not necessarily complete, list of abbreviations that are referenced in the Specifications:

ABMA	-	American Bearing Manufacturers' Association
ACI	-	American Concrete Institute
AGMA	-	American Gear Manufacturers Association
AISC	-	American Institute of Steel Construction
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standards Institute
ASCE	-	American Society of Civil Engineers
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CCDC	-	Canadian Construction Documents Committee
CGA	-	Canadian Gas Association
CGSB	-	Canadian General Standards Board

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CISC	-	Canadian Institute of Steel Construction
CSA	-	Canadian Standards Association
CWB	-	Canadian Welding Bureau
EEMAC	-	Electrical and Electronic Manufacturers Association of Canada
ESA	-	Electrical Safety Authority
IEEE	-	Institute of Electrical and Electronics Engineers
ISA	-	Instrument Society of Automation
MECP	-	Ontario Ministry of the Environment, Conservation and Parks
MTO	-	Ontario Ministry of Transportation
NFPA	-	National Fire Protection Association
NSF	-	NSF International
OBC	-	Ontario Building Code
OESC	-	Ontario Electrical Safety Code
OFC	-	Ontario Fire Code
OHSA	-	Occupational Health and Safety Act
OPSD	--	Ontario Provincial Standard Drawings
OPSS	-	Ontario Provincial Standard Specifications
SSPC	-	Society for Protective Coatings
TSSA	-	Technical Standards & Safety Authority
ULC	-	Underwriters' Laboratories of Canada

## PART 2 - PRODUCTS

A. There are no Products in this Section.

## PART 3 - EXECUTION

A. There are no Execution items in this Section.

END OF SECTION 01090

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. This section specifies restrictions for access to the site and for activities on site.

## 1.03 Access Routing for Vehicles:

- A. Construction vehicles shall use main roads to access the site.
- B. All construction vehicles shall avoid site access routes that pass near schools.

## 1.04 Hours of Work:

- A. Be advised that the working hours for the Contract are between 7:30 a.m. and 5:30 p.m. on weekdays, excluding Statutory Holidays.
- B. Do not perform work on Saturday, Sunday or Statutory Holiday, except in the case of emergency or where required due to facility operations, and then only after submission of a work plan request for review by the Engineer at least four working days prior to the planned work. Failure to submit for review in writing 4 days in advance will be considered an indication that no work requiring the presence of the Engineer or the Owner's representative is to be performed.
- C. The Engineer or Owner shall have the right to order the Contractor to perform any part of the Work outside of normal working hours as specified above, whenever, in the judgment of the Engineer or Owner, it may be necessary or expedient, to do so in order to maintain essential services.
- D. Be responsible for obtaining exemption to the local noise bylaw if construction work is to be performed outside of the regular working hours.

## 1.05 Permitted Shutdowns:

- A. Schedule tie-ins to existing structures, pipelines and services based upon the following Shutdown Restrictions Table.
- B. Shutdown Restrictions Table

ITEM	Process/Facility Service	Maximum Allowable Shutdown Duration and Constraints for Major Tie-ins
1	Total shutdown of the facility	Zero hours (no interruption to service) Minimum 1-month notice of plant bypass to lagoon. Maximum 3-months bypass to the lagoon.

ITEM	Process/Facility Service	Maximum Allowable Shutdown Duration and Constraints for Major Tie-ins
2	Main Access Road to Facility and Major Traffic Routes Inside Facility	<p>Zero hours (no interruption to full access; partial access must be provided).</p> <p>Arrangements must be made with the Owner and Facility operations staff in accordance with Section 01040 – Coordination.</p> <p>Minimum 1-month notice required.</p>
3	Alum Lines	<p>4 hours (but only 1 alum line at a time)</p> <p>Temporary pumps are to be provided if a longer shutdown is required.</p>
4	One existing aeration tank out of service	<p>A maximum of one existing aeration tank can be taken out of service for a maximum of 8 weeks.</p> <p>Installation of a groundwater monitoring system including a dewatering well with level transmitter to continuously monitor ground water levels in the work area is the responsibility of the General Contractor.</p> <p>Draining and wash-out of one aeration tank is the responsibility of the General Contractor</p> <p>Refilling one aeration tank – by Operations.</p> <p>Minimum 1-month notice required.</p>
5	Clarifier	<p>Maximum of 8 weeks.</p> <p>Installation of a groundwater monitoring system including a dewatering well with level transmitter to continuously monitor ground water levels in the work area is the responsibility of the General Contractor.</p> <p>Draining and wash-out of one clarifier is the responsibility of the General Contractor</p> <p>Refilling one clarifier – by Operations.</p> <p>Minimum 1-month notice required.</p>
6	Telephone and paging systems	2 hours
7	Facility effluent water line	4 hours
8	Facility Alarm System	Zero hours (no interruption to service between 4:00 p.m.- 8:00 a.m. Monday to Friday; weekends and long weekends)

## PART 2 - PRODUCTS

A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 General:

- A. Have on hand, all materials, tools, manpower and equipment required for the necessary works in advance of any Facility shutdowns or process interruptions.
- B. Work involving shutdowns will not be permitted to proceed until all parts/materials required are available on-site for immediate use/installation.
- C. Submit in advance, all contingency plans including labour, material and equipment supply in the event of failure, delay, upset or stoppage.

## 3.02 Operation and Construction Constraints:

- A. No work may commence for aeration system (aeration tanks modifications and associated blowers system) until ECA approval is received which may take between 6 to 12 months from the date of ECA submission (June 5, 2024).
- B. No work may commence for aeration system (aeration tanks modifications and associated blowers system) and clarifier upgrades until ground water levels, continuously monitor by the level transmitters in the dewatering wells have been stabilized in the work area.
- C. If the Contractor fails to proceed with the Contractor's work in accordance with any pre-arranged and scheduled shutdown, or if the Contractor's activities result in any unscheduled interruption of facility operations, the Contractor shall reinstate the existing systems immediately. Submit to the Engineer for review, an analysis of the cause of the failure and details of the corrective work.
- D. The working limits for this Contract and adjoining contracts are shown on the Contract Drawings. The working limits are time dependent and may change during the course of the Contract and as other contracts start and finish.
- E. The Contractor is required to work within the space constraints shown and in accordance with the time constraints given. The Contractor is required to coordinate shared work areas with Facility operations such that Facility operations will have access to these shared work areas when required. The Contractor's Schedule of Work shall identify these constraints.
- F. The Contractor shall work with the Owner and the Other Contractors to coordinate the interface between the Contract and other contracts.
- G. The Contractor shall make every effort to consolidate tie-in Work to multiple services during specific shutdowns.

END OF SECTION 01140

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. This section specifies the suggested work sequence.

## 1.03 Related Work

- A. Section 01140 - Work Restrictions

## 1.04 Introduction:

- A. The following document provides notes for major construction staging activities. The Contractor shall complete a detailed work plan and submit for the Owner's review.
- B. The scope of work for this Contract is complex and requires careful planning, staging and interactions between the contractor and facility operations to perform tie-ins and shutdowns in a manner that minimizes disruptions to facility operation.
- C. The Contractor is advised the Facility is a fully operational, continuously functioning facility. Maintaining this function is always the highest priority. The Owner and Operator are under a covenant agreement to protect the environment in the operation of this facility. The Contractor's activities must not impede this ability for the Owner and Operator.
- D. The Contractor is required to maintain flows through the operating facility without interruption by whatever means necessary, including but not limited to temporary piping, acceptable flow diversion methods, pumping, and staging of activities. This will require strong coordination and communication efforts by the Contractor. The Owner has sole authority over what is acceptable in this regard.
- E. The suggested work sequence generally describes the sequence of installation and commissioning of major structures, processes and equipment items. The Contractor is responsible for determining which ancillary permanent or temporary services (ex. Electrical, instrumentation, building enclosure, hoarding and protection, plumbing, heating, etc.) are required to be completed to permit the commissioning as described herein.
- F. The Engineer, Owner, and Operator will assist the Contractor in scheduling and coordinating the work in an efficient and effective manner as the project progresses. Such assistance shall not relieve the Contractor of responsibility for their own schedule, directing of activities, and no basis for a claim will be considered to arise from this assistance.
- G. The "Best Practices" for the Contractor in maintaining an efficient schedule will include:
  - 1. Submitting and effectively updating a realistic and detailed "construction schedule"; expedient submission and management of shop drawings;

2. Submitting detailed proposed “Work Plans” in advance of activities which could impact Operations; convening focused meetings as required, etc.
- H. Any changes in facility operations required by the Contractor in order to carry out the work shall be made in writing to the Engineer and to the senior Facility Operator, at least seven (7) days in advance of the time the change is required.

## PART 2 - PRODUCTS

- A. There are no Products in this Section.

## PART 3 - EXECUTION

### 3.01 Suggested Construction Sequence Narrative:

- A. The suggested construction sequences are not intended to dictate the exact sequence of work, only to illustrate one general sequence that meets the construction constraints outlined in Section 01140 – Work Restrictions- Shutdown Restrictions Table. This is only a suggested construction sequence that has been developed based on the Consultant’s knowledge of the design components of the Contract. Except for Aeration System (aeration tanks modifications and associated blowers system) which are currently under review by the Ministry of Environment, Conservation and Parks (MECP) for ECA approval, all remaining scope of work is exempt from ECA approval and able to proceed with construction. The contractor is suggested to incorporate 6 to 12 months for ECA approval of the aeration system from the date of ECA submission (June 5, 2024) to the construction sequencing and schedule.
- B. This suggested construction sequence in no way relieves the Contractor of complete and sole responsibility for the construction methods, techniques, sequences, and procedures of construction. The Contractor may develop and submit an alternate proposed sequence of construction for the Owner’s review.

### Suggested Sequence

#### **Stage 1 – Submittals and Procurement**

1. Submit a draft schedule for review according to specification Section 01300 – Submittals.
2. Coordinate with Owner regarding field verification requirements of the existing site conditions and structures’ dimensions to facilitate equipment manufacturers’ requirements for shop drawings preparation and submission.
3. Submit shop drawings for review of all critical path items noted in the schedule.
4. Provide an updated schedule based on confirmed delivery dates from major equipment suppliers and incorporate 6 to 12 months for ECA approval of the Aeration System (aeration tanks modifications and associated blowers system) from the date of ECA submission (June 5, 2024) prior to mobilizing to site.

5. At the end of Stage 1, shop drawings will be reviewed, delivery dates of all major equipment will be known and documented on the reviewed schedule. Mobilization to site should be scheduled and coordinated with Owner at the end of this stage to suit the delivery dates of all major equipment and 6 to 12 months for ECA approval of the Aeration System (aeration tanks modifications and associated blowers system) from the date of ECA submission (June 5, 2024).

### **Stage 2 – Lime Chemical Room Modifications to Alum Chemical Room**

1. Installation of the new Alum Chemical Tank can commence after the project schedule and alum related submittals are reviewed.
2. Remove all contents within the existing lime chemical room, including lime pumps, piping, valves, mixers, supports, and associated accessories. Confirm with the Owner regarding removed equipment and accessories to be salvaged prior to disposal.
3. Repair HVAC openings and create new openings for HVAC equipment.
4. Fill in existing depressions in the room and create sump pit as per drawings.
5. Install concrete housekeeping pads and field erect the FRP chemical storage tank as per the manufacturer's instructions.
6. Install concrete containment curb for the Alum tank and chemical feed system with access ladder.
7. Install two temporary chemical pumps at the existing pump's location and relocate the existing alum chemical pumps to the new alum chemical room. Install new piping and valves from the new alum storage tank to the relocated existing chemical pumps including associated piping connecting to and from the new alum storage tank.
8. Install new hot water tank and eye wash station.
9. Test and commission the chemical storage tank and chemical pumps. Test and commission the chemical system using potable water. Discharge water to Lagoon.
10. Test and commission the eye wash station prior to putting the chemical system into service.
11. Following successful commissioning and testing, put the chemical system into operation and remove the temporary chemical pumps and existing chemical storage totes.

### **Stage 3 – Install Groundwater Monitoring System (Dewatering Wells and Level Transmitters)**

1. Install Dewatering Wells with level transmitters to continuously monitor ground water level around the area of aeration tanks and clarifier.



2. Review/update the PCN program to allow for a SCADA alarm based on the High-Water Level in the Dewatering Wells.
3. 'Safe operating levels' for the groundwater are to be reviewed and included as defined parameters in the Construction Staging and Work Sequence Plan.

#### **Stage 4 – Replacement of the Secondary Clarifier Mechanism**

1. Lagoon water level has been lowered to provide storage capacity for plant influent bypass for approximately 90 days (3 months) at average plant daily flow of 430 m<sup>3</sup>/day. .
2. Notify and coordinate with Owner in advance of when bypassing the Rodney WPCP influent flow to the lagoon is anticipated. Owner will open the valve to the existing lagoon at the lagoon inlet distribution valve chamber and close the valve in the same chamber to the treatment plant. The WPCP is now bypassed, and flows are discharging to the lagoon.
3. Remove the FRP enclosure from the clarifier. Drain and empty all contents in the clarifier and dispose offsite.
4. Remove the existing clarifier mechanism, including all supports, anchors, and associated accessories.
5. Clean the interior of the clarifier structure and notify Owner and Engineer of the required repair to any concrete openings or damages to the structures, including filling pipe penetrations and anchor holes. Commence repair work upon receipt of Owner or Engineer approval.
6. Make required modifications to receive the new clarifier mechanism, including modifications to the scum chamber. Install additional concrete fill to adapt a new sludge collection hub as part of the new clarifier mechanism. The clarifier structure is now ready for the new clarifier mechanism.
7. Install the new clarifier mechanism as per the manufacturer's instructions. Test and commission the clarifier system using truck in water. Discharge water to be disposed offsite.
8. Following successful commissioning and testing of the clarifier, dispose of the testing water and return the clarifier to operation. The plant bypass can be stopped once the clarifier and headworks upgrades are complete and commissioned.

#### **Stage 5 – Replacement of Headworks Building**

1. This work shall be completed simultaneously with the replacement of the secondary clarifier mechanism.
2. Remove the existing headworks building including enclosure, screen mechanism, supports, anchors, associated accessories and surrounding graded platforms and stairs. Temporarily remove, and store the RAW Water Sampler until new headworks building and associated accessories are installed.

3. Clean the existing inlet channel, remove and dispose of all debris and material. Repair any damaged concrete in the inlet channel.
4. Complete the concrete work to raise the inlet channel height to receive the new FRP enclosure.
5. Install new grating, platforms, stairs, railings, supports, etc. around the enclosure. Relocate the RAW Water Sampler.
6. Run a flush water pipe from the Control Building B to the new headworks building. The water connection cannot be fully connected until the screen system is installed.
7. Install the FRP enclosure and all associated lighting, plumbing, and HVAC. Then install the new screen system as per the manufacturer's instructions. Test and commission the screen system using clean water. Discharge water to be trucked offsite for disposal.
8. Connect the new decant pump discharge piping to the inlet channel, upstream of the screen system. Test and commission the new decant pump discharge piping using lagoon water.
9. Following successful commissioning and testing of the screen system, return the headworks building to normal operation. The plant influent bypass can be stopped once the clarifier and headworks upgrades are completed and commissioned.

#### **Stage 6 – Install New Decanting Pump Discharge Piping for Lagoon**

1. Obtain SUE for area around existing decant pump discharge piping prior to excavation to verify locations of existing utilities.
2. Remove the existing damaged discharge piping from the existing decant pump (on a raft in the lagoon) surface discharge flexible hose to the inlet channel at the headworks. Remove and dispose of pipes, supports and associated accessories. Make all repairs to walls, floors, etc.
3. Install new pipe from the lagoon decant pump surface discharge flexible hose (point of connection to be confirmed with Owner) to the headworks inlet channel.

#### **Stage 7 – Return Lagoon to Normal Operating Level**

4. Following the commissioning of the new headworks building, clarifier and decant pump discharge piping, Owner will return the lagoon water level to normal operation by stopping influent bypass. Owner will close the valve to the existing lagoon at the lagoon inlet distribution valve chamber and open the valve in the same chamber to the treatment plant. The WPCP is now resumed its normal operation, and influent flow is discharging to the headworks .

#### **Stage 8 – Blower Installation**

1. Blowers installation is part of the Aeration System which may only proceed upon receipt of ECA approval.

2. Remove all contents from the existing storage area. Confirm with the Owner equipment and items to be salvaged.
3. Remove the guardrail and fill the existing sump area with cellular grout and then top with new concrete fill. Repair concrete around sump area and make good.
4. Remove the existing outdoor alum storage tank and associated equipment. Cut existing containment wall to suit a single man door opening per drawings. Repair the existing wall of the building where containment curb section was removed. Match the repaired areas to the existing building.
5. Repair HVAC openings and create new openings for HVAC equipment. Create a new door opening in the pump room and install the new block wall.
6. Install housekeeping pads for all equipment.
7. Install blowers on the housekeeping pads. Install piping, pipe supports, etc. from blower to exterior walls.
8. Create pipe opening through the walls and run pipe from the exterior of the building to the edge of Aeration Tank #2. Pipe cannot be connected to aeration tanks at this time. Blower and pipe network is to be completed prior to aeration tanks upgrades.

#### **Stage 9 – Aeration Tanks Modifications**

1. Aeration tanks modifications is part of the Aeration System which may only proceed upon receipt of ECA approval.
2. Isolate one aeration tank at a time using the existing 2-hand stop gates in the screen channel. Isolate Aeration Tank #2 and direct all flows to Aeration Tank #1. If the work is completed during the plant influent bypass to lagoon when clarifier and headworks upgrades are completed, both aeration tanks could be taken offline simultaneously.
3. Remove the existing mechanical aerators, supports, anchors, and all associated accessories.
4. Install steel cover plates over the openings from the mechanical aerators and repair concrete.
5. Clean the aeration tank and dispose of all debris and material. Remove the baffles within the tank and repair any other damages inside the tank to match with existing wall. Notify Owner and Engineer of other required repair to any concrete openings or damages to the structures, including filling pipe penetrations and anchor holes. Commence repair work upon receipt of Owner or Engineer approval
6. Install the air header routed along the side of Aeration Tank #2 from the Blower Room below the walkway in Aeration Tank #2. Install the pipe through the common wall dividing Aeration Tank #1 and #2. Cap the pipe in Aeration Tank #1. The Contractor is responsible for preventing material from entering Aeration Tank #1 during installation of the pipe.

7. Install the new aeration system in Aeration Tank #2, including valves, drop pipe, manifold and lateral piping, diffusers, supports and anchors.
8. Test and commission the aeration system in Aeration Tank #2 including the blowers. The blowers and air main piping from the blower room should be installed prior to isolating the aeration tank. Test the aeration tank using effluent water.
9. Following successful commissioning and testing of the aeration system, return the Aeration Tank #2 to normal operation.
10. Isolate Aeration Tank #1 and repeat steps 1-9 above.

END OF SECTION 01150

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

PART 2 - PRODUCTS

- A. There are no products in this Section.

PART 3 - EXECUTION

## 3.01 Pre-construction Meeting:

- A. Attend a pre-construction meeting which will be arranged by the Engineer immediately upon award of the Contract. The purpose of this meeting will be to initiate the work under this Contract, to acquaint the Contractor's and the Engineer's designated personnel with each other, and to discuss and determine communication chain-of-command between various parties and contact procedures, to discuss the work procedures and preliminary scheduling, and other matters as required by the Engineer.
- B. Ensure that a senior Contractor's representative and the designated site superintendent, as well as senior representatives from the Process, Mechanical and Electrical subcontractors, are in attendance.
- C. The Engineer may request that representatives of other sub-contractors or suppliers be in attendance also. Comply with the Engineer's request.
- D. Provide emergency contacts and phone numbers for senior Contractor's representatives and designated site superintendent.
- E. Provide schedule of construction, status of bonds and insurance, sequencing of work, major equipment delivery schedule, progress payment procedures, Contractor's health and safety plan, environmental management plan, spill containment procedures and response plan.

## 3.02 Progress Meetings:

- A. Attend progress meetings as required by the Engineer. Such meetings to be held monthly or more frequently should the Engineer deem it necessary. Ensure the attendance of responsible persons, including the site superintendent, who have the required authority to commit the Contractor in carrying out decisions reached at the meeting. Subcontractors, equipment suppliers and others must attend when requested by the Engineer.
- B. Provide an updated schedule of work indicating progress, use of site, temporary facilities, and schedule of shutdowns at each progress meeting.
- C. Meeting notes will be prepared and distributed by the Engineer.

## 3.03 Electrical Safety Authority (ESA) Meetings:

- A. The Engineer or their site representative will attend all meetings with the ESA Inspector. Provide 48 hours' notice of meeting times.

END OF SECTION 01200

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Categories of Submittals:

- A. Submittals fall into three categories: shop drawings, submittals for information only, and requests for information.
  - 1. *Shop drawings* are submittals that are required for all equipment and structures as shown on the Drawings and specified in the individual sections. The Engineer will review and provide comments.
  - 2. *Submittals for information only* are specified as such in the Contract Documents and include design drawings, calculations and specifications that are requested to be sealed by a Professional Engineer and any other reports or plans that do not require a shop drawing review.
  - 3. *Requests for Information* are questions from the contractor that require clarification from the designer.

## 1.03 Work Included:

- A. Submittals covered by these requirements include, but are not necessarily limited to:
  - 1. Shop drawings
    - a) Foundation work drawings, formwork, falsework, rebar drawings, etc.
    - b) Details for all equipment and structures, complete with manufacturer's information, catalogue cuts, materials, samples, etc.
    - c) List of equipment identification tags and pipe labels.
    - d) Other specific shop drawings as requested in individual specification sections.
  - 2. Information Only Submittals
    - a) Sealed Engineering drawings and reports
    - b) Test procedures, test results, installation certificates, instructions, etc.
    - c) Conduit drawings, co-ordination drawings, removal and demolition drawings.
    - d) Schedules for construction, demolition and removals.
    - e) Staging and Sequencing Plans.

- f) Summary list of loose items and spare parts.
- g) Equipment, Operations and Maintenance Manuals complete with as-constructed drawings.
- h) As-Built drawings in accordance with Section 01000.
- i) Equipment Testing and Commissioning plan.
- j) Pre-Construction Condition Survey Report.
- k) Corporate Health and Safety Plan.
- l) Site-Specific Health and Safety Plan.
- m) Environmental Management Plan.
- n) Emergency Response Plan including spill contingency plan, equipment failure, pipe failure, etc.
- o) Sediment and Erosion Control Plan.
- p) Traffic Control Plan.
- q) Electronic Coordination Study report and Arc Flash Study report.
- r) Start-up Commissioning plan.
- s) Completed SCADA SAT
- t) Post-Construction Condition Survey Report.
- u) Other specific information submittals as requested in individual specification sections.

3. Requests for Information (RFI)

1.04 Related Work:

- A. Contract Closeout - Section 01700

1.05 Contractor's Responsibilities:

- A. Provide submittals to the Engineer as specified.
- B. Be responsible for the accuracy and completeness of the information contained in each submittal and ensure that the material, equipment, or method of work is as described in the submittal. Verify that features of products conform to the specified requirements. Edit submittal documents to indicate only those items, models, or series of equipment that are being submitted for review. Cross out or otherwise obliterate extraneous materials. Coordinate submittals among the subcontractors and suppliers and ensure there is no conflict with other submittals. Notify the Owner in each case where a

submittal may affect the work of trades or the Owner. Carry out any relocation of work due to interference at no additional cost to the Owner.

- C. Verify that the materials and equipment to be furnished and method of work comply with the provisions and the intent of the Contract.
- D. Coordinate submittals with the work so that work will not be delayed. Coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. Do not proceed with work related to a submittal until the submittal process is complete. This requires that submittals for review and comment are returned to the Contractor stamped "REVIEWED" or "REVIEWED AS NOTED"
- E. Stamp and date each submittal to certify that you have reviewed the submittal, verified field conditions, and complied with the Contract Documents.
- F. The Contractor may authorize a material or equipment supplier to deal directly with the Engineer with regard to a submittal. These dealings are limited to contract interpretations to clarify and expedite the work and cannot be used for the basis of a claim.
- G. Ensure that all "REVIEWED" or "REVIEWED AS NOTED" submittals are available for viewing at the project site.
- H. All electronic submittals to come via email with a subject line that describes the type of submittal, submittal number, and submittal status. Subject line shall start with the project number followed by a description of the submittal. Subject line shall be no longer than 100 characters long.

#### 1.06 Effect of Review of Contractor's Submittals:

- A. The review of methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of their responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Owner, or by any representative officer, employee or agent thereof. The Contractor shall have no claim under the contract on account of the failure, or partial failure, of the material, or equipment so reviewed.
- B. Submittals provide information concerning features and characteristics of materials, equipment, and methods of operation selected based on the Contractor's judgment of their conformance to the specified requirements. Review of submittals does not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gauges, or fabrication processes, except where specifically indicated or required by the project requirements or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.
- C. The review of submittals shall not relieve the Contractor of their responsibility for errors therein, and shall not be regarded as assumption of risks or liability by the Owner, or by any representative officer, employee or agent thereof. The Contractor shall have no claim under the contract on account of the failure, or partial failure, of the material, or



equipment so reviewed. A mark of "REVIEWED" or "REVIEWED AS NOTED" shall mean that the Owner has no objection to the Contractor, upon their own responsibility, providing the materials or equipment proposed.

- D. The Engineer will review submittals for general arrangement only. Be responsible for checking dimensions, quantities, proper fitting, and construction of the work, and for furnishing materials or doing work required by the Contract Documents, which may not be indicated on shop drawings when reviewed.

1.07 Submittal Review Procedure:

A. Shop Drawing Procedures:

1. Unless otherwise specified, within twenty (20) working days after receipt of a shop drawing submittal for review and comment, the Engineer shall review the submittal and return one (1) copy of the marked-up shop drawing bearing the Engineer's Shop Drawing Review stamp. The review period may be longer depending on the completeness of the submittal and number of submittals being issued. The returned submittal shall indicate one of the following actions:
  - a) If the review indicates that the material, equipment or work method complies with the Contract Documents, the submittal will be marked "REVIEWED". In this event, the Contractor may begin to incorporate the material or equipment covered by the submittal into the work.
  - b) If the review indicates limited corrections are required, the submittal will be marked "REVIEWED AS NOTED." The Contractor may begin incorporating the material or equipment covered by the submittal in accordance with the noted corrections.
  - c) If the review reveals that the submittal is insufficient or contains incorrect data, the submittal will be marked "RESUBMIT AS NOTED". Make the changes to the shop drawings that the Engineer may require. Identify changes on resubmissions and indicate the revision dates. Work on this item is not to commence until the submittal has been revised, resubmitted and returned marked either "REVIEWED" or "REVIEWED AS NOTED".
  - d) If the review indicates that the material or equipment does not comply with the Contract Documents, the submittal will be marked "REJECTED". Work on this item is not to commence until a new submittal is made and returned marked either "REVIEWED" or "REVIEWED AS NOTED".
2. The Contractor shall bear all costs associated with resubmission of a submittal.
3. Contractor shall carry costs of Engineer's and Owner's review for all shop drawing submissions required more than two (2) times.
4. Copies of corrected shop drawings shall be included in the Operations and Maintenance manual.

**B. Information Only Submittal Procedure:**

1. Unless otherwise specified, within twenty (20) working days after receipt of an Information Only submittal, the Engineer shall acknowledge the submittal and return one (1) copy of the submittal bearing the Engineer's Information Only stamp.

**C. Request for Information Procedure:**

1. Within twenty (20) working days after receipt of an RFI submittal the Engineer shall return one (1) copy of the RFI response.
2. For any RFI where the information requested is apparent from field observations, is contained in the contract documents or is reasonably inferable from them, the Contractor shall be responsible to the Owner for all reasonable costs charged by the Engineer to the Owner for the additional services required to provide such information.

**PART 2 - PRODUCTS****2.01 Construction Schedule:**

- A. Submit a construction schedule showing the Contract starting date and the commencement and the completion of each substantial or key portion of the work. Provide the schedule to the Engineer for review within fourteen (14) days after the signing of the Contract. Include in the schedule the work of any sub-contractor, submission dates for shop drawings, and the project completion date.
- B. Indicate in the Construction Schedule the Critical Path of the work including, but not limited to, the following:
  1. Identification and listing in chronological order of all construction, demolition and removal activities required to complete the Work, such as mobilization and other activities; all subcontractor work; major equipment design, fabrication, factory testing, and delivery dates; equipment system testing and start-up activities; project closeout, cleanup, and site restoration; and specified work sequences, constraints, and milestones, including Substantial Performance date.
  2. Project schedule shall be in the form of a GANTT Chart and generated using professional computer software, such as Microsoft Project as a minimum, and updated as required at no additional cost to the Owner.
  3. The construction schedule shall be reviewed before and updated at each progress meeting.
  4. Identify timeframe, duration, early start, and completion for each activity and sub-activity, and any critical activities.
  5. Identify shop drawing submission dates related to equipment or activity on the schedule.

- C. Provide sub-schedules, such as Staging Plans and Sequencing Plans as required, to further define portions of the Work.
- D. The Construction Schedule shall demonstrate that the Contractor has compressed the on-site work to as short a period as possible to limit the amount of disruption to the Owner's operation.
- E. Provide to the Engineer in writing, a step-by-step procedure outlining the proposed method of accomplishing each portion of work that requires an interruption to the operation of the facility. This proposed method of construction must be forwarded to the Engineer for approval at least three (3) weeks in advance before any such work will be permitted. The Contractor shall include proposed specific hours (times) of work in the submission.
- F. Use additional work forces and equipment, or revise methods of operation when the progress of work is not sufficient to meet the Construction Schedule at no additional cost to the Owner.
- G. In the case that a Construction Schedule with insufficient detail is submitted, requests for progress payment will not be reviewed until such time that an appropriate Construction Schedule is provided.

#### 2.02 Proposed Manufacturers and Suppliers List:

- A. Submit a list of proposed manufacturers' products to be used and the name of the supplier, no later than the Pre-Construction meeting. List shall include:
  - 1. Screen System;
  - 2. Air Blowers;
  - 3. Diffusors;
  - 4. Clarifier Mechanism;
  - 5. Chemical Storage Tank;
  - 6. Other Items as requested by Engineer.

#### 2.03 Shop Drawings:

- A. Submit shop drawings, for piping arrangements, support/anchors, fabrication and erection drawings, design calculations, etc., where applicable, for all work in this Contract.
- B. Submit shop drawings for all temporary works that control the dimensions of any part of the structures to be constructed under this Contract, or which impose loads on parts of the completed permanent works or existing works.
- C. Ensure that shop drawings of mechanical and electrical equipment show details of construction, accurate dimensions, capacities and performance characteristics.

- D. Ensure that shop drawings clearly show exposed fastenings and, where applicable, installation details, relationship to the building structure and/or finishes.
- E. Manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data may be accepted in lieu of shop drawings, if they:
  - 1. Supplement standard information to provide additional information applicable to the project.
  - 2. Show dimensions and clearances required.
  - 3. Show performance characteristics and capacities.
  - 4. Show wiring diagrams and controls.
  - 5. Delete non-applicable information.
- F. Submit shop drawings in SI metric, or SI and Imperial units. Shop drawings in Imperial units only will be returned by the Engineer without review.

#### 2.04 Samples:

- A. Where specified submit two (2) samples of material, appliances, finishes and other items included in the work. Samples must be reviewed by the Engineer in writing before the work is executed. Mark samples on the back with the type of material, mix if required, producer's name.
- B. Do not use any material on the work that is in any way inferior to the reviewed samples. Review by the Engineer does not obligate the Owner to pay for any material other than in accordance with the Contract. The review will not prevent the rejection of any material that may be found, in the opinion of the Engineer, to be unsound or unfit for use on the work or not in accordance with the reviewed samples or the requirements of the Contract. The review will not be deemed to be a waiver of objection to the work or any part thereof at any time. The decision of the Engineer with respect to the acceptance or rejection of samples is final.

#### 2.05 Coordination Drawings:

- A. Prepare Coordination Drawings for areas of potential conflict, where interference may be caused by uncoordinated use of available space by the various trades and subcontractors. Clearly show on the same drawing the proposed works of all disciplines, such as process piping, plumbing and drains, air ducts, electrical cable trays and conduits, including valve orientation and access.
- B. Show piping and other services that are to be cast into concrete.
- C. Submit Coordination Drawings for review as specified prior to commencement of the work.
- D. Update and resubmit the Coordination Drawings when changes and relocations are to be made.

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**2.06 Construction Coordination and Sequencing:**

- A. Submit a detailed Schedule and Sequencing Plan outlining the steps to be taken to construct the works. Review the proposed Staging Plan and discuss timing and constraints with the Owner's operations staff. Both the Owner and the Engineer reserve the right to request revisions to either the stages and or the timing. Do not proceed with the work until the Staging Plan has been reviewed and accepted by the Owner.
- B. Prepare and submit, to the Engineer, Sequencing Plans where interferences exist and where a specific work sequence is required to avoid or minimize operational interruptions of the existing facilities. Tie the Sequencing Plans to the project schedule.

**2.07 Falsework, Shoring or Bracing Drawings:**

- A. Submit drawings of falsework, shoring and bracing sealed by a Professional Engineer. One copy of the reviewed drawings be kept on site.

**2.08 Conduit and Cable Layout Drawings:**

- A. Submit conduit and cable layout drawings on full size sheets. Include on the drawings:
  - 1. Conduit sizes, types and locations.
  - 2. Cable sizes and types.
  - 3. Whether conduits are concealed or exposed.
  - 4. Cable support methods including cable tray and open conduit
  - 5. Spare conduit and cables
- B. At the completion of the project, submit as-built conduit drawings, clearly showing exact routings of conduit.

**2.09 Other Submittals:**

- A. Submit promptly, all other items required to be submitted in accordance with various Sections of the Specifications including but not limited to:
  - 1. Test reports of concrete reinforcement and materials proposed concrete mix design, concrete supplier and cold weather protection.
  - 2. Electrical Coordination Study in accordance with Division 16.
  - 3. As-constructed drawings and maintenance manuals, as specified in Section 01700.
  - 4. Arc flash study in accordance with Division 16.
  - 5. Installation/Inspection Certificates and various warranties, as specified in individual specification sections.

6. Mock-ups.
7. Updated schedules.
8. Test and inspection reports.
9. Emergency response plan for spill contingency, temporary and standby equipment failure.
10. Summary list of loose items and spare parts in a tabular form with columns indicating Specification Section, Item Number, Description, Number of Units, and Expected Date of Delivery.

### **PART 3 - EXECUTION**

#### 3.01 Transmittal Procedure for Submittals:

- A. When the Contract Documents require a submittal, submit the specified information as either hard-copy submissions or electronic submissions as follows:
  1. Electronic Submissions
    - a) Upload submittal package to the Engineer's ftp site, which will be set up after Contract award.
    - b) Send an email to the Engineer notifying that the submittal or submittals have been uploaded. In the email, include the name and division number of the submittal and the folder/location it was uploaded to.
    - c) All submittals shall be named using the following nomenclature: [1]-R[2]-[3]-[4].pdf, where the fields in the filename are defined as follows:
      - i. [1] = Specification and clause number
      - ii. [2] = Revision number
      - iii. [3] = Contractor specific unique reference number (if applicable)
      - iv. [4] = Submittal/Shop Drawing title
    - d) At the request of the engineer, the Contractor shall submit native files of certain submittals (MS Word, MS Excel, MS Project, etc.) to help expedite the review process.

The Engineer reserves the right to require that a submittal be based only in hard-copy or only in electronic format.
- B. For Shop Drawings and Information only Submittals, attach Form 01300-A Submittal Transmittal Form included at the end of this Section. Apply a unique number, sequentially assigned, on the transmittal form. Original submittal numbers to have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals to have the following format: "XXX-Y"; where "XXX" is the

originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

- C. On the transmittal form, clearly identify Contract, Contract No., Contractor, Pertinent Drawing No., Specification Sheet No. and Article No., as applicable, for the submittal.
- D. Use a separate transmittal for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment to be identified with all the appropriate equipment numbers. Make submittals for various items with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
- E. Submittals for Request for Information are to be completed on Form 01300-B Request for Information Form.
- F. Submittals for operation and maintenance manuals, information and data are to be accompanied by a properly completed Form 01700-A, Operation and Maintenance Transmittal Form included in Section 01700. Refer to Section 01700 for additional requirements.

### 3.02 Submittal Completeness:

- A. Submittals that do not have all the information required to be submitted, including acknowledgement of deviations, are not acceptable and will be returned without review.
- B. Bear the cost of any delay or cost implications arising from the improper submittals.

### 3.03 Specification Compliance:

- A. Provide a copy of each specification section, addenda and referenced sections with each paragraph check-marked to indicate compliance. Check marks (✓) shall denote full compliance with a paragraph. Underline all deviations and provide a detailed justification for each deviation.
- B. Failure to include a copy of the marked-up specification sections, along with justifications for any requested deviations to specified requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

### 3.04 Sealed Engineering Drawing Submittal Procedure:

- A. For all submittals that require a Professional Engineers seal, an initial submittal should be made prior to the placing of the Engineer's seal. Comments will be provided to the Professional Engineer and the Contractor. Submit the sealed final drawings for Information Only.

## 3.05 Construction Schedule:

- A. Update the progress schedule when requested by the Engineer. As a minimum, update the schedule monthly and distribute it four (4) days prior to site meetings.
- B. If an activity is not completed by its latest scheduled completion date and this failure may extend the Contract Time (or may affect the project critical path), within 7 days of such failure, submit a written statement as to how the non-performance will be corrected and the original schedule will be maintained.
- C. All schedules must indicate contingency and alternative dates and times in the event of postponement of any activity for any reason.
- D. Regardless of the schedule or schedules submitted by the Contractor, the Engineer reserves the right to direct the Contractor by employing whatever means necessary, to expedite the work.
- E. Submission of a schedule does not relieve the Contractor from their responsibility for the completion of the Work in the time required by the Contract.

See Form 01300-A Submittal Transmittal Form and Form 01300-B Request for Information on the next pages which form part of Section 01300.

END OF SECTION 01300



SECTION 01300 – SUBMITTALS

01300 - A SUBMITTAL TRANSMITTAL FORM

Submittal Description:		Submittal #:	
Spec Section and/or drawing number:			

Project Information	Routing	Date Issued	Date Received
Owner:	Contractor to Engineer:		
Project Name:	Engineer to Contractor:		
Contractor Name:			

Type of submission:       Shop Drawings                       Information Only Submittal                       Other

Remarks: \_\_\_\_\_

Item	Section No.	Description	Review action*	Reviewer initials	Review comments attached?

\*  
 REV = Reviewed = No exceptions taken;  
 RAN = Reviewed as noted = Make corrections noted;  
 RSN = Resubmit as noted = Amend and resubmit;  
 REJ = Rejected = Rejected  
 RIO = Reviewed for Information Only

Contractor to Certify either A or B

- A      We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- B      We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

Certified By:

\_\_\_\_\_

(Name)

\_\_\_\_\_

(General Contractors Signature)

RVA Stamp

SECTION 01300 – SUBMITTALS

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01300 - B REQUEST FOR INFORMATION FORM

Project Name:		RVA Project Number:	
Date:		RFI #	
Subject:			
Drawing #:		Specification #:	
Cost Impact: <input type="checkbox"/> Yes <input type="checkbox"/> No	Schedule Impact: <input type="checkbox"/> Yes <input type="checkbox"/> No	Attachment: <input type="checkbox"/>	
Question:			
Contractor Suggestion:			
RVA Response:			
Answered By:		Response Date:	
<p>Note: This RFI does not provide authority to proceed with additional work. If the General Contractor considers the RFI response a changed condition, provide written notice to the Engineer in accordance with the Contract provisions.</p>			

Within twenty (20) week days after receipt of an RFI submittal the Engineer shall return one (1) copy of the RFI response.

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

### 1.02 Work Included:

- A. Provide materials for inspection and perform inspection as shown on the drawings and specified herein.

### 1.03 Compaction Testing:

- A. Contractor to perform testing throughout progress of work, using a nuclear densometer, to determine adequacy of compaction.
- B. Contractor's equipment and method of compaction are subject to the approval of the Contract Administrator.
- C. After the Contractor has completed compaction, compaction tests will be taken randomly. Re-excavate and re-compact, at the Contractor's expense, any areas where the tests do not meet the specified degree of compaction. Compact native materials to 95% Standard Proctor Maximum Dry Density unless otherwise specified.

## PART 2 - PRODUCTS

- A. There are no Products in this Section.

## PART 3 - EXECUTION

### 3.01 Inspection and Testing:

- A. The Engineer will provide reasonable notice of the materials and equipment which is needed to inspect or test during the process of preparation or manufacture, save that in the case of materials or equipment specifically stated in the Contract as required to be tested or inspected by, or in the presence of, the Engineer, the Engineer will not give such notice.
- B. Notify the Engineer in writing seven days in advance of the commencement of preparation or manufacture of each item of such materials or equipment of the time and place at which such preparation or manufacture is to commence in order that the Engineer may be present.
- C. If any material or equipment prepared or manufactured away from the site of the works and required by the Contract or by the Engineer to be inspected, or tested by, or in the presence of, the Engineer at the place of preparation or manufacture become ready for delivery to the site of the works without being inspected or tested as required, notify the Engineer in writing and do not have such material or equipment delivered to the site of the works until authorized to do so in writing by the Engineer.

- D. In any event, do not incorporate into the work material or equipment required by the Contract or by the Engineer to be inspected or tested by, or in the presence of, the Engineer until the required inspection or testing has been carried out to the satisfaction of the Engineer.
- E. Provide and ensure that all Sub-contractors and those carrying out the process of preparation or manufacture provide every reasonable facility and co-operation to assist the Engineer in carrying out inspection and testing.
- F. Do not backfill or otherwise cover up work without having it reviewed by the Engineer. If ordered by the Engineer, open for inspection any work covered up without prior review by the Engineer. Make good again openings, excavations and disturbances of property, resulting from the inspection.
- G. Be responsible for the obligations under the Contract regardless of the approval by the Engineer or failure of the Engineer to carry out an inspection. Do not interpret action or lack of action of the Engineer as being an acceptance of defective or improper work or material. Remove and replace properly or otherwise rectify such work or material to the satisfaction of the Engineer.
- H. If it is required by the Contract, local laws or by-laws or the Engineer to have any part of the works inspected by others, give the Engineer and the other parties' concerned, reasonable notice of the time and date proposed for the inspection.
- I. Where required by the Engineer, supply certified copies of tests reports pertaining to materials or equipment to be used in the construction of the works, indicating that materials comply with the Specifications. Ensure that such tests are made by an approved testing company.
- J. Any and all materials or manufactured products, including pipe, may be tested. Supply samples for testing as directed of materials or manufactured products being used or proposed for use in the work. Provide adequate time in the project schedule for testing as specified.
- K. Immediately remove from the site materials whose test specimens fail to meet specified requirements and those materials that are rejected upon inspection.
- L. The Contractor will pay the costs of the following testing:
  - 1. Inspection and testing required by law, ordinances, rules, regulations or orders of public authorities.
  - 2. Inspection and testing performed exclusively for the Contractor's convenience, or testing performed for items or parts designed and built by the Contractor.
  - 3. Testing, adjustment and balancing of mechanical and electrical equipment and systems.
  - 4. Forcemain pressure test.
  - 5. Coordination study and Arc Flash Study.

6. Mill tests and certificates of compliance.
  7. Vibration monitoring, where required.
  8. Tests specified to be carried out by the Contractor under the supervision of the Engineer.
  9. Inspection and testing of water retaining structures and tanks as specified.
- M. Where test specimens fail to meet specified requirements or where re-testing is required to verify the quality of work previously tested, provide additional test specimens and pay for the additional testing until satisfactory test results are obtained.
- N. Quality control inspections, other than those noted above to be paid for by the Contractor, will be carried out by inspectors or inspection services under the direction of the Engineer on behalf of the Owner, and at the Owner's cost. Provide clear access to work areas to be inspected and assist as required by providing safety equipment, ladders, materials, etc., for these inspections, including but not necessarily limited to, welding X-ray inspections, concrete testing, painting inspections and compaction tests.
- 3.02 Receipt and Acceptance of Materials:
- A. During the process of unloading any material inspect it for loss or damage in transit in the presence of the Engineer. Notify the agent of the carrier of any loss or damage to the shipment.
  - B. The Engineer may reject materials if found faulty or defective upon delivery. Replace such faulty or defective materials.
  - C. Be responsible for removing faulty or defective materials and replacing same with good materials regardless of when the defects are discovered.
  - D. Carefully unload equipment and materials in an approved manner to avoid injury thereto. Provide ample facilities for handling and storage of the equipment.
- 3.03 Quality Assurance:
- A. The Owner may request any required samples at any reasonable time.
  - B. Testing may be performed by the Owner at the source plant or pit for concrete and aggregates respectively, however, such testing shall not determine acceptability of materials delivered to the site and only results of testing on delivered materials shall dictate acceptability of materials for incorporation into the work.
  - C. Provide minimum 48 hours notice to the Engineer's site representative for delivery of concrete and granular materials to the site.
  - D. Where routine testing shows the construction to be inadequate, or where the Contractor's materials and procedures have not been as specified, or when work has proceeded without review, additional testing at the Contractor's expense will be required to prove the adequacy of construction.

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- E. Where the Owner's Quality Assurance testing results differ from the Contractor's Quality Control results, the Owner's results shall govern. If the Contractor desires the Owner to repeat their testing the Contractor shall pay all costs.

END OF SECTION 01400

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. The work under this Section includes, but is not limited to, provision of:
  1. Temporary facilities including site and building enclosures, storage areas, shelters, sanitary facilities, Engineer's field office.
  2. Temporary utilities.
  3. Temporary controls, including fire protection, first aid, security, traffic control.
  4. Temporary equipment to maintain treatment facility operations during construction.

## 1.03 Codes and Standards:

- A. Ontario Traffic Manual (OTM), Book 7 – Temporary Conditions.

PART 2 - PRODUCTS

## 2.01 Engineer's Field Office:

- A. Provide for the sole use of the Engineer a field office as specified.
  1. Within seven (7) days of the order to commence work or at least seven (7) days prior to the commencement of work on-site, provide a trailer equipped as specified for the sole use of the Engineer or their representatives for the entire duration of the Work.
  2. Locate the Engineer's trailer to the satisfaction of the Engineer and as shown on the drawings.
  3. Failure to comply with 1 and 2 above, will result in the Owner outfitting the specified office and back-charging the Contractor.
  4. Ensure that the floor of the trailer is a minimum of 0.3 m above grade, that the floor area is a minimum of 30 m<sup>2</sup>, that the ceiling height is not less than 2.4 m and that it is divided into two (2) rooms separated by a substantial partition wall and a locking door so that one room can be used as an office and the other room can be used for meetings. Finish the interior walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish the floor with 19 mm thick plywood.
  5. Ensure that the trailer is equipped with two (2) entrance doors from the outside, one into each room located on the same side of the trailer.

6. Provide the doors, including the door in the partition wall with suitable locks. Provide all keys to the Engineer.
7. Ensure that there are windows in each exterior wall of each room, each 1.16m wide by 0.76m high, each capable of being opened to 50% of the total area of each window.
8. Provide a cleaning service for the Engineer's trailer on a weekly basis minimum.
9. Provide private washroom facilities for the sole use of the Engineer adjacent to the Engineer's trailer complete with flush or chemical type toilet, lavatory, mirror and sink with hot and cold running water. Washroom to be heated during fall and winter months. Provide paper towels, hand soap, toilet tissue, and fragrance-free ethyl alcohol gel (minimum 62% ethyl alcohol) throughout the duration of the Contract.
10. Provide one top load combination hot water and cold water cooler with 5 gallon water bottle. Provide a spare water bottle and one additional bottle every week.
11. Provide one refrigerator.
12. Provide weekly janitorial services and all washroom supplies.
13. Equip the office with:
  - a) a plan table with sloping top spanning the width of the trailer, 900 mm wide and 960 mm high; with smooth plywood top and cubby holes both above and below the table to hold rolled drawings;
  - b) two (2) stools, approximately 710 mm high for the above plan table;
  - c) one (1) standard office desk with drawers on both sides of the leg hole with locks and key and one (1) ergonomically suitable chair satisfactory to the Engineer;
  - d) one (1) legal-size, 4 drawer file cabinet with lock and key;
  - e) two (2) wastebaskets;
  - f) two (2) 1800 mm high open bookcases;
  - g) one (1) 2.5 m x 1 m table with folding legs;
  - h) one (1) 3.0 m x 1.2 m conference table with rigid non-folding legs;
  - i) eight (8) additional chairs of the stacking type for use during job meetings;
  - j) electrical lighting system to provide a minimum of 750 lx using surface mounted, shielded commercial fixtures with 10% upward light component, with supplementary lighting over the meeting room table, plan table and desks;



- k) fire extinguisher, first aid kit and hand sanitizer; replenish as necessary;
  - l) wall mounted electrical heaters sized to maintain an interior temperature of 21°C when the outside temperature is -30°C;
  - m) electrical outlets at 1.9m o.c. maximum; minimum 2 double outlets per long wall in each room and 1 double outlet per short wall in each room;
  - n) one (1) wall-mounted air conditioning unit in each room capable of maintaining a maximum temperature of +21°C when the outside temperature is +30°C;
  - o) shelves, plan racks, and a lockable steel wardrobe and storage cabinet, 1900 mm high 900 mm wide and 500 mm deep for storing instruments and clothing;
  - p) window shades and screens on every window.
  - q) one (1) microwave oven and one (1) electric kettle;
  - r) one (1) broom and one (1) mop.
14. Provide and maintain electrical service connections.
15. Provide high speed mobile internet access suitable for a minimum of 20 GB monthly usage (Bell or Rogers internet service). Pay for all monthly charges by the Internet service provider.
16. Take every reasonable precaution to protect the office and its contents against fire and theft, or other damage. Indemnify the Engineer and its agents against loss by fire, theft and injury to the building, to the office or its contents.
17. Provide Property and Contents Insurance – The Engineer’s trailer and all contents shall be insured for replacement value up to and including \$15,000.00
18. Maintain the field office on-site and the performance of the office equipment as specified until at least three (3) months following Substantial Performance.

### PART 3 - EXECUTION

#### 3.01 General:

- A. Any disruption of operating facilities must be accommodated by temporary facilities to the satisfaction of the Engineer.
- B. All schedules must indicate contingency and alternative dates and times in the event of postponement for any reason, or breakdown of temporary by-pass equipment during the shutdown.
- C. Comply with local Police, Fire Department and EMS requirements regarding notification of all interested parties concerning the construction work and provisions for traffic movement.

### 3.02 Access:

- A. Provide access to the site and work as required, in a proper and safe fashion. The Engineer may assist in space allocations.
- B. Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to the work. Obtain approval from the Engineer before constructing temporary roads.
- C. Provide construction warning signs along traveled roads as required or as requested by the Engineer. Keep temporary road surfaces over backfilled excavations free from potholes.
- D. Provide for mud and snow removal and dust suppression, as required during the construction period.
- E. Vehicular Access to Adjacent Properties
  - 1. Vehicular access to all properties within and adjacent to the Working Area shall be maintained at all times except when Contractor's operations reasonably necessitate a temporary restriction. Such restrictions shall be kept to a minimum and shall be co-ordinated with the affected property owner or occupant. Vehicular access shall be the responsibility of the Contractor. All traffic arrangements shall be subject to the approval of the Contract Administrator and the Local Municipalities.
- F. Repair promptly damage to existing roads, walks, and other existing facilities.

### 3.03 Location of Temporary Facilities:

- A. Coordinate the location of temporary facilities with the operations staff subject to the satisfaction of the Engineer.
- B. Contractor's field office and storage facilities shall be located within a compound indicated on the Contract Drawings.

### 3.04 Temporary Site Enclosures:

- A. Supply and place fencing to prevent pedestrians from entering the work zone. Fencing to be 1.8m high prefabricated modular fencing of welded metal frame with wire mesh fabric. Fence openings to pass 100mm ball test. Fencing base to be weighted with sandbags. Fence sections to be securely joined.

### 3.05 Protection of Open Trenches and Excavation:

- A. In addition to the provisions of Ontario Regulation 213/91 made under the Occupational Health and Safety Act, R.S.O. (1990), and in particular Part III – Excavations, employ the following protection measures for trenches and excavations left open at the end of the work day or where, during any work day, a trench or excavation is left unattended by the Contractor.

- B. Where the public has access to the perimeter of an excavation, install a barrier at least 1.1 m high around the complete perimeter of the excavation. Vertical supports must be from the top of the wall of the excavation. The barrier shall include a fencing fabric, with openings not exceeding 100 mm, securely attached to the vertical supports at the top, center and bottom and spacing not exceeding 100 mm. If the excavation is greater than 0.3 m in depth, install toe board with the fencing fabric securely fastened to it to prevent persons from slipping under the fabric and into the excavation. If an excavation is adjacent to a sidewalk or an area commonly used by the public as a walkway or recreation area, the fencing fabric shall be a metal mesh.
- C. Where an excavation is greater than 1.0 m in depth, and the public has access to the perimeter, signs shall be posted indicating “Danger Due to Excavation”.
- D. Ensure barriers are in good condition and stable prior to vacating the project at the end of each work day.

### 3.06 Installation and Removal:

- A. Provide temporary utilities, facilities and controls to execute the work expeditiously.
- B. Remove temporary utilities, facilities and controls at the conclusion of Contract, unless otherwise directed by Engineer.
- C. Site to be left in tidy and clean condition after removal of temporary facilities.

### 3.07 Storage of Material and Equipment:

- A. Storage areas are defined on the Contract Drawings, or as designated by the Engineer.
- B. Store materials to ensure the preservation of their quality and fitness for the work.
- C. Store materials on wooden platforms or other hard, clean surfaces a minimum of 150 mm off the ground.
- D. For materials and equipment not suitable for storage in the open, provide weather tight heated storage sheds with raised floors, a minimum of 150 mm off the ground for the storage of equipment, as required by the Engineer and/or equipment manufacturers. Supply to the Engineer all storage instructions from equipment suppliers well in advance of the scheduled delivery dates.
- E. Locate stored materials to facilitate inspection.
- F. Handle and store products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer’s instructions.
- G. 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.
- H. Store products subject to damage from weather in weatherproof enclosures.
- I. Store cementitious products clear of earth or concrete floors, and away from walls.

- J. 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.
- K. Store sheet materials, lumber, etc. on flat, solid supports and keep clear of ground. Slope to shed moisture.
- L. Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from the site daily. Take every precaution necessary to prevent spontaneous combustion.
- M. Remove and replace damaged products to the satisfaction of the Engineer.
- N. Do not use private property for storage purposes without the written permission of the property owner. Pay rental charges and damages associated with occupying private lands.

### 3.08 Temporary Building Enclosures:

- A. Provide temporary weather tight enclosures and protection for exterior openings until permanent sash and glazing, exterior doors, louvers, etc., are installed.
- B. Provide temporary enclosures for the work as required for weather protection and heating purposes.
- C. Erect enclosures to allow accessibility for installation of materials and working inside the enclosure.
- D. Keep temporary buildings in a clean and sanitary condition at all times and do not permit to become a health hazard or a nuisance to adjoining properties.

### 3.09 Temporary Shelter and Sanitary Facilities:

- A. Provide and properly maintain in clean condition, a portable toilet for the Contractor's personnel as required by the Occupational Health and Safety Act and Regulations for Construction Projects.
- B. Provide all required toilet supplies.
- C. Provide and maintain drinking water and washing facilities as required by the Occupational Health and Safety Act and Regulations for Construction Projects.
- D. Provide shelter for workers.

### 3.10 Temporary Fire Protection:

- A. During the entire construction period provide fire extinguishers in each construction shed and temporary office, as well as in other locations reasonably required, and all other fire protection necessary to protect the project and to comply fully with the requirements of insurance underwriters for the project and local, provincial and federal authorities.

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### 3.11 Temporary First Aid Facilities:

- A. Provide and maintain the necessary first aid items and equipment as required.
- B. Designate employees who are properly instructed to be in charge of first aid. Ensure that at least one such employee is always available on the site while work is being conducted. Comply with the Occupational Health and Safety Act and Regulations for Construction Projects.

### 3.12 Temporary Utilities:

- A. Make arrangements for the supply of water, electrical power, gas, sanitary facilities, heat, and any other temporary services required during construction. Be responsible for all fees, permits and charges, including arrangements for all necessary applications, incurred throughout the construction period until the date of acceptance as established by the Engineer.
- B. Be responsible for providing electrical power generators as required to maintain construction activities and all temporary facilities at no extra cost to the Owner, if temporary electrical power supply is delayed or unavailable from the local authority.
- C. Permanent utilities installed under this Contract may be used for construction requirements provided that no guarantees are affected thereby. Make good any damage.
- D. Operate equipment according to the requirements of the MOL under the Occupational Health and Safety Act and Regulations for Construction Projects.
- E. Arrange, pay for and maintain temporary electrical power supply until Substantial Performance as follows:
  - 1. Temporary facilities for power, where required outside the construction site, such as pole lines and underground cables with the approval of the Owner and local utility company.
  - 2. Connection to the existing power supply system in accordance with the Ontario Electrical Safety Code. Provide meters and switchgear as required by the utility company and the Engineer.
  - 3. Electrical power and lighting system as installed under this Contract may be used for construction requirements provided that no guarantees are affected thereby. Make good any damage and replace all lamps which have been used for three months or longer.
- F. Pay the costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment. Do not use direct-fired heaters discharging waste products into work areas unless prior approval is given by the Engineer. Provide temporary heat and ventilation in enclosed areas, to:
  - 1. Facilitate progress of work.
  - 2. Protect work and products against dampness and cold.

3. Prevent moisture condensation on surfaces.
  4. Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  5. Provide adequate ventilation to meet health regulations for safe working environment.
  6. Prevent hazardous accumulation of dust, fumes, mist, vapours or gases in areas occupied during construction.
  7. Prevent harmful accumulation of hazardous substances into the atmosphere of occupied areas.
  8. Ensure that the disposal of exhaust materials will not result in harmful exposure to persons or the environment.
  9. Ventilate storage spaces containing hazardous or volatile materials.
  10. Ventilate temporary sanitary facilities.
  11. Remove harmful elements even though the work process ceased.
- G. Maintain strict supervision of operation of temporary heating and ventilating equipment, to:
1. Enforce conformance with applicable codes and standards.
  2. Enforce safe practices.
  3. Prevent abuse of services.
  4. Prevent damage to finishes.
- H. Ensure that direct-fired combustion units are vented to the outside.
- 3.13 Temporary Equipment:
- A. Provide temporary and standby equipment including pumps, power generator(s) and bypass piping as required to maintain operation of the Rodney Water Pollution Control Plant (WPCP).
  - B. Be responsible for operation, maintenance, power supply, power cost, and fuel during construction, and removal of all temporary equipment at completion of works.
- 3.14 Maintaining Existing Sewerage Flows:
- A. Maintain existing sanitary sewerage flows, where applicable, and provide alternative interim service utilizing duplicate portable sewage pumps and tank trucks. Prevent interruption to service throughout the construction period and until the new works are placed in service.

- B. Provide and install all temporary sumps, bulkheads and/or other works in existing sewers, maintenance holes and service connections and provide temporary pumps in duplicate and pipelines to dewater and control the sewage.
- C. Discharge sewerage flows only to those sanitary sewers remaining in service or to tank trucks for disposal. Under no circumstances shall contaminated water be discharged or permitted to enter any drainage or natural watercourse.
- D. Temporarily drain or pump any leakage to permit work to be performed in the dry. The Contractor's method shall be subject to the approval of the Contract Administrator and/or Engineer.

### 3.15 Drainage Ditches and Storm Sewers:

- A. All ditches, drainage channels and/or storm sewer systems, which may be affected by construction, shall have their flows maintained at all times during construction, unless permission to the contrary has been obtained from the Contract Administrator and/or Engineer. No extra cost shall be incurred by the Owner for this work.
- B. Make allowance in prices for any problems that may be encountered as a result of ditch flows or storm sewer flows. Drainage shall not be impeded nor shall blockages or water backups be permitted. Any damage because of water or flooding shall be the responsibility of the Contractor.

### 3.16 Security:

- A. Be responsible for the security of construction site materials, tools, equipment and construction.

### 3.17 Traffic Signs and Barricading:

- A. The Contractor shall be responsible to supply and erect all construction signs, barricades, delineators, flashing lights and such other devices and protection as required by the Ontario Traffic Manual, Book 7 and the Contract Drawings both inside and outside the Working Area. Any other traffic control devices ordered by the Contract Administrator shall be paid "extra over" to the Contract.
- B. The Owner shall be responsible for all detour signage and a work identification sign (where required) at all approaches to the Working Area.
- C. The Contractor shall check the Working Area daily to ensure that all necessary signing, barricading and flashing lights are placed correctly, clean and operating satisfactorily.

### 3.18 Traffic Control and Parking:

- A. Observe load and truck route restrictions on the access road and streets to be used.
- B. Provide flagging for traffic control in accordance with the procedure outlined in the pamphlet entitled "Correct Methods for Traffic Control" issued by the Construction Safety Association of Ontario.
- C. Locate parking areas for vehicles on the project site as directed by the Engineer.

- D. Provide secure, rigid guardrails and barricades around deep excavations, open shafts, open stairwells, open edges of floors and roofs, as required by governing authorities.

3.19 Removal and Restoration of Temporary Facilities and Controls:

- A. Remove temporary facilities and controls from the site on completion of the works, or as otherwise ordered in writing by the Engineer. Unless specifically stated otherwise in the Contract Documents, maintain ownership over the temporary facilities including furnishings.
- B. As each portion of the work is completed, as determined by the Engineer, restore disturbed areas, roadways, fences, building, etc. equal to or better than the initial condition and clean up the construction area as instructed by the Engineer.
- C. Leave clean and in good order, roads, parking areas, walks, sodded, seeded and other areas disturbed by the construction. Failure to make satisfactory progress in the execution of this work within forty-eight (48) hours of receipt of written notice from the Engineer may result in the Engineer having the surplus material removed, or re-grading any area or performing any work necessary to leave the site in a satisfactory condition and having the costs deducted from payments due under the Contract.

END OF SECTION 01500



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PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Regulations:

- A. Occupational Health & Safety Act R.S.O. 1990 (as amended).
- B. MOL– O. Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, under the Occupational Health & Safety Act.
- C. MOL – R.R.O. 1990, Reg. 837 – Designated Substances – Asbestos, as amended by O. Reg. 279/05.
- D. MECP – R.R.O. 1990, Reg. 347 – General – Waste Management, under the Environmental Protection Act, as amended to O.Reg. 395/07.
- E. MOT – R.R.O. 1990, Reg. 261 – General, under the Dangerous Goods Transportation Act, as amended to O. Reg. 252/02.
- F. CSA Standard Z94.4-02: Selection, Use and Care of Respirators.

## 1.03 Construction Safety Measures:

- A. Observe and enforce construction safety measures required by the latest edition of the following documents: the National Building Code, the Ontario Building Code, Occupational Health and Safety Act and Regulations for Construction Projects, other applicable safety regulations, and municipal statutes and authorities.
- B. Comply with all Federal, Provincial and Municipal Health and Safety Acts, Regulations and By-Laws and with all applicable industry safety standards.
- C. Comply with Ontario Regulation 145/00 which amends Ontario Regulation 213/91 (Construction Projects) made under the Occupational Health and Safety Act (OHSA).
- D. In the event of conflict between any provisions of the above authorities, the most stringent provision governs.
- E. Assume the role of the 'Constructor', as defined by the Occupational Health and Safety Act and Regulations unless otherwise specified in the Contract Documents.

PART 2 - PRODUCT

- A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 Overloading:

- A. Ensure that no part of the Work is subjected to a load that will endanger its safety or will cause permanent deformation.

## 3.02 Special Protection and Precautions:

- A. Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and the provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.
- B. Inform the Owner of the location of hazardous materials and ensure that these materials are not kept stored or used on site without the Owner's prior consent or approval.
- C. Comply with the Owner's Health and Safety policies, programs, rules and requests.
- D. Provide to the Engineer for review, a copy of Contractor's current Health and Safety Policies and Program. Implement the Health and Safety program prior to the commencement of construction.
- E. If workers fail to comply with any program, policy, rule, or request regarding health and safety, the Owner reserves the right to remove that person from the Work.
- F. Ensure that Subcontractors and suppliers are aware of and comply with all Owner's Health and Safety policies, programs, rules and requests. Obtain copies of all Subcontractors' Health and Safety Policies and Programs prior to such Subcontractor commencing work on the site if and when requested.
- G. Maintain on site at a location accessible to all workers, the Engineer and the Owner, current MSDSs.
- H. Provide the Owner's Project Manager with a list of Designated Substances that will be brought to the site prior to commencing work. Material Safety Data Sheets (MSDS) and the hazardous material inventory for each substance listed must be kept on site.
- I. List of Designated Substances at the Site:

- 1. Be advised that the designated substances listed hereunder are or may be present on the site and within the limits of this Contract:

Designated Substance	Identified on the Existing Site?
Acrylonitrile	To be determined
Arsenic	To be determined
Asbestos	To be determined
Benzene	To be determined
Coke Oven Emissions	To be determined
Ethylene Oxide	To be determined

Designated Substance	Identified on the Existing Site?
Isocyanate	To be determined
Lead	To be determined
Mercury	To be determined
Silica	To be determined
Vinyl Chloride	To be determined

2. Refer to the Designated Substances Survey Report included in the addendum.
3. Hazardous materials shall be removed from the site and handled in accordance with the MECP Regulations current at the time of construction.
4. The Contractor shall comply with the governing MOL Regulations respecting protection of workers, removal, handling and disposition of any Designated Substances encountered in carrying out the work.
5. Prior to commencement of this work, provide written notification to the local office of the MECP of the location(s) proposed for disposal of Designated Substances. Provide a copy of the notification to the Engineer a minimum of two weeks in advance of the commencement of the work.
6. In the event that the MECP has concerns with any proposed disposal location, further notification shall be provided until the MECP's concerns has been addressed.
7. Should a Designated Substance not herein identified be encountered in the work, then management of such substance shall be treated as Extra Work.

J. Health and Safety Warnings:

1. The Engineer and the Owner shall have the right to issue warnings and/or to stop any Contractor's work if the Contractor fails to comply with any requirements under this Section.
2. Similarly, the Engineer and the Owner shall have the right to issue warnings and/or stop work for any Contractor violations of the contract including the Owner's health and safety policy, programs, rules and/or if the Contractor creates a health or safety hazard.
3. Written warnings and/or stop work orders shall be given to the Contractor using the Owner's Contractor Health and Safety Warning / Stop Work Order Form.
4. The Owner reserves the right to have a hazard corrected at the Contractor's expense.

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**3.03 Safety Equipment and Hazardous Areas and Materials:**

- A. Safety equipment such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety harness, Self-Contained Breathing Apparatus (SCBA) and ropes are to be made available to the resident inspection staff. When it is required for the resident inspection staff to enter manholes, elevated areas or other potentially hazardous areas, provide competent personnel to assist with the entry into the said areas with the inspection staff and personnel with the necessary safety equipment to be present as required.
- B. Provide personal protective equipment for Contractor's own workers where prescribed.
- C. Work areas suspected of containing explosive or toxic gases or that are oxygen deficient must be routinely tested for presence of same before any work is done. Make safe work areas that are found to be hazardous before work proceeds, in accordance with safe practice and applicable statutes.
- D. Post warning signs at hazardous areas or where hazardous materials are stored and install protective barriers. Instruct personnel in proper safety procedures.
- E. Identify areas considered to be hazardous locations and comply with requirements of the MOL.
- F. Use only non-sparking tools in potentially explosive areas.

**3.04 Confined Space:**

- A. Persons intended to work in confined spaces must have formal training in performing work in confined spaces.
  - 1. Provide proof of valid certificates of such training for all workers prior to entry of such workers into confined spaces.
  - 2. Provide all necessary safety equipment for entry into confined spaces.
  - 3. Where workers are required to enter a confined space, as defined by the OHSA, O.Reg. 632/05, ensure that workers of the Contractor and all Subcontractors follow the requirements of the above legislation, including but not limited to:
    - a) having a method for recognizing each confined space to which the program applies.
    - b) having a method for assessing the hazards to which workers may be exposed.
    - c) having a method for the development of confined space entry plans (which include on-site rescue procedures)
    - d) having a method for training workers.
    - e) having an entry-permit system.

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4. Supply the necessary tools and equipment to perform the confined space entry. These items include, but are not limited to, required documentation, gas detectors, breathing equipment, fall protection and rescue equipment.

3.05 Temporary Lighting:

- A. Contractor is responsible to meet all safety requirements regarding proper illumination of work areas. In addition, the Contractor is to install temporary string lighting in all rooms before any other work is performed. Temporary lighting is to consist of Lumapro Light Strings or approved alternate. Provide at least five 100-watt equivalent lamps for each room. Damaged or inoperable lamps are to be replaced promptly.

END OF SECTION 01545

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

### 1.02 Work Included:

- A. Meet or exceed the requirements of environmental legislation and regulations, including amendments in force for the duration at the work provided that in case of conflict or discrepancy, the more stringent requirements apply.
- B. Construct this project in accordance with construction and restoration guidelines established by the MECP and the Ministry of Natural Resources, or other applicable approval agencies, and Owner's requirements through Work Permit Regulations.

### 1.03 Codes and Standards:

- A. Silt Fence Barrier - OPSD Division 200
- B. Straw Bale Barrier - OPSD Division 200
- C. Miscellaneous - OPSS Division 5

### 1.04 Submittals:

- A. Submit a sediment and erosion control plan, environmental management plan and a spill contingency plan prior to commencement of construction.

## PART 2 - PRODUCTS

### 2.01 General:

- A. Unless otherwise specified, provide materials for the following environmental controls in accordance with the OPSS and OPSD standards listed in this Section.
  - 1. Heavy-duty silt fence barrier,
  - 2. Heavy-duty straw bale barrier,
  - 3. Excavated sediment trap,
  - 4. Filter fabric.

## PART 3 - EXECUTION

### 3.01 Enforcement:

- A. Protection of the environment is considered to be of prime importance during the work.
- B. Progress payments will not be made to the Contractor while any requirements for environmental protection are outstanding.

- C. Take immediate action to correct environmental deficiencies at the direction of the Engineer.
- D. In the event that deficiencies in work are not corrected in a timely manner, the Engineer may take the necessary corrective action and may deduct the cost thereof from payments under the Contract.

### 3.02 Drainage and Control of Deleterious Materials:

- A. Provide temporary drainage and pumping as necessary to keep excavations and site free from water. Refer also to Division 2 of these Specifications for details on dewatering excavations.
- B. Silt Fence Barrier:
  - 1. Unless otherwise specified, install heavy-duty silt fence in accordance with OPSS 805 and corresponding drawings:
    - a) OPSD 219.130 – Heavy Duty Silt Fence Barrier
    - b) OPSD 219.130 – Silt Fence Flow Check
- C. Straw Bale Barriers:
  - 1. Unless otherwise specified, install heavy-duty barriers in accordance with OPSS 805 and corresponding drawings:
    - a) OPSD 219.120 – Heavy Duty Straw Bale Barrier
    - b) OPSD 219.180 – Straw Bale Flow Check
- D. Excavated Sediment Trap:
  - 1. Install sediment trap in accordance with OPSS 805 and corresponding drawings:
    - a) OPSD 219.220 - Excavated Sediment Trap
    - b) OPSD 219.211- Temporary Rock Flow Check
  - 2. Use filter fabric TERRAFIX 270R or equivalent.
- E. Re-excavate settling ponds or silt traps or otherwise maintain as required from time to time. Re-excavate in such a manner as to ensure that no deleterious materials are introduced into adjacent watercourses. Dispose of excavated deleterious materials off site in accordance with applicable regulations.
- F. Inspect and clean protective devices once per day minimum. During rainy weather, inspect the protective devices twice per day or as directed by the Engineer. Replace clogged filter materials such as filter fabric, crushed stone or straw bales as required and as directed by the Engineer.

- G. Ensure that stockpiles of topsoil, excess excavated material, etc., are located and protected so that no environmental damage occurs. Cover stockpiles with plastic sheeting and construct perimeter drainage ditches to intercept and divert run-off to adjacent settling ponds.
- H. Have additional materials such as rip-rap, filter cloth, clear stone, silt fencing, erosion control blankets and filter bags readily available in case they are needed quickly for erosion and deleterious materials control.
- I. Regrade temporary ditches and remove and dispose of sediment controls after restored areas have an established ground cover and upon approval from the Engineer.

### 3.03 Disposal of Water:

- A. Provide temporary ditches and /or sedimentation ponds of sufficient capacity to contain site run-off and truck wash water. Provide ditches and ponds with silt traps built up with silt fence, straw bales and rock check dams as shown on the Drawings and specified in Division 2 required to retard and filter run-off before it is discharged to a watercourse.
- B. Discharge pumped water through a geotextile filter bag or through a system of a geotextile filter cloth layer on either side of a minimum 300 mm clear-stone layer.
- C. Do not pump or drain water containing deleterious materials into waterways and sewers. Intercept concentrated run-off from unstabilized areas and divert to a temporary ditch or other stabilized areas under sheet flow conditions. Pump water from excavations to an "upstream" location on the temporary ditch, to allow maximum settling and filtration prior to discharging to a natural watercourse.

### 3.04 Pollution Control:

- A. Be responsible for all sediment and erosion controls as described in the "GGHA CAS Erosion and Sediment Control Guidelines for Urban Construction".
- B. Maintain temporary erosion and pollution control features installed under this Contract.
- C. Control emissions from equipment to local authorities' emission requirements.
- D. Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- E. Maintain all construction equipment properly, to minimize exhaust emissions.
- F. Clean all construction equipment prior to entering public roadways to avoid spilling of construction debris. Collect construction debris in a designated area, for ultimate disposal off site.

### 3.05 Work Adjacent to Waterways:

- A. Do not operate construction equipment in watercourses.
- B. Do not operate construction equipment nearer than 10 m from water courses.



- C. Do not dump excavated material, waste material or debris in water courses.
- D. Design and construct temporary crossings to minimize erosion to water courses.
- E. Do not skid logs or construction materials across water courses.
- F. Avoid spawning beds when constructing temporary crossings of water courses.

### 3.06 Dust and Mud Control:

- A. Take such steps as required to prevent dust and mud nuisance resulting from construction operations within the site. Carry out dust control practices at all locations on site and on adjacent roads.
- B. Permitted dust control measures include the application of calcium chloride or water. In general, minimize the use of calcium chloride, particularly in close proximity to watercourses, and use more frequent water applications. Do not initiate chemical means of dust control without prior approval of the Engineer.
- C. Transport excessively dusty materials in covered haulage vehicles.
- D. Where the work requires saw-cutting of the asphalt or the saw-cutting or grinding of concrete, use blades and grinders of the wet type together with sufficient water to prevent the incidence of dust.
- E. Ensure that all debris and mud tracked upon traveled roadways resulting from construction operations or the delivery of materials to the site are removed at the end of each day's operation.
- F. Mud Control:
  - 1. Be responsible for all dirt and mud that is tracked onto the roadways from vehicles entering or leaving the job site. Upon request from the Engineer, immediately proceed with clean-up operations at Contractor's expense. If, after written instruction, or if, in the opinion of the Engineer, the Contractor has not, or cannot, sufficiently remove mud from the road, the Engineer/Owner may arrange the necessary clean-up with all costs being charged to the Contractor.
  - 2. Comply with local municipal by-laws regarding mud control.
  - 3. Keep public roadways clean and free of mud unless closed to through traffic with the permission of the Engineer.
- G. Repair promptly damage to existing roads, walks, and other existing facilities due to construction activities.

### 3.07 Noise Control:

- A. Ensure that vehicles and equipment are provided with efficient muffling devices to minimize noise levels in the project area. Provide noise barriers as required to limit the noise level at site boundaries in accordance with local by-laws.

- B. Establish and maintain site procedures consistent with the objective that noise levels from the construction area be minimized, and in accordance with local by-laws.

### 3.08 Construction Wastes:

- A. Provide sufficient suitable refuse containers throughout the site to receive and control construction wastes. Keep containers closed to prevent contents from blowing around site.
- B. Segregate and store waste materials so as to maximize recycling opportunities.

### 3.09 Equipment Maintenance and Refueling:

- A. Undertake a detailed review of the construction site to plan access routes and fueling areas. Do not refuel or maintain equipment in, adjacent to or within 30 m of, watercourses. Establish suitable fueling and maintenance areas subject to the approval of the Engineer and restrict maintenance and fueling to these areas. Submit procedures for the interception and rapid clean up, and disposal and reporting of spillage that does occur to the Engineer for review prior to starting work.
- B. Keep materials required for clean up of fuel spillages readily accessible on site.
- C. Generators, cranes, backhoes or shovels may be fuelled at other than the designated fuelling areas. However, do not refuel equipment within 30 metres of any watercourse. This requirement may be relaxed at the discretion of the Engineer if no-spill fuelling facilities are used.
- D. Store fuel in accordance with TSSA, MECP and other applicable guidelines/regulations.
- E. Clean construction equipment prior to entering roadways.
- F. Do not clean equipment in watercourses.
- G. Do not clean equipment in locations where debris may gain access to sewers or watercourses.

### 3.10 Spills:

- A. Submit a contingency plan for dealing with spills to the Engineer for approval.
- B. The spill contingency plan must describe in detail, the action to be taken and the persons and the agencies to be notified in the event of such a spill, including a spill reporting procedure. The plan shall include procedures for interception, rapid clean-up and disposal of any spillage that may occur.
- C. Be prepared at all times to intercept, clean-up and dispose of any spillage that may occur.
- D. Immediately report to the local District Office of the MECP and the Engineer spills or discharge of pollutants or contaminants that cause or are likely to cause adverse effects. Such spills or discharges and their adverse effects are defined in the Environmental Protection Act, R.S.O. 1990.

- E. Assume that all spills or discharges of liquid, other than accumulated rainwater, from luminaires, internally illuminated signs, lamps, and liquid type transformers contain PCB's. Immediately report such spills to the Engineer.
- F. Be advised that this reporting does not provide relief of legislated responsibilities regarding such spills or discharges.

### 3.11 Fires:

- A. Do not light fires or burn rubbish on site.

### 3.12 Tree Protection:

- A. Protect trees and shrubs on the site, which are not specifically designated to be removed. Isolate trees from the construction area with protective orange construction fence with laminated caution tape wired to T-bar posts spaced at 1.8 m on center erected along the tree drip line.
- B. Do not place anything within the dripline of existing trees.
- C. Repair any limbs removed or any scars caused by machinery and paint with reviewed dressings.

### 3.13 Cleaning and Disposal of Wastes:

- A. Dispose of all wastes and rubbish off site in accordance with applicable legislation. Do not bury wastes on site.
- B. Do not dispose of wastes, fuels, lubricants, pesticides or volatile materials into water courses or sewers.
- C. Clean during the course of the work, before the start-up of a part of the works, and at completion, as required.
- D. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- E. Store volatile wastes in covered metal containers, and remove from premises daily.
- F. Prevent accumulation of wastes which may create hazardous conditions.
- G. Maintain the project site and adjoining public properties free from accumulation of waste materials and rubbish.
- H. Provide on-site dump containers for collection of waste materials and rubbish.
- I. Provide adequate ventilation at all times when volatile or noxious substances are used.
- J. Do not burn debris on the project site or adjacent areas.

3.14 Transport of Dangerous Goods:

- A. Comply with Federal Regulation "Transport of Dangerous Goods Act, 1992" administered in the Province by the MTO.

3.15 Environmental Management Plan:

- A. Ensure that the Environmental Management Plan contains procedures to mitigate environmental impacts due to construction that includes the following components as a minimum in addition to items identified elsewhere in the Contract Documents:
1. All machinery and equipment operated by the Contractor and related hauling trucks shall have muffling systems that are up-to-date and fully operable. Trucks shall shut off engines while loading and unloading.
  2. Allow for and co-ordinate with the Owner, at project commencement, instruction (by Owner's designated personnel) for the Contractor's workers on the identification of species of relevance to this project.
  3. Contractor shall comply with Section 32(1) of the Federal Species at Risk Act, which states "No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species", as well as compliance with the relevant sections of the Ontario Endangered Species Act.
  4. On encountering any species at risk, contact the Engineer, Owner and the Ministry of Natural Resources to discuss management options to minimize, reduce or control adverse effects and design compensatory mitigation and environmental effects monitoring if required to avoid destruction, injury or interference with the species, its residence and/or its habitat at any time during the project.
  5. All mitigation measures outlined in the Environmental Management Plan included in the Contract Documents.
- B. The Environmental Management Plan may be required to be submitted to the Conservation Authority and/or the Ministry of National Resources, prior to the commencement of the work. Coordinate with the review agencies such that the schedule of the work is not delayed. No additional payment will be authorized for issues arising from the review of the Environmental Management Plan.

END OF SECTION 01561

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. This Section specifies the requirements for material and equipment to be incorporated in the works.
- B. The requirements specified in other sections of these Specifications modify some of the items of this Section for that particular application.

## 1.03 Related Work:

- A. Quality Control - Section 01400

## 1.04 Quality:

- A. Provide materials, products, and equipment of the quality specified.
- B. Defective products, whenever identified prior to the completion of the Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace rejected products and be responsible for delays and expenses caused by rejection.
- C. Should any dispute arise as to the quality or fitness of products, the decision rests strictly with the Engineer based upon the requirements of the Contract Documents.

PART 2 - PRODUCTS

## 2.01 Fastenings – General:

- A. Provide metal fastenings and accessories in the same texture, colour and finish as the base metal in which they occur, unless specified otherwise. Prevent electrolytic action between dissimilar metals. Use non-corrodible, hot dip galvanized steel fasteners, anchors and spacers for securing exterior work, unless stainless steel or other material is specified.
- B. Space anchors within limits of load bearing or shear capacity and ensure that they provide positive, permanent anchorage. Wood plugs are not acceptable.
- C. Keep exposed fastenings to a minimum, space evenly, and lay out neatly.
- D. Fastenings which may cause spalling or cracking of material to which anchorage is made are not acceptable.

### 2.02 Fastenings – Equipment:

- A. Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- B. Use heavy hexagon heads, semi-finished unless otherwise specified. Use AISI Type 304 stainless steel for exterior areas. Use AISI Type 316 L stainless steel for items in contact with chemicals or sludges.
- C. Bolts may not project more than one diameter beyond nuts.
- D. Use plain-type washers on equipment, sheet metal and soft gasket lock-type washers where vibration occurs and resilient washers with stainless steel.

### 2.03 Lubricants and Charts:

- A. Provide lubricants and maintenance charts as required, for a complete, operational system.
- B. Provide hot-plasticized charts suitable for wall mounting.

### 2.04 Special Tools and Templates:

- A. Provide templates and special tools required for the installation and operation of any part of the system. Provide such templates and tools complete with a detailed list thereof. Hand over templates and tools to the Owner at the end of the initial operation period.
- B. Provide special tools required for the routine maintenance of equipment items supplied under this Contract.

## PART 3 - EXECUTION

### 3.01 General:

- A. Be responsible for ensuring that products supplied under the Contract comply with the requirements of the Contract. Ensure that suppliers of products comply with the specified requirements. If a supplier fails to comply with specified requirements, be responsible for ensuring that the requirements of the Contract have been fulfilled.
- B. Give preference to equivalent products of local suppliers and give preference to products of Canadian origin or manufacture.
- C. Use only new products and material of best quality unless otherwise specified, and suitable for the specific service. At the request of the Engineer, provide evidence as to type, source and quality of products to be supplied.
- D. If there is question as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance. The cost for such testing will be borne by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.

- E. Have the equipment conform to the requirements of the applicable standards of Canadian Standards Association (CSA), Technical Standards and Safety Authority (TSSA), and Electrical Safety Authority (ESA).
- F. When material or equipment is specified to standard or performance specifications, at request of the Engineer, obtain from the manufacturer an independent laboratory testing report stating that the material or equipment meets or exceeds the specified requirements.
- G. Provide ancillary parts, fittings, connections, piping, nuts and bolts, gaskets, wiring, and other items necessary to properly install the component and equipment into a complete system.

### 3.02 Availability:

- A. Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for any items, including those items supplied by the Owner. Notify the Engineer of delays in supply of products, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the Work.
- B. In the event of failure to notify the Engineer at commencement of the Work and should it subsequently appear that the Work may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in contract price.

### 3.03 Delivery and Storage:

- A. Store and maintain materials in accordance with suppliers' instructions. Provide copies of storage instructions to the Engineer prior to delivery.
- B. Inspect material and equipment upon delivery in the presence of the Engineer, for loss or damage in transit and notify the agent of the carrier of any loss or damage to the shipment per Section 01400.
- C. Leave intact all manufacturers' labels and seals.
- D. Prevent damage, adulteration and soiling of materials during delivery, handling and storage.
- E. Immediately remove rejected materials from the site.

### 3.04 Manufacturer's Instructions:

- A. Unless otherwise indicated in the Specifications, install or erect products in accordance with manufacturer's instructions.
- B. Provide cores, through walls and floors, for new piping and appurtenances, based on reviewed equipment shop drawings and field measurement. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers. The Contract Drawings are approximate.

- C. Notify the Engineer, in writing, of conflicts between the Specifications and manufacturer's instructions, so that the Engineer may establish the course of action.
- D. If products are installed or erected without complying with the manufacturer's requirements or the Specifications, remove and reinstall products properly and to the satisfaction of the Engineer.

END OF SECTION 01600



PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Provide all work necessary to start-up and commission the Work.
- B. It is envisaged that multiple Commissioning Periods may be required for the various processes in this Contract. Refer to Section 01040- Work Restrictions for details.

## 1.03 Related Work:

- A. Project Meetings - Section 01200
- B. Submittals - Section 01300
- C. Environmental Protection and Control - Section 01561
- D. Equipment - Section 11000
- E. Pipe Fittings - Section 15060

## 1.04 Contractor Responsibilities:

- A. The Contractor shall attend testing and commissioning meetings.
- B. The Contractor shall provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing and commissioning.

PART 2 - PRODUCT

## 2.01 Equipment Identification Tags:

- A. Provide Equipment Identification tags for all new equipment identified with an alphanumeric "Tag" on the Drawings.
- B. Provide Equipment Identification tags for all existing equipment identified with a revised alphanumeric "Tag" on the Piping and Instrumentation Diagrams.
- C. Tags to be outdoor grade lamicaid, 50 mm square minimum or larger to fit required text, 1.6mm thick, beveled edge, white background with 4mm high black letters.
- D. Tag text to include the alphanumeric "Tag" and equipment description.
- E. Fasten tags to each item of equipment using 2 self-tapping stainless-steel screws, manufacturer supplied self-adhesive backing for clean flat surfaces, or in some other convenient location with black heavy-duty zip-ties.

- F. Coordinate the type and naming convention with the Engineer, prior to submitting shop drawings. Submit a tag list for review. List to identify equipment name, location, tag name, tag size, tag text, fastening method.

#### 2.02 Chemicals and Fuels for Initial Facility Operation:

- A. Provide initial fills of chemicals and fuels to conduct testing and commissioning of the chemical feed, and hydronic equipment.
- B. Provide all lubricants required for the new equipment.
- C. Refill all chemicals and fuels at the completion of commissioning.

#### 2.03 Water

- A. Provide all water required for Cleaning, Testing and Commissioning.
- B. Owner will provide effluent water for testing the clarifier and aeration tanks.
- C. Owner will provide potable water for process piping testing and commissioning.
- D. Contractor to provide water for all other uses.
- E. Contractor to provide certified backflow preventor for potable water connections.

### PART 3 - EXECUTION

#### 3.01 Start-up Procedure:

- A. Submit five (5) copies of the Start-up and Commissioning Plan for the Work, four (4) weeks prior to the start of related testing for review by the Engineer. Revise the schedule based on the Engineer's review and resubmit copies of the reviewed schedule.
- B. Include in the Start-up and Commissioning Plan the following items:
  - 1. Scheduling commissioning meetings.
  - 2. Development of static and operating check certificates for individual equipment.
  - 3. Time and date of each test.
  - 4. Equipment to be tested and parties to be present.
  - 5. Test procedures for each piece of equipment.
  - 6. Assembly of commissioning reports, including testing and balancing reports, maintenance manuals, startup reports, and testing reports.
- C. Refer to individual equipment specification sections for details on start-up, testing and commissioning requirements.

- D. Include start-up and commissioning for all existing equipment that has been re-wired, moved or modified.
- E. Before starting processes or equipment, notify the Engineer, and ensure that isolating valves, etc., are properly adjusted to prevent inadvertent and/or improper operation. Also, observe proper precautions not to create excessive surges, water hammer, overflows, and vibrations to the detriment of the works.
- F. Have all required personnel on site, including manufacturer's and instrumentation/controls supplier's representatives as and when requested by the Engineer.
- G. Check rotating equipment and test for vibration as specified in Section 11000. Have the tests witnessed by the Engineer and the Owner's staff.
- H. Check equipment for soundness and for correctness of setting, alignment and relative arrangement of various parts of the systems. Provide additional start-up tests as specified in specific equipment sections.
- I. Continue start-up procedure until each individual component item or system demonstrates all operational features and until controls function while in automatic modes.

### 3.02 Commissioning of Equipment:

- A. Contractor's personnel shall be present during equipment testing and facility startup meetings as specified in Section 01200 – Project Meetings and shall be available at all times during testing, facility startup and performance evaluation period.
- B. Do not commence commissioning procedures until relevant submissions are received and reviewed (example: air balancing reports, power coordination studies, individual equipment inspection certificates, etc.).
- C. Direct each equipment Supplier to commission their respective equipment before it is operated.
- D. Ensure that the Supplier provides the services of the manufacturer's technical representative for a minimum period required to commission the equipment. Ensure that the technical representative operates and/or demonstrates the equipment to the satisfaction of the Engineer. Ensure that each Supplier furnishes to the Engineer, a certified report stating that the qualified representative has found the installation to be to their satisfaction. Have the certificate indicate the tests performed and the results.
- E. The Contractor is responsible for any damage caused to the equipment if it is operated before the Supplier/Manufacturer has commissioned it,
- F. Notify the Engineer at least 48 hours in advance of planned commissioning of any equipment to allow the Engineer and other representatives of the Owner to attend. Failure to do so will result in a second commissioning at the Contractor's expense.

### 3.03 Equipment Testing:

#### A. Functional Testing

1. Test in the presence of the Engineer and Owner to demonstrate that installed equipment meets the manufacturer's installation, calibration and adjustment requirements as specified.

#### B. Dry Testing shall include:

1. Complete inspection of components, including correct rotation and electrical services, and check for quality assurance prior to startup and operation;
2. Approval and delivery of operation and maintenance manuals;
3. Completion of training;
4. Approval of test plan;
5. Delivery of manufacturer's certificate of proper installation;
6. Completion of equipment tagging and electrical services;
7. Confirmation of "Ready to test" by Engineer.

#### C. Wet Testing shall include:

1. Initial startup of equipment with service fluid.
2. Refer to individual equipment specifications for further details on specific equipment.

#### D. Performance Testing shall include:

1. Test in the presence of the Engineer and Owner to demonstrate and confirm that equipment meets the performance requirements specified.

### 3.04 Testing Mechanical and Electrical Systems:

- A. Test mechanical equipment, including valves, gates, plumbing units, etc., for proper operation, leaks, etc. Adjust, as required, in advance of the main commissioning.
- B. Test piping for pressure and leakage as specified.
- C. Do not pressure test piping against existing or new valves. Provide blind flanges or paddle blinds to isolate valves.
- D. Test pumps, motors, and other machinery for proper function within the respective sub-systems in which they operate. Demonstrate to the Engineer that the systems function as specified.

- E. Test, adjust, and balance the instrumentation and control systems in conjunction with the equipment supplier, including all pressure switches, sensors, level detectors, etc., and adjust as required.

### 3.05 Cleaning:

- A. Before start-up, ensure that equipment, piping, conduits, etc., are properly cleaned, and all debris and foreign matter removed. Clean, brush, flush with water as required, to provide clean work.
- B. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until the date of substantial performance or occupancy, whichever occurs first.
- C. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.
- D. Use only cleaning materials recommended by the manufacturer of the surface to be cleaned, and as recommended by cleaning material manufacturer.
- E. Vacuum clean the interior of all control and electrical panels.

### 3.06 Flushing:

- A. Before operating a piping system, thoroughly flush with water to remove construction debris and dirt from the system. Dispose of water used in flushing in accordance with Section 01561.

### 3.07 Leakage Tests for Water Retaining Structures:

- A. Arrange for and pay the costs associated with the filling of the structure with water for purposes of hydrostatically testing the structure for leakage. Fill the structure to a maximum possible level as determined by the Engineer and test for leakage. This tank leakage test may be conducted simultaneously with the disinfection procedure, if applicable. Test each cell for leakage independently.
- B. Conduct leakage test prior to the commencement of the Commissioning.
- C. All test procedures shall be subject to the Engineer's approval and shall be carried out prior to any backfilling operations. Achieve "Zero" leakage results in the following areas:
  - 1. Into adjacent basement areas with a head of water on one side.
  - 2. Trough walls or troughs above grade.
- D. The Engineer may permit minor seepage in areas other than those noted above, below grade where the walls of the water retaining structure are adjacent to backfill or to other tanks containing liquid. Minor seepage is defined as a 0.1% drop in total cell volume over a 24 hour period (as measured by surface level drop).

- E. Repair visible leaks.

### 3.08 Pipe Pressure Testing:

- A. For testing of yard piping refer to Section 02600.
- B. For testing of all other piping refer to Section 15060.

### 3.09 Pipe Disinfection:

- A. Disinfect piping systems, including valves, fittings and appurtenances, that carry potable water or water that will become potable, in accordance with the Ontario Watermain Disinfection Procedure and AWWA C651.
- B. The standard also applies to existing mains opened by design or accident. Provide required materials, labour, temporary connections, etc. Arrange for bacteriological testing after final flushing and pressure testing. If bacteriological testing shows incomplete disinfection, repeat the procedure.
- C. Do not dispose of the disinfection water to streams or sewers until the total residual chlorine is reduced to 0.002 mg/L.

### 3.10 Initial Facility Operation:

- A. Prior to initial operation submit the following:
  - 1. Equipment test reports and operating certificates.
  - 2. Electronic copy of the valve tag list.
  - 3. Inspection certificates from authorities having jurisdiction.
  - 4. Required copies of shop drawings.
  - 5. Manufacturer's operating and maintenance brochures of all major equipment.
- B. Prior to initial operation ensure all systems have been started, adjusted to design criteria, and are functionally operational, ready for operation.
- C. Allow for work, effort, and associated costs necessary to assist the Owner for completion of the initial operation of each individual facility for a period of fourteen (14) calendar days. Some upgraded facilities may be initially operated simultaneously.
- D. Ensure that all trades are present during the day and available on call as required to rectify any discrepancies or omissions to the satisfaction of the Engineer. Any major breakdown of any part of the facility that affects the treatment process will require the re-start of the 14-day period.
- E. A satisfactory, continuous 14-day operation of each facility is required as part of Substantial Performance.

- F. Correct deficiencies found during the initial operation. Make corrections and adjustments to equipment operation to the satisfaction of the Engineer.
  
- G. Provide instructions to the Owner's operating staff in the proper operation and maintenance of designated equipment and instrumentation. Ensure that each major equipment supplier provides a minimum of two (2) training sessions on their respective equipment. Provide training sessions of duration as specified in the individual equipment specification.

END OF SECTION 01650

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

## 1.02 Related Work:

- A. Submittals - Section 01300
- B. Temporary Facilities - Section 01500
- C. Environmental Protection and Control - Section 01561
- D. Commissioning of the Works - Section 01650
- E. Equipment - Section 11000

PART 2 - PRODUCTS

- A. There are no Products in this Section.

PART 3 - EXECUTION

## 3.01 Cleaning:

- A. Replace light bulbs if lights were operated for more than three (3) months during construction.
- B. Clean all areas prior to contract closeout, as required, to the satisfaction of the Engineer. Refer to Section 01650 for additional requirements.
- C. Refer to Section 01561 for requirements for storage and disposal of wastes.
- D. Use only cleaning materials recommended by the manufacturer on surfaces to be cleaned, and as recommended by cleaning material manufacturer.
- E. Remove waste materials and rubbish from the project site.
- F. Vacuum all MCC and control or instrumentation units within the scope of the Contract.
- G. In preparation for completion or occupancy, conduct final inspection of exposed interior and exterior surfaces, and of concealed spaces.
- H. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from interior and exterior finished surfaces open to view including glass and other polished surfaces, and mechanical and electrical equipment.
- I. Broom clean paved surfaces. Rake clean other surfaces or grounds.
- J. Remove debris and materials from roof areas, tank, filters and reservoir interiors, etc.



- K. Remove snow and ice from access to buildings.
- L. Clean roofs, downspouts and gutters.
- M. Replace heating, ventilating and air conditioning filters if such units were operated during construction.

### 3.02 Removal of Temporary Facilities:

- A. Remove temporary facilities from site on completion of the works, in accordance with Section 01500.

### 3.03 Project Record Documents:

- A. Refer to Section 01000 for requirements for maintenance of as-constructed documents on site.
- B. At the completion of the project and in advance of final inspection, neatly transfer as-constructed notations to the second set of white prints and submit both sets to the Engineer.

### 3.04 Operating and Maintenance Data and Manuals:

- A. Four (4) weeks prior to the start of the initial operation of each facility, submit to the Engineer for review one (1) draft copy of a set of manuals containing complete instructions for operation and maintenance of equipment and materials supplied. Following the Engineer's review submit to the Engineer four (4) copies of the final version of the manuals and one (1) digital copy of the manuals. The digital copy shall be provided on a USB and shall include both a single compiled PDF with bookmarked Divisions and Sections and separate individual PDF files for each Division and Section.
- B. Submittals for operation and maintenance manuals, information and data are to be accompanied by a properly completed Form 01700-A, Operation and Maintenance Transmittal Form included at the end of this Section.
- C. Have the manuals bound in Acco® Casemade Flip-Lock Style Catalogue Ring Binder, 4", Black – Staples. Permanently label the front and the spine of each binder with the following information:
  - 1. Owner's name.
  - 2. Equipment manual for (project name).
  - 3. Contract number.
  - 4. Year of completion.
  - 5. Volume number (e.g. 1 of 3).
  - 6. Set number (e.g. 1 of 6).
  - 7. Contractor's name.

D. The manuals will include the following information:

1. Manufacturer's data on operation, maintenance, replacement parts lists, lubrication charts and recommended inspection intervals for all equipment covered by Divisions 11, 13, 14,15 and 16 of the Specifications as well as mechanically and/or electrically operated items of equipment, including, but not limited to, valves, plumbing fixtures, electrical lighting, controls, cranes, switches, heating and ventilating equipment, etc. Ensure that the manufacturer's data includes a maintenance schedule for the equipment including a list of required activities as well as the recommended frequency for each activity.
2. The manual shall be divided in accordance with the Division and Section format of the Specifications and shall include tabs for each section.
3. The manual shall include the table of contents, contractor's/subcontractor's names and contract details.
4. Instructions for the care and maintenance of the building components, including, but not limited to, the care of tiled and other types of floor finishes, wall finishes or other surfaces, as well as manufacturers' data with suppliers' names and addresses for, finishing hardware, doors, etc.
5. Vibration data on major rotating equipment items per the individual specifications where such are specified.
6. Contact persons, companies, names, mail and e-mail addresses and telephone and facsimile numbers of sub-contractors and suppliers.
7. Copy of hardware and paint schedules.
8. As-constructed room finishing/paint schedule.
9. HVAC testing and balancing reports, vibration studies, coordination studies, electrical wire resistance test reports, etc.
10. Guarantee commencement date, and duration of guarantee. Copies of various product and/or equipment guarantees.
11. A final, reviewed copy of shop drawings and product data sheets. Provide as-built drawings of the Motor Control Centres (MCC) and Control Panels.
12. A complete list of instructions and names of products to be used for the cleaning of and the maintaining of finished building surfaces.
13. Complete explanation of operation principles and sequences of each process and/or equipment.
14. Instructions for installation, adjustment and operation, lubrication and maintenance of each item of equipment.
15. Complete parts list with catalogue numbers, as well as equipment, valve and hardware schedules.

16. Copies of signed inspection/installation reports.
  17. A final version of the Process Control Narrative.
  18. A final version of the Instrument and Variable Frequency Drive (VFD) Data and Set-up Sheets.
  19. USB drives of Instrument Ladder Logic drawings.
  20. Certificates and Instructions for Equipment as specified.
  21. Guarantees and Warranties.
  22. Provide three (3) copies of all equipment manuals and shop drawings on USB drives in PDF format.
  23. Provide one (1) PDF file per equipment.
- 3.05 Reports, Certificates and Instructions for Equipment:
- A. Submit to the Engineer two (2) weeks prior to the start of the initial facility operation the following:
    1. Complete inspection reports of tests done and results signed by the manufacturers of the equipment incorporated into the works, or by their accredited agents, stating that their qualified representatives have tested the equipment which they supplied and have found it to be satisfactorily installed in all respects, and in proper working order.
    2. An electrical inspection certificate from the Electric Safety Authority having jurisdiction, stating that its representative has inspected the electrical installations in the works and is satisfied that they are in accordance with the code requirements.
    3. Final reports and certificates of special tests and balancing of heating, ventilating and air conditioning systems, per Division 15 specification sections.
    4. Final reports and certificates of electrical coordination study, arc flash study, and other tests and reports per Division 16 specification sections.
    5. Provide six (6) copies of the report of rotating equipment vibration analysis, carried out per Section 11000, including graphical vibration signatures of all rotating equipment.
  - B. Submit to the Engineer, before the end of the warranty period, six (6) copies of a second report of rotating equipment vibration, per Section 11000, showing that the equipment remains in proper operating condition.
- 3.06 Touch-up and Repair:
- A. Perform touch up of paint on buildings, equipment, piping, conduits, etc.
  - B. Repair construction damage to the buildings, equipment and furnishings.

C. Repair damage to yard areas.

3.07 Warranty and Maintenance:

- A. The Warranty and Guarantee periods commence at Substantial Performance of the entire project, unless otherwise agreed to by the Owner in writing.
- B. Unless otherwise specified, provide a one (1) year Warranty for all components of the work.
- C. Promptly correct any defects during the Warranty Period.
- D. Be responsible for all maintenance during the progress of the work up to the date of completion and rectification of deficiencies during the Warranty Period.
- E. Be responsible for extended warranties and/or guarantees as detailed in the various sections of the Specifications.
- F. Submit the required Guarantee/Warranty certificates and/or written documentation as specified.
- G. Repairs during Warranty Period:
  - 1. Perform all repairs required upon receipt of verbal or written notices from Engineer.
  - 2. Repair or make good settlements and defects on surfaces of backfilled trench or excavations.
  - 3. Repair all damages to structures caused by settlement of ground adjacent to or over excavation.
  - 4. All deficient work shall be rectified within two (2) months of receipt of the written deficiency report from the Engineer. If the Contractor fails to repair all noted deficiencies to the Engineer's satisfaction within this time, the Owner shall have the right to have any and all outstanding repairs completed at the Contractor's expense.

END OF SECTION 01700

## 01700-A - OPERATION AND MAINTENANCE TRANSMITTAL FORM:

Date: \_\_\_\_\_ Submittal No: \_\_\_\_\_

To: \_\_\_\_\_ Contract No: \_\_\_\_\_

Spec. Section: \_\_\_\_\_

Submittal Description: \_\_\_\_\_

From: \_\_\_\_\_

Attention: \_\_\_\_\_

Checklist	Contractor			
	Satisfactory	N/A		
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and post-shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Contractor's Signature:

PART 1 - GENERAL

1.01 Reference:

- A. Section 01000 applies to and governs the work under this Section.

1.02 Codes and Standards

- A. OPSS 504 – Construction Specification for Preservation, Protection and Reconstruction of Existing Facilities.
- B. OPSS 565 – Construction Specification for Protection of Trees.

PART 2 - PRODUCTS

- A. There are no Products in this Section.

PART 3 - EXECUTION

3.01 Existing Services and Structures:

- A. Comply with all regulations and guidelines of the road authorities, utility companies, railway companies, Technical Standards and Safety Authority (TSSA) and the Electrical Safety Authority (ESA) including those pertaining to protective work, inspection and safety.
- B. Exercise extreme caution when working near existing underground and overhead utilities.
- C. Make necessary arrangements with railway and utility companies for support and protection of existing structures where required.
- D. All traffic control system conduits that are broken or damaged shall be repaired immediately.
- E. Any damage to existing utilities, deemed to have been caused by the Contractor's lack of reasonable caution shall be repaired at the Contractor's expense.
- F. No extra payment shall be made for working around conditions resulting directly or indirectly from the Contractor's lack of reasonable caution. Sign boards shall be erected in locations indicated by the Owner or Engineer.
- G. Clean the first existing downstream maintenance holes and catch basins prior to completion.

3.02 Protection of Trees:

- A. A tunnel under or around roots by hand digging without damaging roots where trees are identified for preservation.
- B. In the case of woodlots, it shall not be necessary to trim exposed roots.

- 
- C. Branches 75 mm or larger in diameter that are damaged by the Contractor's operations shall be cut back in accordance with good arboricultural practice.

3.03 Raising Grades around Trees:

- A. When fill is less than 400 mm deep, place clean wash rounded gravel 25 mm to 50 mm in size around tree trunk to a minimum radius of 450 mm and approximately 50 mm above finished grade.
- B. Place gravel before earth fill.
- C. Do not leave earth fill in contact with trunks.
- D. When fill is more than 400 mm deep, remove and replant tree to match finished grade.

3.04 Damaged Trees:

- A. Engineer shall determine if damaged tree must be replaced.
- B. Replace trees ordered for replacement with similar size and species.

3.05 Pruning:

- A. Obtain permission from Engineer prior to pruning.
- B. Employ specialized personnel to carry out pruning.
- C. Pruning to be done in accordance with good arboricultural practice.

3.06 Survey Monuments:

- A. Do not remove survey monuments, iron bars, round iron pipes or stakes representing property boundaries and locations encountered on line of work without written permission of Contract Administrator.
- B. All survey monuments disturbed or removed by the Contractor carelessly or without the permission of the Contract Administrator, shall be re-established by a registered Ontario Land Surveyor at the Contractor's expense.

END OF SECTION 01890

DIVISION 2

SITE WORK



INDEX

SECTIONS

- Section 02000 – Site Work
- Section 02050 – Removals and Demolition
- Section 02100 – Site Preparation
- Section 02220 – Excavation
- Section 02221 – Backfilling and Filling
- Section 02480 – Landscaping
- Section 02600 – Yard Piping

END OF INDEX DIVISION 2

PART 1 - GENERAL

## 1.01 Governing Conditions:

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

## 1.02 Work Included:

- A. The work of this Division includes, but is not necessarily limited to, the supplying of all labour, materials, tools and equipment to carry out the following:
  - 1. Disposal of excess and/or contaminated material.
  - 2. Demolition and disposal of existing structures, piping, grating, handrail and other facilities designated for removal.
  - 3. Supply, placement and compaction of approved fill to final grades.
  - 4. Spreading of stockpiled quantities and/or import and placement of topsoil in areas to be sodded or seeded, fine grading, fertilizing, sodding, seeding and clean-up of the work site and other areas disturbed by construction.
  - 5. Sheeting, shoring and bracing of excavations, including dewatering as required.
  - 6. Restoration of sodded and seeded areas, asphalt and gravel driveways and parking lots.
  - 7. Restoration of fine grading of areas disturbed by construction activities. Provision of swales and positive drainage as well as satisfactory blending with the existing grades as required throughout the disturbed areas.

## 1.03 Related Work:

- A. Field Engineering - Section 01050
- B. Material and Equipment - Section 01600
- C. Piping systems within structures and any exposed runs thereof are included under Division 15. The supply of the required coupling and connection to Division 15 piping at the first joint outside the foundation wall is included in the work of Division 2.

## 1.04 Definitions:

- A. The term "utility", as used herein, includes services such as gas, electricity, water supply, yard piping, drains, and sewers.

PART 2 - PRODUCTS

2.01 General:

- A. Select other materials not specifically described but required for the proper completion of the work of this Division, per Section 01600, subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 Setting Out:

- A. Be responsible for the setting out of the work, with reference to a baseline and a benchmark provided by the Engineer, per Section 01050.

END OF SECTION 02000

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 02000 applies to and governs the work of this Section.

## 1.02 Work Included:

- A. Removals and Demolition work includes, but is not necessarily limited to, the following:
  1. Decant System: remove existing decant pump discharge piping from the lagoon to the headworks building.
  2. Headworks Building: remove one (1) existing screen system, an FRP enclosure and associated accessories.
  3. Existing Aeration Tanks: remove existing six (6) mechanical aerators, associated accessories and baffle walls in the tanks.
  4. Clarifier: remove one (1) clarifier mechanism, FRP cover and associated accessories, including all piping to the scum chamber and all associated equipment.
  5. Alum Storage and Dosing System: remove one (1) existing outdoor alum storage chemical tank, associated piping, supports and accessories.
  6. Relocate existing alum dosing pumps to the chemical storage room.
  7. Lime Storage and Dosing System: remove one (1) existing lime storage chemical tank and associated equipment including pumps, piping, valves, mixers, and associated accessories.
  8. Control Building B: new openings in existing structures for doors, walkways, HVAC, piping, venting, and plumbing. Remove existing equipment including temporary alum totes, WAS/RAS motors, and associated electrical and control wiring and connections.

## 1.03 Related Work:

- A. Backfilling and Filling - Section 02221
- B. Landscaping - Section 02480

## 1.04 Submittals:

- A. Submit a detailed execution plan for demolition and removals work, including a work sequencing plan and schedule. Include the following:
  1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Interruption of Facility processes. Indicate how long Facility processes will be interrupted.
  4. Coordination for shutoff, capping, and continuation of utility services.
  5. Locations of temporary fencing and hoarding.
  6. Means of protection for items to remain and items in path of waste removal.
- B. Provide a detailed list of equipment, piping and appurtenances to be demolished and removed and obtain approval from the Owner.

## PART 2 - PRODUCTS

- A. There are no products under this Section.

## PART 3 - EXECUTION

### 3.01 General:

- A. Use the Ontario Provincial Standard Form 180-5 for disposal of all Solid Non-Hazardous Waste in accordance with OPSS.MUNI 180.
- B. Grant the Owner the first right of refusal of items removed. Before proceeding with the demolition work, remove equipment and materials designated, by the Engineer, to be retained by the Owner. Clean the equipment and material to the satisfaction of the Engineer. Store the equipment and material in a manner and in a location satisfactory to the Engineer.
- C. Disconnection of Utilities:
1. Before starting removal/demolition, disconnect or arrange for the disconnection of all utility services designated to be removed, performing such work in accordance with the requirements of the utility company or agency involved and the Occupational Health and Safety Act (OHSA).
- D. Protection of Utilities:
1. Preserve in operational condition active utilities traversing the site that are designated to remain in operation until the new facilities have been constructed and commissioned.
  2. Locate existing utility lines and provide protection, temporary supports, disconnections and capping.
  3. Provide support structures for the existing utilities for the duration of the construction.

- E. Remove and dispose of remaining loose items off site, in accordance with the regulatory requirements.
  - F. Remove items indicated as well as all related equipment, piping, valves, supports, insulation, controls, wiring and conduit made redundant by the work of this contract.
  - G. Remove all wiring and appurtenances from removed equipment back to the first breaker panel.
  - H. Electrical conduits embedded in concrete. Remove all surface mounted conduit and any embedded conduit to a depth of 50mm. Fill the resultant space with non-shrink grout.
  - I. Removal of concrete bases supporting equipment to be removed. Square up adjacent surfaces to remain in place by saw cutting.
  - J. Removal of piping:
    - 1. Remove all piping made redundant by the work of this Contract. Remove all valves, fittings, hangers, hanger rods, supports, braces, insulation, control components, wiring and appurtenances associated with piping and equipment removed.
    - 2. Branch piping to be removed which connects to piping which is to remain shall be removed completely back to the pipe which is to remain or to an existing isolating valve if the valve is located on the branch in the immediate vicinity of the main. Dead-end branches shall be removed. Cap or blank flange branch connections.
    - 3. Remove piping and ductwork not reused through walls/slabs. Fill the resultant space with non-shrink grout or in accordance with details shown on the Drawings.
  - K. Holes in floors, walls, ceilings, roof and other surfaces left by the removal of piping, equipment, sleeves, supports, hangers and other items shall be patched and finished to match the surrounding surfaces using matching compatible materials.
  - L. Removal of fasteners. Cut off non-removable fasteners in concrete, drill fastener out to a depth of 50mm, fill hole with grout.
  - M. Fill depressions and excavated areas with "Approved Fill" in accordance with Section 02221, consolidate and grade.
  - N. Provide final grading, placement of topsoil and sodding /or seeding in accordance with Section 02480.
- 3.02 Temporary Facilities:
- A. Provide protection to ensure safe passage of people around the demolition area and to and from occupied portions of building.

- B. Provide temporary weather protection, during the interval between demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
- C. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during demolition operations.
- D. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### 3.03 Removal of Asbestos:

- A. Conform to and enforce strict compliance with Ontario Regulation 278/05, Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations under the OHS Act.
- B. Submit necessary permits for transportation and disposal of asbestos containing waste and, upon completion of work, proof that asbestos containing waste has been received and properly disposed of. Provide receipts / disposal forms from an MECP licensed disposal site accepting the asbestos containing waste materials within seven calendar days of removal from the site.
- C. Submit certification that every worker has had instruction and training in the hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

### 3.04 Removal of Lead-Containing Paint:

- A. Demolish and remove materials coated with lead-containing paint in conformity to and strict compliance with regulations under the OHS Act pertaining to lead. Take all steps necessary to prevent the spread of lead-containing dust particles from the work site when performing work involving, but not limited to, lead-containing paint (i.e. greater than 0.1% lead).
- B. Conform to the recommendations contained in the designated substances report and conform to the requirements of the Environmental Abatement Council of Ontario (EACO) lead guideline for Construction Renovation, Maintenance or Repair and Federal and Provincial regulations for the removal, handling and disposal of lead containing paint.
- C. Ensure that the Contractor responsible for the removal of lead-containing paint is a member of EACO.

### 3.05 Removal of Polychlorinated Biphenyls (PCBs):

- A. Remove and dispose of PCB-containing materials in accordance with federal, provincial and municipal acts, regulations, by-laws, policies and guidelines.

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### 3.06 Temporary Fencing and Hoarding:

- A. At the demolition working area, erect orange construction fencing with "T" posts to define the area. Agree with the Engineer on the extent of each working area.
- B. Provide hoarding as required and to the satisfaction of the Engineer, to protect the operations staff and the public.

### 3.07 Removal and Disposal of Debris:

- A. Remove and dispose of debris from the site and leave the site in a neat and orderly condition in accordance with prevailing regulations. Do not allow materials to accumulate on site. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Classify and dispose of wastes in accordance with applicable regulations, including Ontario Regulation 347 under the Environmental Protection Act.
- C. Be responsible for selecting the disposal sites unless stipulated by the Owner. All disposal site agreements shall be in writing and a copy of the agreement shall be provided to the Engineer and Owner prior to use of the site.
- D. Dispose of all surplus, cleared, or removed materials and any other material not to be incorporated into the completed work, to an off-site location arranged by the Contractor unless provided for elsewhere in the Contract.
- E. Comply with the requirements of the MECP, MOL, MTO, Local Municipalities, local Conservation Authority, and any other authorities having jurisdiction and be responsible for any damage to the streets/roads used as a haul road.
- F. It is recommended that the Contractor have their proposed disposal site pre-screened by the local Conservation Authority to determine if the site is subject to Conservation Authority regulations on the placement of fill.
- G. Do not burn debris on the project site.

### 3.08 Cleaning:

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

END OF SECTION 02050



## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 02000 applies to and governs the work under this Section.

### 1.02 Work Included:

- A. Site preparation required for this work includes, but is not necessarily limited to:
  1. Placement of temporary fencing and silt controls around work areas.
  2. Removal and disposal of sod;
  3. Removal and disposal of trees and bushes;
  4. Stripping and stockpiling of topsoil;
  5. Removal and disposal of sludge and debris;

### 1.03 Related Work:

- A. Temporary Facilities and Controls - Section 01500
- B. Environmental Protection and Control - Section 01561
- C. Material and Equipment - Section 01600

### 1.04 Definitions:

- A. Sludge: solid or semi-solid material that is a by-product of a water or wastewater treatment process.

## PART 2 - PRODUCTS

### 2.01 Temporary Fencing and Controls:

- A. Use silt/sediment control fence where required, as specified in Section 01561.

### 2.02 Other Materials:

- A. Select materials not specifically described but required for proper completion of the work of this Section, subject to the approval of the Engineer. Refer also to Section 01600.

## PART 3 - EXECUTION

### 3.01 Preparation:

- A. Site Inspection:

1. Inspect the entire site carefully and obtain direction from the Engineer as to which loose items, if any, are to be removed by the Owner before any work commences.
  2. Locate existing utility lines and determine requirements for temporary supports, disconnecting and capping.
  3. Locate existing active utility lines traversing the site and determine the requirements for their protection.
- B. Clarification:
1. The Contract Drawings do not purport to show every object or every tree, bush, etc. existing on and about the project site.
  2. Before starting any work under this Section, verify with the Engineer objects, trees, bushes, etc. to be removed and objects to be preserved if applicable.
- C. Disconnection of Utilities:
1. Before starting site operations, disconnect or arrange for the disconnection of utility services designated to be removed, performing such work in accordance with the requirements of the utility company or agency involved and the Occupational Health and Safety Act (OHSA).
- D. Protection of Utilities:
1. Preserve in operational condition active utilities traversing the site that are designated to remain in operation until the new facilities have been constructed and commissioned.
  2. Provide support structures for the existing utilities, as required, for the duration of the construction.
  3. Refer to Division 1 for additional requirements.
- 3.02 Temporary Fencing:
- A. At each working area erect orange construction fencing and "T" posts in accordance with Section 01500, to define such area. Agree with the Engineer on the extent of each working area.
- 3.03 Temporary Silt Controls:
- A. Construct temporary silt controls, including interceptor ditches, rock check dams, and silt fences as specified in Section 01561.
- 3.04 Stockpiling Topsoil:
- A. Strip topsoil that is clean, entirely free from debris and suitable for supporting vegetation, from the areas to be disturbed and stockpile for subsequent use. Agree with the Engineer on the suitability of topsoil for re-use.

- B. Co-ordinate the stockpile locations with the Engineer who will designate stockpiling areas in the field.
- C. Protect stockpiles from the effect of wind by covering with tarpaulins, as necessary and to the satisfaction of the Engineer.

3.05 Removal and Disposal of Sod:

- A. Remove and dispose of the sod in an environmentally safe manner.

3.06 Removal and Disposal of Sludge and Debris:

- A. Classify and dispose of wastes in accordance with applicable regulations, including Ontario Regulation 347 under the Environmental Protection Act.
- B. Remove and dispose of sludge and debris from the site in accordance with regulatory requirements.
- C. Grade and level the site to provide adequate drainage and leave the site in a neat and orderly condition to the satisfaction of the Engineer and in accordance with prevailing regulations.
- D. Do not burn debris on the project site.

END OF SECTION 02100

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 02000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Excavation required for this contract includes but is not necessarily limited to:

1. Excavation for footings, foundations and slabs on grade.
2. Trenching for yard piping and electrical conduits.
3. Over-excavation to remove unsuitable material.
4. Disposal of surplus and rejected excavated material and rock.

## 1.03 Related Work:

- A. Regulatory Requirements - Section 01060
- B. Environmental Protection and Control - Section 01561

## 1.04 Standards and Codes:

- A. Management of Excess Material - OPSS.MUNI 180

## 1.05 Classification of Excavated Material:

- A. The following general classification of excavated material applies to this contract:
  1. Topsoil - material overlying the silt, clay and silty clay strata. Topsoil contains organic substances.
  2. Silt, Clay and Silty Clay - inorganic materials overlain by topsoil. Silt, Clay and Silty Clay are not glacial deposits.
  3. Silty Sand and Gravel - inorganic deposits overlying bedrock formation. May contain boulders large enough to be classified as "Rock".
  4. Rock - bedrock formation lying in solid horizontal or inclined beds, and boulders measuring 0.40 m<sup>3</sup> or more in volume
  5. Other Materials:
    - a) Frozen materials, which in the thawed state would not qualify for classification as rock.

- b) Soft or disintegrated rock, which can be loosened by picks or excavating machinery.
- c) Debris such as construction materials, cinders, ashes, garbage, refuse, equipment, trees or tree stumps and other materials unsuitable for foundations.
- d) Contaminated, non-leachate toxic soil in accordance with Ontario Regulation 347 as amended.
- e) Contaminated, leachate toxic soil in accordance with Ontario Regulation 347 as amended.
- f) Miscellaneous inclusions such as asphalt, concrete, bricks, steel, wood, etc.

## PART 2 - PRODUCTS

### 2.01 Sheeting and Shoring:

- A. Provide material used for sheeting or sheet-piling and shoring or bracing in open cut to the satisfaction of the Engineer, who reserves the right to order any unsatisfactory material replaced. If the order is not carried out, the Engineer may order all or any part of the work to be stopped until an acceptable material is furnished and the condemned material replaced.

## PART 3 - EXECUTION

### 3.01 General:

- A. Complete excavations to the necessary depths as shown on the Drawings. Construct slabs and footings on a granular mat or mud slab placed on undisturbed ground, unless otherwise required by field conditions or noted on the Drawings.
- B. Slope earth banks created by excavating at sufficient angle to prevent sliding or caving in. If necessary to protect adjacent structures, for safety, for dewatering operations, to expedite the work or for other reasons as deemed necessary by the Engineer, supply and install, to the satisfaction of the Engineer, caissons, cofferdams, sheet-piling, underpinning, well points and/or pumps at no additional cost to the Owner. The cost of any steel or timber sheeting or sheet piling will be reimbursed only if ordered by the Engineer to be left in place. Payment for this sheeting or sheet piling shall be made as agreed during construction, in accordance with the General Conditions of Contract.
- C. Provide, install and maintain necessary fences and barricades before and during excavation work.
- D. Include the removal of water, ice, snow and material of any nature from the excavations that could interfere with construction work.

- E. Where the bearing value of the subgrade is determined by the Engineer to be unsuitable, over-excavate to the depths directed by the Engineer.

### 3.02 Trench Excavation:

#### A. General

1. A trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation.
2. Be responsible for maintaining the stability of the excavations by employing suitable construction methods including, but not limited to, sheeting and shoring, and dewatering of soil.
3. Excavate for utilities by open trench unless otherwise specified or shown on the Drawings. Obtain prior approval of the Engineer for tunneling or jacking any portion not so specified. Complete such tunneling or jacking at no additional cost to the Owner.

#### B. Maximum Length of Open Trench:

1. Except by permission of the Engineer, ensure that the maximum length of open trench is 30 meters or the distance necessary to accommodate the length of pipe installed in a single day, whichever is the greater. The distance is the collective length at any location, and includes open excavation, pipe length and appurtenant construction and backfill that has not been completed.

#### C. Maximum and Minimum Width of Trench:

1. Unless otherwise shown on the Drawings or approved by the Engineer, ensure that the minimum and maximum width of pipe trench (except for corrugated metal pipe) permitted at the height of 300 mm above the top of the pipe is as follows:
  - a) Minimum trench width for a single pipe:
    - i. For pipes with inside diameter of 900 mm or less: allow 300 mm on each side of the outside diameter of the pipe or 760 mm, whichever is greater, plus allowance for any shoring.
    - ii. For pipes with inside diameter larger than 900 mm: allow 500 mm on each side of the outside diameter of the pipe, plus allowance for any shoring.
  - b) Minimum trench width where multiple pipes are laid side by side: 300 mm between the trench wall and the edge of the pipe, closest to the trench wall, on both sides of the trench or 760 mm, whichever is greater, plus allowance for any shoring. Allow a minimum distance of 400 mm between adjacent pipe walls.

- c) Maximum trench width, including an allowance for shoring: 700 mm greater than the minimum width specified above, for pipes 450 mm diameter and larger; and 400 mm greater than the minimum width specified above for pipes with diameter smaller than 450mm.
  - d) Minimum trench width for corrugated metal pipe and flexible piping: 600 mm wider than the outside diameter of the pipe to be installed.
2. If the maximum trench width, as measured at 300 mm above the top of the pipe, is exceeded, the Contractor may be required to provide additional bedding, another type of bedding or a higher strength of pipe, at the Contractor's expense, to the satisfaction of the Engineer.

D. Sheeting and Shoring:

1. Furnish, put in place and maintain such sheeting, shoring and bracing and at such locations and elevations as are necessary or as may be required to support and protect the sides, bottom and roof (if any) of the excavation and to prevent any movement that may in any way disturb or weaken the supporting material below or beside the works or diminish the width of the excavation or otherwise disturb, damage or delay the work, or damage or endanger adjacent pavements, property, buildings or other works.
2. In open cut, withdraw and remove timbering and steel sheet piling, as the trenches are being backfilled. Where sheeting and sheet piling are to be withdrawn, exercise special care to ensure that voids or holes left by the sheeting as it is withdrawn are filled with suitable material and compacted as specified.
3. Be responsible for providing, placing, maintaining and withdrawing sheeting, shoring and bracing, notwithstanding either the absence of a direction from the Engineer or the approval or disapproval by the Engineer of the measures taken.
4. Carry out shoring and trench timbering in strict accordance with the requirements of the Occupational Health and Safety Act O.Reg. 213/91 and applicable regulations of the Ontario Ministry of Labour, Immigration, Training and Skills Development.

E. Excavation May Be Stopped:

1. The Engineer may stop the excavation at any portion of the work and require the Contractor to complete the pipe laying and backfilling up to such point as he may direct before the excavation is continued. In this case, no allowance or compensation other than an extension of the time of completion for as many days as the Engineer may determine will be granted.

## F. Depth of Trenches:

1. Excavate trenches to provide a uniform and even surface at the depth and in the shapes required for the foundations of the pipes, appurtenances and their bedding as shown on the Drawings and as specified. If the trench is excavated below the required grade, fill the excavation to grade with approved fill concrete or other approved material to the satisfaction of the Engineer.
2. Where, in the opinion of the Engineer, the ground at the bottom of the excavation for the base does not afford a satisfactory foundation after dewatering as specified has been carried out, excavate the trench to such increased depth as the Engineer may direct and bring the bottom of the trench to the required level with an approved material to the satisfaction of the Engineer.
3. Wherever the bottom of the trench is in rock, excavate to 150 mm below the bottom of the pipe barrel and refill to the underside of the bedding material or pipe barrel as required with sand-gravel mixture as specified, having a maximum particle size of 25 mm.

## G. Changes in Depth of Trenches:

1. If necessary, due to changes in plans, excavate the trench to such additional depth as the Engineer may direct. Compensation for such extra depth of excavation will be in accordance with the unit prices in the Form of Tender or the General Conditions of Contract, whichever is applicable.

## 3.03 Excavation for Structures:

- A. Excavate for footings, foundations and basement walls, floor pits and other subsurface construction. Make allowance for construction of formwork, bracing and supports and pumping and drainage systems. Remove from the excavation material that the Engineer deems unsuitable for foundations, including any material that sloughs off the sides of the excavation. Maintain the bottom of the excavation firm and dry.
- B. Except where over excavation is specified (e.g. for removing unsuitable material), ensure that machine excavation for base slabs and footings does not extend closer than 50 mm to the finished sub-grade. Trim the finished subgrade evenly and remove loose materials.
- C. Fill voids between the limits of excavation and the neat lines of the underside of structures with fill-concrete, except where otherwise specified. Be responsible for excavations that exceed the limits reviewed by the Engineer. Bear the costs of such unauthorized excavation and the necessary fill-concrete required to fill the void.
- D. Where the bearing value of the sub-grade is determined by the Engineer to be unsuitable, over-excavate to the depth directed by the Engineer. Payment for any over-excavation, as directed by the Engineer, will be in accordance with the unit prices in the Form of Tender or the General Conditions of Contract, whichever is applicable.



### 3.04 Protection of Structures and Utilities:

- A. Take the necessary precautions to protect existing or newly constructed works, but if undermining should occur, correct the undermining by breaking out and repairing the existing structure and/or replacing the disturbed foundation material with fill concrete, grout, sand, etc., as may be directed by the Engineer. This applies also to electrical cables, yard piping and appurtenances already constructed in the area whether above ground or underground or which appear within the trench. Should damage of any kind, including settlement or lateral movement of adjacent structures, utilities or surface features occur as a result of the work, immediately rectify such conditions and any resultant damage to the satisfaction of the Engineer.
- B. Take the necessary precaution to protect the subgrade below structures, utilities and other parts of the work from freezing.

### 3.05 Dewatering of Excavations:

- A. Keep excavations and trenches free from water. Provide dams, dikes or other work necessary for dewatering including duplicate pumps of sufficient capacity for the purpose as necessary. The use of well points for dewatering trenches may be permitted by the Engineer.
- B. Refer to Section 01561 for additional drainage control requirements.
- C. Do not place concrete under water. Do not allow water to flow over recently placed concrete.
- D. Obtain "Permit To Take Water" from the MECP as required in Section 01060 if necessary.
- E. Protect against floatation during construction and backfilling of works.

### 3.06 Stockpiling and Disposal of Excavated Materials:

- A. Stockpiling:
  - 1. Separate excavated materials into the following groups.
    - a) Approved topsoil.
    - b) Approved silt-clay or sand-gravel materials.
    - c) Approved fill.
    - d) Rejected topsoil and rejected silt-clay or fill materials.
    - e) Rock.
    - f) Other material.
  - 2. Stockpile these excavated materials separately in locations within the construction site as designated by the Engineer.

3. Material excavated from trenches may be stockpiled beside the trench within the provisions herein set out. Deposit excavated material on one side of the trench only, unless otherwise directed. Remove, dump, spread and regrade any excess material remaining after backfilling of trenches as directed by the Engineer.
4. Do not stockpile excavated material immediately adjacent to cuts or trenches if a safety hazard is created.
5. Control the stockpiling of material removed from trenches in such a manner as to prevent water running into the excavation.
6. Do not obstruct surface drainage. Provide means whereby storm and waste waters are diverted into existing gutters, other surface drains, or temporary drains.
7. Stockpile contaminated soils and suspected contaminated soils separately from the soils to be reused for backfill as directed by the Engineer. Stockpile contaminated soils on ground sheets and cover with tarpaulins as directed by the Engineer.
8. Stockpile excess materials in accordance with requirements of Section 02210 – Excess Soil Management.

B. Disposal:

1. Haul to waste rocks, rejected excavated material and surplus excavated material that will not be required for use in backfilling, spreading, repairing and restoration, except as noted otherwise in Contract Documents, to the satisfaction of the Engineer.
2. In case of a dispute, the Engineer shall be the sole judge as to what material is suitable or unsuitable for reuse.
3. Provide to the Engineer written statements from property owners acknowledging acceptance of excavated materials on their sites. Use the Ontario Provincial Standard Form 180-3 available from OPSS.MUNI 180.
4. Dispose of rejected and contaminated soils off-site at properly licensed facilities in conformance with applicable regulatory requirements.
5. Be responsible for selecting the disposal sites unless these are stipulated by the Owner.
6. When it is necessary to haul material over streets, promptly clean up and remove any spills or deposits, as frequently as directed by the Engineer.
7. Dispose of excess materials in accordance with requirements of Section 02210 – Excess Soil Management.

END OF SECTION 02220

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 02000 applies to and governs the work under this Section.

### 1.02 Work Included:

- A. The backfilling and filling work includes, but is not necessarily limited to:
  1. Backfilling for structures and filling to attain the grades indicated on the Drawings;
  2. Backfill of demolished areas/structures;
  3. Trench backfilling;
  4. Rough and finish grading.

### 1.03 Related Work:

- A. Yard Piping - Section 02600

### 1.04 Codes and Standards:

- A. Material Specification for Aggregates` - OPSS.MUNI 1010

## PART 2 - PRODUCTS

### 2.01 General:

- A. Ensure that fill material is free of rubbish, roots, wires, cans or debris of any sort. Boulders, rock or concrete fragments over 100 mm in size are not suitable backfill material. The fill material is subject to the approval of the Engineer.

### 2.02 Materials:

- A. Approved fill: to consist of suitable earth or granular material that has been removed from the excavated areas, designated borrow area, or that has been hauled from an approved off-site source. Ensure that this material is acceptably dry, free from roots, large stones, boulders or large broken rocks, refuse, vegetable matter, topsoil, silt or debris.
- B. Approved Granular Fill: suitable granular material meeting the requirements of the Ontario Provincial Standard Specification OPSS.MUNI 1010 for Granular 'B' type II with maximum stone size of 100 mm diameter.
- C. Granular 'A' material: conforming to the requirements of the OPSS.MUNI 1010 for Granular 'A'.

- D. Granular 'B' material: conforming to the requirements of the OPSS.MUNI 1010 for Granular 'B'.
- E. Crusher-Run (19 mm) material: conforming to the requirements of the OPSS.MUNI 1010 for Granular type 'M'.
- F. Backfill and bedding sand: conforming to the requirements of the OPSS.MUNI 1010.
- G. Pea gravel: washed, rounded durable stone, 9.5 mm to 4.74 mm in size, with no more than 2% passing a 75 micrometer sieve.
- H. Crushed stone: conforming to the requirements of the OPSS.MUNI 1010 for Granular 'B', type II with maximum stone size of 50 mm diameter.
- I. Rip-rap material: durable stone with a mass of a single stone being between 25 and 50 kg. Stones smaller than 25 kg mass are unsuitable.
- J. Other Materials: select all other materials, not specifically described but required for proper completion of the work of this Section, subject to the approval of the Engineer.

### PART 3 - EXECUTION

#### 3.01 General:

- A. Do not backfill with frozen material. Do not place fill in areas where the material already in place is frozen. Do not use stones, rock or concrete fragments larger than 60 mm in their greatest dimension in the backfill within 300 mm of the pavement subgrade or within 300 mm of utilities. Do not use stones, rocks or concrete fragments over 100 mm in their greatest dimension in any trench backfill.
- B. Suspend backfilling work at any time when satisfactory compaction results cannot be obtained due to rain, freezing weather or other adverse conditions in the field. At all times, drag, blade or slope the fill to provide proper surface drainage.
- C. Place materials that are to be compacted in layers not thicker than 300 mm, loose depth, and of the proper moisture content before compacting, to facilitate obtaining the prescribed compaction shown on the Drawings or specified herein.
- D. Remove temporary planking, formwork, etc., as backfilling progresses to avoid formation of voids.
- E. Ensure that excavated foundations are inspected and approved by the Engineer before proceeding with further work, including placing of skim coat, bedding, reinforcing steel, etc.
- F. Make grades and lines as indicated on the Drawings. Notwithstanding, the Engineer reserves the right to make minor adjustments to the lines and grades or revisions where necessary, to correct any discrepancy, accommodate piping runs, etc.

- G. Complete final grading for roadways, parking areas and walkways to within 25 mm of the elevations shown on the Drawings. Complete final grading at sodded or seeded areas to within 50 mm. Slope areas to avoid puddles.
- H. Where the Engineer deems the native material to be unsound for the purpose of backfill, use imported approved granular fill.
- I. Repair damage and correct deficiencies that may result from the settlement of backfilled areas.
- J. The Owner will pay for the costs of any testing of backfill materials, deemed necessary by the Engineer, to determine the acceptability or degree of compaction. Should unsatisfactory results be obtained, undertake required remedial work and bear the cost of additional testing required to achieve satisfactory results.

### 3.02 Foundation Bedding:

- A. Unless otherwise specified, construct new concrete foundation floors and base slabs on the bedding.
- B. Compact the bedding material, except for clear crushed stone, by mechanical means at optimum moisture content to a value of 98% Standard Proctor Maximum Dry Density (SPD).
- C. Where indicated on the Drawings, install perforated underdrains with risers and flap gates in granular trenches, below the foundation bedding with risers for flap gates.
- D. Refer to the Drawings for details of underdrain bedding, filter cloth and pea gravel.

### 3.03 Backfilling Against Walls:

- A. Unless otherwise specified on the Drawings or approved by the Engineer, ensure that the period of time after which the Contractor may place backfill against or on top of any cast-in-place structures is greater than or equal to the time periods as shown in the table below:

Operation	Location	
	Against Sides of Structures	On Top of Structures
Placement of Loose Backfill	5 days	21 days
Compaction of Backfill	7 days	28 days

- B. Observe any special backfilling requirements or materials, such as those for sub-drain and perimeter drain filters and insulation/expansion material where specified and/or shown on the Drawings.
- C. Use approved Granular Fill, as specified, as backfill around the walls of the structures. Place the fill in maximum 150 mm layers loose depth and compact by mechanical means to a value of 98% SPD, unless otherwise indicated on the Drawings. Except as otherwise approved by the Engineer, do not use heavy compaction equipment within 3 m of new

walls. To achieve the specified degree of compaction, bring the moisture content of the material up to the optimum level and ensure that the moisture content does not exceed this optimum by more than 2%. Bring the backfill up to within 600 mm of finished grade elevation. For the remaining fill, use approved fill and topsoil, as required for site grading, unless otherwise specified. Place backfilling in road and parking areas to within 750 mm of the surface and then complete using road construction materials as specified.

- D. Where walls are waterproofed on the exterior, or where insulation/expansion material has been placed, place backfill by hand against walls to prevent damage to the waterproofing membrane. Should any damage to waterproofing occur, re-excavate such areas and repair the membrane or coatings to the satisfaction of the Engineer.
- E. Where fill is required on both sides of a wall, foundation or culvert, deposit it layer for layer at each side, alternately.

#### 3.04 Backfilling of Piping and Electrical Conduit Trenches:

- A. Proceed with backfilling of pipe and conduit trenches as specified in the Drawings, as soon as possible. Do not backfill pipe that is to be tested, except for bracing purposes, until testing has been completed to the satisfaction of the Engineer. Where concrete thrust blocks are used, allow sufficient time for the concrete to obtain adequate strength before testing and backfill.
- B. Backfill starts at the top of the bedding above the pipe or conduit. All materials below this elevation are considered as bedding. Refer to Section 02600.
- C. Backfill for cast-in-place piping, appurtenances or structures such as manholes starts at the subgrade for the structure. Ensure that the backfill is brought up simultaneously and equally on all sides of the structure.
- D. Exercise care during backfill operations to prevent damage or dislodging of pipe and conduit. Should any damage occur, correct damage or dislodging of pipe or conduit to the satisfaction of the Engineer.
- E. Backfill trenches in the general site area (except in road, parking and walkway areas) using Approved Fill to the underside of the topsoil or finished grade as required in layers not exceeding 300 mm in loose depth. Compact in layers to 98% SPD. Backfill material shall not be dropped from the side of the trench so that there is a clear fall onto the partially covered pipe or conduit.
- F. Backfill buried electrical conduit and other utilities as indicated on the Drawings and similar to that specified for yard piping.
- G. Where it has become necessary to excavate beyond the limits of normal excavation lines to remove previously unknown boulders or other interfering objects, the voids remaining shall be backfilled to the approval of the Engineer. Payment for removing such boulders and other interfering objects and the backfilling of the voids will be made in accordance with the Schedule of Unit Prices or the General Conditions, as may be applicable. The boulders removed will be classified as rock excavation for payment purposes, if sufficiently large in size.

### 3.05 Roads and Parking Areas:

- A. Refer to Section 02510.
- B. Bring the backfill in areas under roads and parking areas to the underside of the sub-base using Approved Granular Fill. Compact in layers of 150 mm to 98% SPD. In areas adjacent to structures, thinner layers may be required to suit lighter compaction equipment.
- C. In road cut sections, excavate unsuitable material (silt, humus, topsoil, etc.) and replace it to the level of the sub-base with Approved Granular Fill. Ensure that the minimum excavation in cut sections extends to the depth of the road base as shown on the Drawings. Where directed by the Engineer, due to excessive thickness of unsuitable material, over-excavate in cut sections to a maximum depth of 900 mm or as otherwise directed. Payment for over-excavation and backfilling with Approved Granular Fill will be made at the prices given in the Schedule of Unit Prices, or in accordance with the General Conditions, as may be applicable.

### 3.06 Site Grading:

- A. General:
  1. Grade the site to the elevations indicated on the Drawings with due allowance for topsoil and sodding, or as directed by the Engineer. In the immediate vicinity of structures, ensure that the ground slopes away from the structures.
  2. Have the site grading reviewed by the Engineer before proceeding with any landscaping. Provide drainage to an outlet point without ponding.
  3. Place fill for site grading in 300 mm layers and compact to a value of 98% SPD.
- B. Additional Fill for Site Grading:
  1. Supply necessary additional fill material that may be required to raise the new site grades above the existing grades, as indicated on the Drawings.
  2. Procure additional material required from the designated borrow site, or other approved source and deliver to the site. Use Approved Fill as specified, free from topsoil, boulders, roots, rubble, organic material, stumps of trees or other deleterious items.
  3. Bear the cost of loading, hauling, placement and compaction as specified, of Approved Fill material.
- C. Ditches and Swales:
  1. Trim, grade and slope ditches and swales as shown on the Drawings, to the satisfaction of the Engineer.

## 3.07 Settlement Repairs:

- A. During the specified period of maintenance, make good damage to walks, roads, sodded areas, etc., due to settlement of backfilled areas upon notification by the Engineer. Bear the costs of such repairs.
- B. Should the Contractor fail to carry out the necessary remedial work within two (2) working days after receiving written instruction from the Engineer, the Owner may carry out the work and deduct the cost incurred from the moneys owed to the Contractor.

END OF SECTION 02221



**PART 1 - GENERAL**

## 1.01 Reference:

- A. Section 02000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Landscaping includes, but is not necessarily limited to:

1. Supply and placement of topsoil and fertilizer.
2. Supply and application of seed.
3. Removal, preservation (during construction period) and planting of any existing trees, shrubs and other plants, affected by the proposed work. The new location to be determined after final grading is completed.

- B. Areas to be sodded or seeded and mulched:

1. Areas designated on the Drawings.
2. Areas outside of the specified work area disturbed by construction or regraded are to be sodded or seeded and mulched. Sod, seed and mulch to the extent as shown on the Drawings.

## 1.03 Related Work:

- A. Quality Control - Section 01400

## 1.04 Codes and Standards:

- A. OPSS 512 - Gabions
- B. OPSS 804 - Seed and Cover
- C. OPSS 1430 - Gabion Materials
- D. OPSS 1860 - Geotextile Materials

## 1.05 Guarantee:

- A. Provide a one (1) year guarantee, or as elsewhere stipulated, effective from the date of completion of the General Contract, that plant material grows healthily and vigorously, and is in satisfactory growth at the end of the specified period of maintenance. Damage resulting from acts of vandalism is excluded from the guarantee. Replace plant material that, in the opinion of the Engineer, is not in a healthy growing condition. Provide an additional one (1) year guarantee on replacement plant material.
- B. Ensure that settlements or other irregularities in the sodded areas and the gabion mats are covered by the one (1) year guarantee.

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**PART 2 - PRODUCTS****2.01 Topsoil Testing:**

- A. Prepare representative topsoil samples at the request and direction of the Engineer from each area of the project. Submit the required amount of sample to a testing laboratory acceptable to the Engineer.
- B. Ensure that tested samples are an amalgamation of at least three (3) samples randomly taken from each area or stockpile, carefully mixed, recorded, labeled and otherwise documented prior to delivery to the testing laboratory.
- C. Carefully communicate to the testing laboratory the intended use to which the topsoil is to be put. (To grow turf, trees, shrubs, naturalized areas, etc.).
- D. Submit two (2) copies of the test results to the Engineer for review. Ensure that topsoil test reports include N:P:K, Mg, soluble salt content, organic matter content and pH.
- E. Ensure that the test results indicate that the topsoil is a fertile, friable, natural loam containing not less than 4% organic matter for clay loams and not less than 2% for sandy loams to a maximum of 15% and capable of sustaining vigorous plant growth, free of subsoil contamination, roots and stones over 50 mm in diameter, free of weeds and having a pH ranging from 6.0 to 7.6.
- F. Refer to Section 01400 for details on payment of testing costs.

**2.02 Topsoil:**

- A. Topsoil for Sodded and Seeded Areas: obtain topsoil from the top 150 mm of topsoil loam. Do not include either heavy clay or light sandy soil.
- B. If the test results indicate that the topsoil does not meet the above-noted quality criteria with regard to organic matter content and the Engineer decides that remedial action is required, make the necessary amendments to improve the topsoil to a quality level acceptable to the Engineer. A cost of such improvement is a negotiated addition to the Contract price.

**2.03 Soil Amendments:**

- A. When required, add and thoroughly mix with the specified and tested topsoil the following amendments:
  - 1. Peat moss
  - 2. Sand
  - 3. Organic Matter
  - 4. Limestone
  - 5. Fertilizer

## 2.04 Lime:

- A. Use lime as a soil amendment in cases where the pH of the soil is less than 6.0 and contains not less than ninety percent (90%) of calcium and magnesium carbonates combined. Grind lime finely to pass a ten (10) mesh sieve. Determine the rate of application after measuring the pH of the topsoil.

## 2.05 Seed and Mulch:

- A. Seed: Certified Canada #1 Lawn Grass Seed Mixture grade (Standard Roadside Mix) to comply with Canada Seeds Act and Regulations in accordance with OPSS 804.05.01 and 804.05.02.
- B. The rate of seed application for the Standard Roadside Mix seed is 1 kg/100 m<sup>2</sup>.
- C. Mulch: Hydraulic Mulch in accordance with OPSS 804. No substitutes will be allowed without the approval of the Engineer.
- D. Water: potable, free of impurities that would inhibit germination.
- E. Fertilizer: complete, commercial fertilizer of approved manufacture with an analysis of 8:32:16 (N:P:K) in granular form, dry, free flowing and free from lumps. Fertilizer to comply with the provisions of the Canada Fertilizers Act and Fertilizer Regulations.
- F. The rate of fertilizer application for the Standard Roadside Mix seed is 3.5 kg/100 m<sup>2</sup> minimum.

PART 3 - EXECUTION

## 3.01 Preparation of Existing Grade:

- A. Examine the prepared sub-grade and eliminate local depressions, ruts, ridges, lumps, rock exposures, debris, sub-soil contaminated with oil or gasoline etc., so that a positively drained visually smooth surface is created. Obtain the approval of the sub-grade from the Engineer prior to commencement of spreading of topsoil.
- B. Verify that grades are correct. If discrepancies occur, notify the Engineer and do not commence work until instructed.
- C. Remove stones, sticks, sub-soil lumps, or other debris in excess of 50 mm diameter, and surface litter and live weeds from the topsoil and dispose of off site.
- D. Compact sub-grade to 95% Standard Proctor Density.
- E. Scarify the sub-grade to a depth of 50 mm.

## 3.02 Placing and Spreading of Topsoil/ Planting Soil:

- A. Place topsoil after the Engineer has accepted sub-grade.
- B. Haul and spread approved topsoil materials in areas designated to receive topsoil. Provide a layer of topsoil a minimum of 150 mm thick as measured in place. Level and

trim the topsoil to finished elevations and in such a manner that it is free draining at all times. Be satisfied as to the amount of topsoil available at the site and make due allowance for additional topsoil to be hauled in.

- C. Do not spread topsoil when it is in a frozen or muddy condition.
- D. Fine-grade topsoil eliminating rough and low areas to ensure positive drainage and meet the lines and levels indicated. Do all fine-grading with approved equipment being careful not to excessively compact topsoil. Roll topsoil with a light roller.
- E. For sodded areas keep topsoil 15 mm below the finished grade adjacent to walkways to ensure no obstruction to drainage.
- F. Spread topsoil to the following minimum depths after settlement.
  - 1. 150 mm for seeded areas
  - 2. 150 mm for sodded areas
  - 3. 300 mm for flower beds
  - 4. 500 mm for shrub beds
- G. Manually spread topsoil/planting soil around trees, shrubs and obstacles.

### 3.03 Seed Delivery and Storage:

- A. Deliver grass seed in original containers showing:
  - 1. Composition of seed mixture.
  - 2. Percentage of pure seed.
  - 3. Year of production.
  - 4. Net mass.
  - 5. Date when tagged and location.
  - 6. Percentage germination.
  - 7. Name and address of distributor.

### 3.04 Preparation of Surfaces for Seeding:

- A. Examine the condition of the fine graded and topsoiled slope prior to commencement of the work.
- B. Obtain Engineer's approval of topsoil grade and depth before starting seeding.

- C. Ten (10) days after application of herbicide, cultivate soil to a depth of 25 mm (shallow tilling or disking). Fine grade free of humps and hollows and free of deleterious and refuse material. Seed immediately afterwards.

### 3.05 Hand Seeding:

- A. Native Seed Mixtures to be broadcast.
- B. Commence seeding once the Engineer has collected labels from seed bags showing:
  - 1. Seed composition and percentage of pure seed;
  - 2. Weight (net mass);
  - 3. Percentage germination;
  - 4. Name and address of grower/supplier.
- C. Hand seeding to be executed in two applications. Seed area with half amount of the seed mixture. Once area has been seeded, take the second half and spread it evenly across the same area, applying the mixture perpendicular to the first pass.
- D. Rake seed mixture so that it is lightly covered with soil, 3 mm to 6 mm deep.
- E. Roll site with a roller to firm the seed into the soil. Do not roll, if soil is wet. Wait until the soil is dry to avoid unnecessary soil compaction.
- F. Apply light covering of clean, weed free mulch. Do not use field hay.
- G. Blend applications into adjacent grass or sodded areas or into previous applications to form uniform surfaces.
- H. Re-seed at 2 week intervals where germination has failed. This is a contractual requirement and no extras will be paid to the contractor for this requirement.

### 3.06 Seeding and Mulching:

- A. Ensure that seeding and mulching is a one-step process in accordance with OPSS 804 and in areas described in Item 1.02 B. above.
- B. Workmanship:
  - 1. Keep site well drained.
  - 2. Clean up immediately, soil, mulch, or other debris spilled onto pavement, dispose of deleterious materials off site.

### 3.07 Seed Placement on Slopes:

- A. Hydroseed and mulch the sloped surfaces and cover them with anchored erosion control blankets as specified in OPSS 804.

**3.08 Maintenance of Seeded Areas:**

- A. Keep soil moist during germination period and adequately water grassed areas until accepted by the Engineer.
  - 1. Apply water to ensure moisture penetration of 75 to 100 mm. Control watering to prevent wash-outs.
- B. Water as per the following schedule for the first four weeks after planting:
  - 1. Water every other day for first week (min. 3 times). Water in morning only.
  - 2. Water once a week for the next 3 weeks.
  - 3. Should the following two weeks be excessively hot and dry, water once a week as per Engineer's directions.
  - 4. Watering frequency may be increased or decreased as per climatic conditions, as consulted by the Engineer.
  - 5. Provide additional watering at no extra cost to ensure a complete seed take, 98% free of bare spots.
- C. Make good any washouts, dieback, or slumps during the guarantee period.
- D. Maintain grassed areas free of pests and disease.
- E. Fertilize seeded areas one month after seeding. Spread evenly and water in well. Postpone fertilizing until next spring if application falls within four-week period prior to expected end of growing season in locality.
- F. Apply herbicide when it will not cause damage to new grass or other plants.
  - 1. Avoid use of dicamba and picloram solutions near trees and shrubs.
- G. Maintain seeded areas free of weeds to the satisfaction of the Engineer.

**3.09 Acceptance of Seeded Areas:**

- A. Areas will be accepted by the Engineer provided that:
  - 1. Seeded areas are properly established.
  - 2. Turf is free of eroded, bare or dead spots and 98% free of weeds.
- B. Areas seeded in fall will be accepted in the following spring, one month after start of growing seasons provided acceptance conditions are fulfilled.
- C. The Engineer has collected labels from seed mixture containers verifying seed mixture and quantities are as per contract documents.

END OF SECTION 02480

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 02000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Provision of piping, fittings, manholes and appurtenances outside and under buildings and structures as shown on the Drawings and specified herein.

## 1.03 Related Work:

- A. Commissioning of the Works - Section 01650
- B. Backfilling - Section 02221
- C. Pipe Fittings - Section 15060
- D. Copper Pipe and Fittings - Section 15063
- E. Ductile Iron Pipe and Fittings - Section 15064
- F. Stainless Steel Pipe and Fittings - Section 15066
- G. Process and Service Valves - Section 15100
- H. Piping Insulation - Section 15260
- I. Ontario Provincial Standards for Roads and Public Works

## 1.04 Submittals:

- A. Submit shop drawings for all materials in this section.

## 1.05 Codes and Standards:

- A. Use Class B bedding unless noted otherwise. For multiple pipe installations allow minimum distance of 400 mm between adjacent pipe walls.
- B. Materials and installation to meet the following standards:
  - 1. OPSD 802.010 – Flexible Pipe Embedment and Backfill - Earth Excavation.
  - 2. OPSD 802.013 - Flexible Pipe Embedment and Backfill – Rock Excavation
  - 3. OPSD 802.030 - Rigid Pipe Bedding, Cover and Backfill Type 1 or 2 soil – Earth Excavation.
  - 4. OPSD 802.031 - Rigid Pipe Bedding, Cover and Backfill Type 3 soil – Earth Excavation.

5. OPSD 802.032 - Rigid Pipe Bedding, Cover and Backfill Type 4 soil – Earth Excavation.
6. OPSD 802.033 - Rigid Pipe Bedding, Cover and Backfill – Rock Excavation.
7. OPSS 405 - Construction Specifications for Pipe Subdrains.
8. OPSS 407 - Construction specifications for the Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers Installation.
9. OPSS 408 - Construction Specifications for Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers.
10. OPSS 410 - Construction Specifications for Pipe Sewer Installation in Open Cut.
11. OPSS 421 - Construction Specifications for Pipe Culverts Installation in Open Cut.
12. OPSS 410 - Construction Specifications for Pipe Sewer Installation in Open Cut.
13. OPSS 441 - Construction Specification for Water Main installation in Open Cut.

## PART 2 - PRODUCTS

### 2.01 General:

- A. The following product specifications cover some products, which are not specifically required on this project. Actual pipe materials required are as noted on the Drawings.

### 2.02 Pipe Materials:

#### A. Polyvinyl Chloride (PVC) Sanitary Pressure Pipe:

1. Pipe: manufactured to CSA Standard B137.3.
2. Joints: bell and spigot with rubber gaskets to ASTM Specification D3139.
3. PVC sanitary 300 mm in diameter and less: Class 150, DR26, manufactured to AWWA C900 Standard and with iron pipe size iron outside diameter IPSOD dimensions.
4. PVC main between 350 mm to 450 mm in diameter: Class 150, DR26, manufactured to AWWA C905 standard and with iron pipe size iron outside diameter dimensions.

#### B. Valves:

1. Valves to be supplied in accordance with Section 15100.
2. Buried valves to be iron-body, bronze-mounted, double-disc gate valves with non-rising stems or solid-wedge gate valves with non-rising stems in accordance with AWWA C500.



3. Rubber seated valves to meet AWWA C509.
4. Working pressure minimum of 1205 kPa, hydrostatic test of 2070 kPa.
5. Valve ends to be mechanical joint unless otherwise shown on the Drawings.
6. Buried gate valves to be supplied with screw type or auger type valve boxes with a minimum inside diameter of 125 mm. Acceptable makes - Ferguson, Bibby.
7. One operating wrench for buried valves to be supplied.

C. Subdrain Pipe:

1. Pre-wrap polyethylene subdrain pipe with a geotextile. Pipe to be Terrafix TS-700 or equivalent to OPSS 1840.

2.03 Flexible couplings:

- A. At all building or buried structure penetrations, provide two flexible couplings. Install the first coupling 500 mm outside of the wall and provide a 500 mm spool piece between the couplings.
- B. Conform to ASTM F-1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications. Provide Class 2, flexible and restrained couplings.
- C. Provide a coupling that will accommodate differences in pipe diameter when transitioning from building pipe to yard pipe.
- D. Acceptable Manufacturer:
  1. First Named: Romac
  2. Acceptable alternates: Dresser, Straub, Sigma, HYMAX

2.04 Tracer Wire:

- A. Provide steel core, 10 guage, white tracer wire for all buried pipes. Tape the tracer wire to the crown of the pipe at 5 m intervals and run the wire into each valve box to ground surface and connect to test stations.
- B. For directional drill applications provide high strength tracer wire rated for the application.
- C. Wire to pipe connections and buried wire to wire connections to be made with exothermic welding by a certified welder.
- D. Acceptable Manufacturer:
  1. First Named: Copperhead
  2. Acceptable alternates: Priority Wire

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**2.05 Test Stations:**

- A. Provide Big Fink test stations for sodded/seeded areas. Provide FlushFink in paved, concreted and travelled areas. The cap on the test station is to be colour coded, blue for water and orange for wastewater.
- B. Provide a test station at each end of tracer wire. Bring tracer wires up to the surface at all valve boxes and locations where piping breaks grade. Bring tracer wires into valve chambers and route to cover.
- C. Provide a test station on all forcemains and watermains every 300m. Provide a test station for each location where a pipe enters a building.
- D. Provide a test box at one end of every steel casing. Bond tracer wire to casing.

**2.06 Restraining Pressure Pipes:**

- A. Provide mechanical restraints for all joints and fittings on pressure pipes.
- B. All buried restraint hardware to be coated with Denso.
- C. Acceptable Manufacturer:
  - 1. First Named: EBAA
  - 2. Acceptable alternates: SIGMA, Star, Ford Meter Box

**2.07 Fire Hydrant:**

- A. In accordance with AWWA C502 and shall have steamer ports, installed to OPSD 1105.010, complete with gate valve to AWWA C509, 1205 kPa min. working pressure, with screw type or auger type valve box of min. 125 mm inside diameter.

**2.08 Miscellaneous Appurtenances:**

- A. Provided the following miscellaneous appurtenances in accordance with the noted OPSD:
  - 1. OPSD 401.010 - Cast iron, Square Frame with Circular Closed or Open Cover for Maintenance Holes (Type A unless otherwise noted).
  - 2. OPSD 403.010 - Galvanized Steel Honey Comb Grating for Ditch Inlet.
  - 3. OPSD 405.020 - Maintenance Hole Steps (Solid Rectangular Aluminum).
  - 4. OPSD 701.010 - Precast Concrete Maintenance Hole (1200 mm dia).
  - 5. OPSD 701.011 - Precast Concrete Maintenance Hole (1500 mm dia).
  - 6. OPSD 705.010 - Precast Concrete Catch Basin (600 x 600 mm).
  - 7. OPSD 705.020 - Precast Concrete Twin Inlet Catch Basin (600 x 1450 mm)

8. OPSD 1103.010 - Concrete Thrust Blocks for Tees, Plugs and Horizontal Bends.  
\*delete if not using thrust blocks\*
9. OPSD 1103.020 - Concrete Thrust Blocks for vertical Bends.
- B. Maintenance hole adjustment units are to be minimum 150 mm, maximum 300 mm in height.
- 2.09 Bedding Materials:
- A. Refer to Section 02221 for specified bedding materials.
- 2.10 Corrosion Protection:
- A. Protect all buried valves, fittings, fasteners and bolted connections using Denso paste tape wrap.
- 2.11 Pipe Insulation Material:
- A. For board type insulation use as specified on the drawings or minimum Dow SM 50mm thick.
- B. Refer to Section 15260 for details on pipe insulation requirements.
- 2.12 Pipe Schedule:

#### PIPE SCHEDULE - Division 2

Service	Description	Pipe Joint Type	Max. Working Pressure (kPa)	Specification No. & Material
WASTEWATER				
Decant	Lagoon decant pump discharge to headworks	Bell and Spigot Rubber Gasketed, Mechanically Restrained	600	02600 PVC DR26 Pressure Pipe

Note: Piping located within the confines of buildings is included under division 15.

### PART 3 - EXECUTION

- 3.01 General:
- A. Install yard piping as specified in this section and in accordance with the Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD).
- 3.02 Bedding and Backfilling:
- A. General:
1. Bedding and backfilling to comply with OPSS 401.

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**B. Bedding:****1. Full Concrete Cradle to Spring Line:**

- a) Where concrete bedding is specified or required due to trench conditions, construct the bedding to the dimensions shown on the Drawings. After the trench has been prepared, carefully lay the pipe to line and grade and support the pipe on precast concrete blocks.
- b) After the pipe has been jointed and the pipe laying reviewed, place 20 MPa concrete to the lines and grades shown on the Drawings. Take care to work the concrete under the pipe. To achieve this, place the concrete on one side of the pipe and work it under the pipe. Take care that the alignment and grade of the pipe are maintained. Place concrete on the other side of the pipe only after it has been worked completely under the pipe.
- c) Each pour not to be more than 300mm thick. Do not place the subsequent pour until the prior pour has cured for a minimum of 24 hours. Key the pours together.
- d) Clean the external surface of the pipe before placing concrete.
- e) Where the concrete cradle is poured to the sheathing of a trench, place at least one thickness of bond break between the sheathing and the concrete. Withdraw the sheathing without displacing or damaging the cradle.

**2. Granular Cradle:**

- a) Lay the granular material to the dimensions shown on the Drawings. Take care to have even compaction of the bedding. Take special care to ensure that the material to the side of the pipe is compacted to the same degree as that under the pipe.
- b) Fill the excavated trench to the level 100 mm lower than the springline of the pipe with granular material. Once the bedding has been placed, hand shape the material to allow for placement of the barrel of the pipe. Do not place the pipe until the bedding has been placed and compacted to a minimum of 98% S.P.D.
- c) Over-excavate pockets of unsuitable bearing material beneath sewers and other yard piping to a maximum of 900. Backfill these areas with 50 mm crushed stone placed in 150 mm layers.
- d) Unless otherwise noted on the Drawings, all yard piping to have granular bedding. Bed plastic pipe with sand.

**3. Earth Foundation:**

- a) Trim the bottom of the trench to conform to the lower portion of the pipe barrel for a width of at least 50% of the O.D. and in such a manner that the pipes have a uniform bearing throughout their whole length.
- b) Entirely surround the pipe to a height of at least 150 mm above the top of the pipe and to the full width of the trench with compacted granular 'A'.

C. Backfilling:

1. Compact backfill using suitably sized compaction units. Hand tamping or light blade type mechanical tampers will be permitted within 300 mm above the pipe unless otherwise reviewed by the Engineer. Backfill shall be compacted to a minimum of 98% S.P.D.

3.03 Installation and Jointing:

- A. Ensure that pipe, before being lowered into the trench is thoroughly cleaned inside and outside. Examine the pipe for cracks, flaws or other defects.
- B. Ensure that trenches where pipe laying is in progress are kept dry and that no pipe is laid in water or upon wet bedding. Do not lay a length of pipe until the preceding length has been thoroughly embedded and secured in place so as to prevent any movement or disturbance of the finished joint. At the end of each working day, plug the open end of pipe securely.
- C. Lay sewers and gravity drains from the lower end of the line and progressing in an uphill direction with bell end of the pipe laying upgrade.
- D. Lay corrugated metal pipe (CMP) with interior laps pointed in the direction of the flow. Locate the longitudinal laps at the sides of quarter points.
- E. Lay the pipe true to line and grade with uniform bearing under the full length of the barrel of the pipe. Make suitable excavation to receive the bell or collar to ensure that these features do not bear upon the subgrade or bedding. Remove and relay any pipe that is not in true alignment or shows any undue settlement after laying.
- F. Do not permit walking on or working over the pipe after it has been laid until there is at least 300 mm of cover over it, except as may be necessary in refilling the trench and compacting the backfill.
- G. Check the grade of each pipe laid by means of a laser.

3.04 Cathodic Protection:

- A. Provide 11 kg zinc anodes at all buried cast iron or ductile iron fittings. Use thermite weld connections and Royston coating repair kit.

3.05 Valve Installation:

- A. Support valves located in valve chambers or buried structures with a cast-in-place concrete support.

- B. Support valves located in valve boxes with wood blocks, located between valve and undisturbed soil. The bedding to be the same as for the adjacent pipe.
- C. Valves are not to be supported by the pipe.

3.06 Pipe Crossing or Exposure:

- A. Support pipe that appears within the trench or excavation.

3.07 Flushing:

- A. Refer to Section 01650.

3.08 Pipe Testing:

A. General:

1. Do not use compressed air or pressurized gas for testing of pipes.

B. Gravity Sewers and Drains:

1. Conduct infiltration/exfiltration tests on gravity sewers and pipes. Provide necessary labour, tools and equipment necessary to carry out the infiltration/exfiltration tests. Total infiltration/exfiltration not to exceed 30 litres/100 mm diameter/100 m of pipe/day.

C. Pressure Pipe:

1. Conduct a pressure test on a new pipe. Isolate valves that have lower pressure rating than the test pressure. Submit a test plan for review in advance regarding the method of testing and locations for caps and bulkheads.
2. Conduct pressure tests after the pipes have been flushed. For potable water lines disinfect after pressure testing.
3. Pressure testing of water mains is to include hydrants.
4. The test protocol:
  - a) Apply a hydrostatic pressure of 150% of the maximum working pressure for the pressure pipe in question at the lowest point of section under test for a period of at least 2 hours. The permissible leakage:
  - b) Not greater than 10 liters/100 mm diameter/100 m of pipe/day.
5. Leakage is defined as the quantity of water that must be supplied into the newly laid pipe to maintain the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
6. If any section under test discloses leakage in excess of the permissible amount specified, determine the cause and make required changes or repairs. Re-test

that section, repeating the procedure until a satisfactory test result has been obtained. Carry out pressure tests before backfilling, in the presence of the Engineer. The Engineer will document the tests. Repair visible leaks regardless of the results of the pressure/leakage test specified.

7. Supply labor, pumps, taps, bulkheads, drains, air valves, connections, gauges, fittings and other appurtenances necessary to carry out the leakage tests.

### 3.09 Field Testing of Storm and Sanitary Piping:

- A. When directed by the Engineer, draw a tapered wooden plug, with diameter of 50 mm less than the nominal pipe diameter, through the sewer pipe to ensure that it is free of obstructions.
- B. Remove foreign materials from the pipe and related appurtenances by flushing with water.
- C. Video inspect the pipe and laterals in accordance with OPSS 409 and repair leaks prior to the commencement of top asphalt application or landscaping. Submit a copy of the video no later than one (1) week prior to the commencement of top asphalt application.

### 3.10 Pipe Disinfection:

- A. Refer to Section 01650.

END OF SECTION 02600

**DIVISION 3**

**CONCRETE**



**INDEX**

SECTIONS

- Section 03000 – Concrete
- Section 03100 – Concrete Formwork
- Section 03200 – Concrete Reinforcement
- Section 03250 – Concrete Accessories
- Section 03300 – Cast-In-Place-Concrete
- Section 03346 – Concrete Floor Sealer
- Section 03372 – Non-Shrink Grout
- Section 03500 – Concrete Repair

END OF INDEX DIVISION 3

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Work Included:**

- A. Provide all labour, material and equipment necessary to perform all concrete work indicated on the Drawings or specified herein, including but not necessarily limited to the following:
  - 1. Formwork and falsework;
  - 2. Reinforcing steel;
  - 3. Waterstops;
  - 4. Cast-in-place concrete;
  - 5. Curing and finishing;
  - 6. Installation of inserts, anchors, etc.;
  - 7. Keys and recesses;
  - 8. Concrete topping and benching.

**1.03 Related Work:**

- A. Cast in Place Concrete - Section 03300

**1.04 Codes and Standards:**

- A. Comply with CSA Standards A23.1 and A23.2.
- B. Where provisions of pertinent codes and standards conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.
- C. Provide at least one copy of CSA Standards A23.1 and A23.2 for reference during construction.

**PART 2 - PRODUCTS****2.01 General:**

- A. Comply with product requirements outlined in the Standard Sections, and as specified on the Drawings.
- B. Select all other materials, not specifically described but required for proper completion of the work of this Division.

**2.02 Cast-In-Place Concrete:**

- A. Concrete Mixes:
  - 1. Refer to Section 03300.

**PART 3 - EXECUTION****3.01 General:**

- A. Comply with execution requirements outlined in the Standard Sections, and as specified herein.
- B. Satisfy the Sub-grade approval requirements of Division 2 before any concrete is placed:

**3.02 Testing:**

- A. The cost of testing will be borne by the Owner. The testing agency will be retained by the Owner. The testing is performed for the Owner benefit and does not relieve the Contractor of responsibility for ensuring quality control.

**3.03 Special Construction:**

- A. Water-Tightness:
  - 1. The bottom slabs and all exterior walls must be made watertight so as to prevent seepage from the inside to the outside. Comply with Standard Drawing "Waterproof Construction Joints". Repair all cracks which leak to the satisfaction of the Engineer.

**3.04 Schedule of Concrete Finishes:**

- A. Refer to Section 03300 for finish types.

END OF SECTION 03000

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Design, construct and remove all formwork and falsework required for the construction of the permanent structures.

**1.03 Quality Assurance:**

- A. One person shall be present at all times to direct and supervise the work and shall be thoroughly familiar with the materials, standards, and specific requirements of this Section.

- B. Codes and Standards:

1. Comply with all the Occupational Health and Safety standards and regulations applicable covering the construction of this project.
2. Comply with CSA Standard A23.1.
3. Comply with all pertinent codes and regulations including the recommendations of "Guide to Form Work for Concrete", ACI 347R-14 of the American Concrete Institute.
4. Where provisions of pertinent codes and standards conflict with these Specifications or each other, comply with the more stringent provisions.

- C. Design:

1. Provide falsework designed by a Professional Engineer (hereinafter named the Designer) to withstand all loads before, during and after the placing of the concrete. The design shall recognize the requirements of the concrete mix including the possible retardation of the concrete due to the effects of the specified admixtures.
2. Drawings of the falsework shall:
  - a) show design loads and material specifications;
  - b) show locations of all construction joints and concrete pouring sequences and,
  - c) bear the formwork Designer's signature and seal and be kept at the project site.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Refer to CSA A23.1.
- B. For exposed concrete, use 16 mm minimum plastic-coated plywood forms.
- C. For concealed surfaces and rough work, undressed lumber may be used, provided the edge contacts are made sufficiently tight to hold mortar.
- D. Use waterproof formwork ties for water retaining structures and foundation walls.

**PART 3 - EXECUTION****3.01 Examination:**

- A. Inspection:
  - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades, and verify that such work is complete to the point where this installation may properly commence.
  - 2. Verify the work will be constructed in accordance with all pertinent codes and regulations, and the original design.
- B. Discrepancies:
  - 1. In the event of any discrepancy, immediately notify the formwork Designer and the Engineer.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.02 Construction:**

- A. General:
  - 1. Refer to CSA A23.1. Construct all formwork and falsework so that the concrete is placed in the position and to the dimensions detailed on the Drawings within the specified tolerances.
- B. Formwork:
  - 1. Erect formwork in accordance with the design drawings.
  - 2. Use plywood panels in large sheets and arrange so that the face grain is perpendicular to the studs or joists. Arrange joints between sheets to avoid irregular joint locations.
  - 3. Chamfer all exposed edges and corners 20 mm x 20 mm, unless otherwise detailed on the Drawings.

4. Arrange internal form ties so that when forms are removed, no metal is within 38 mm of any exposed surface.
5. Use outside forms as well as inside forms on all walls.

C. Falsework:

1. Erect falsework in accordance with the design drawings.
2. Use hardwood wedges or screw jacks to adjust forms to proper height or correct any settlement before or during the placing operation.
3. Set falsework to give camber indicated and to allow for shrinkage and settlement.
4. Support falsework on mudsills, concrete foundations or piles, to adequately support any construction loads.
5. On completion of the work, remove mudsills and concrete foundations; cut off piles 0.6 m below finished grade, ground level or bed of stream.

D. Treatment of Forms:

- E. Refer to CSA A23.1. Where form release agent is used, apply it before reinforcement is placed. No agent shall remain on interior concrete walls or ceilings, or exterior walls to be waterproofed or damp-proofed after the forms are removed.

**3.03 Engineering Review:**

- A. Prior to the pouring of concrete, the contractor shall have the formwork Designer or their designated agent inspect the formwork and falsework and approve in writing that the work is in compliance with the design drawings.
- B. The inspection of the formwork and falsework by the Engineer during or after its erection, or any suggestion or assistance furnished by the Engineer, shall not be construed as relieving the Contractor of any part of the responsibility for the accuracy, sufficiency or safety of any formwork or falsework, or for the satisfactory completion of the concrete work operations.

**3.04 Removal:**

- A. Refer to CSA A23.1. Do not remove formwork and falsework until the concrete has thoroughly hardened and is of sufficient strength to safely carry its own weight together with construction loads likely to come upon it. Obtain results of compressive strength cylinder tests prior to removing formwork and falsework of suspended slabs. Unless otherwise reviewed by the Engineer, do not remove sooner than that specified in the following schedule:
1. Side forms of slabs and footings: 12 hours
  2. Walls 300 mm and less in thickness: 2 days
  3. Walls over 300 mm thick: 3 days

4. Placement units requiring shoring: 14 days

The removal limits apply if the curing conditions of CSA A23.1 have been complied with. For colder temperature, do not proceed with removal without the review of the Engineer.

- B. Fill indentations caused by cone-ties with a non-metallic, non-shrink grout of same colour as the concrete.

END OF SECTION 03100

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide all concrete reinforcement and associated items as detailed on the Drawings and specified herein.

**1.03 Codes and Standards:**

1. ASTM A775/A775M, Specification for Epoxy-Coated Reinforcing Steel Bars.
2. ASTM A1064/1064M, Carbon Steel Wire and Welded Wire reinforcement, Plain and Deformed.
3. ASTM D3963/D3963M, Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
4. CSA A23.1, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.
5. CSA G30.18, Carbon Steel Bars.

**1.04 Quality Assurance:**

- A. Qualifications of Workmen:
  1. One person shall be present at all times to direct and supervise the work and shall be thoroughly familiar with the material standards, and specific requirements of this Section.
  2. Comply with CSA Standard A23.1
  3. Comply with all pertinent recommendations contained in “Manual of Standard Practice”, published by the Reinforcing Steel Institute of Canada.
  4. Where provisions of pertinent codes and standards conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.

**1.05 Submittals:**

- A. Shop Drawings:
  1. Submit bar lists and placing drawings prepared under the direction of an experienced and competent detailer.
  2. Placing drawings to show locations of all construction joints indicated on the Drawings and as required by the Contractor.



3. Review of bar lists and placing drawings by the Engineer will be for general compliance with design and will not signify complete checking of bending and cutting details or numbers of bars. No claim for extra payment will be entertained which results from any errors in the bar lists and placing drawings.

**B. Mill Test Reports:**

1. Provide a certified copy of a mill test on each delivered order batch of reinforcing steel providing physical and chemical analysis.
2. Where mill test certificates are not available, employ an approved independent testing agency for the inspection and testing of the reinforcement, the number of tests and testing procedure in accordance with CSA G30.18.

## **PART 2 - PRODUCTS**

### **2.01 Materials:**

**A. Materials to meet the following standards**

1. Reinforcement: CSA G30.18, Grade 400, deformed.
2. Welded wire fabric: ASTM A1064/1064M.
3. Expansion Joint Dowels: CSA G30.18, Grade 300W, plain with steel caps.

**B. Epoxy Coating**

1. Where identified on the drawings or specification provide for reinforcement that meets ASTM A775/A775M and ASTM D3963/D3963M.

## **PART 3 - EXECUTION**

### **3.01 Fabrication:**

**A. Splices:**

1. Submit for Engineer's review all locations of splices not shown on the Drawings.
2. For beams and slabs, locate splices away from points of maximum stress in the steel.

**B. Welded Wire Fabric:**

1. Provide all welded wire fabric of #4 gauge and larger bar sizes in flat sheets.

### **3.02 Delivery, Storage and Handling:**

- A. Deliver, store and handle all materials in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.**

### **3.03 Installation:**

## A. Supports:

1. Support all reinforcement adequately by bar supports, spacers, or hangers. Secure against displacement within the tolerances permitted. Use only approved bar supports of strong, durable and non-corrodible materials which fasten or tie securely to the reinforcement.
2. Use concrete blocks for slabs on grade, footings, skim slabs or similar construction.

## B. Concrete Cover:

1. Provide concrete cover for all reinforcement as shown on the Drawings and as follows:

Location	Cover
(i) Concrete deposited against the ground without forms.	75 mm ± 8 mm
(ii) Concrete exposed to weather, water or ground after removal of forms	
Bars greater than 15 M	60 mm ± 8 mm
Bars 15 M or smaller	60 mm ± 8 mm
(iii) Concrete in slabs or walls not exposed to weather, water or ground	
Bars greater than 15 M	60 mm ± 5 mm
Bars 15 M or smaller	60 mm ± 5 mm
(iv) Concrete in beams and columns not exposed to weather, water or ground	60 mm ± 8 mm

## C. Tying:

1. Tie bars at the lesser of every fourth intersection or 1000 mm.

## D. Field Bending and Welding:

1. Field bending is not permitted without prior review by the Engineer. When authorized by the Engineer, field bend reinforcement without heat and slowly with a steady even pressure to a minimum radius of 4 bar diameters.
2. Welding of reinforcement will not be allowed without prior review by the Engineer.

## E. Splices:

1. Provide contact lap splices for all spliced bars.

## F. Cleaning:

1. Remove all deleterious materials in contact with the reinforcement.

**3.04 Placement of Concrete:**

- A. Do not place concrete until the reinforcement has been reviewed by the Engineer.

END OF SECTION 03200

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide Cast-in and drilled in anchors for concrete as shown on the Drawings and specified herein.

**1.03 Submittals:**

- A. Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
- B. Samples: Representative length and diameters of each type anchor shown on the Drawings.
- C. Quality Assurance Submittals:
  - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- D. Manufacturer's installation instructions.

**1.04 Quality Assurance:**

- A. Installer Qualifications:
  - 1. Drilled-in anchors shall be installed by a contractor with at least three years of experience performing similar installations.
  - 2. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
  - 3. Submit installer qualifications as stated.
- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the contractor on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:
  - 1. Hole drilling procedure
  - 2. Preparation & cleaning technique
  - 3. Adhesive injection technique & dispenser training / maintenance
  - 4. Rebar dowel preparation and installation

5. Proof loading/torquing

## **PART 2 - PRODUCTS**

### **2.01 Materials:**

#### **A. Fasteners and Anchors:**

1. Bolts and Studs: ASTM A307; ASTM A449 where “high strength” is indicated on the Drawings.
2. Carbon and Alloy Steel Nuts: ASTM A563.
3. Carbon Steel Washers: ASTM F436.
4. Carbon Steel Threaded Rod: ASTM A36; or ASTM A193 Grade B7; or ISO 898 Class 5.8.
5. Wedge Anchors: ASTM A510; or ASTM A108.
6. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
7. Stainless Steel Nuts: ASTM F594.
8. Zinc Plating: ASTM B633.
9. Hot-Dip Galvanizing: ASTM A153.
10. Metric Anchor Bolts, Screws, and Studs: ISO 898 Part 1.
11. Metric Anchor Nuts: EN 24033.
12. Metric Anchor Stainless Steel Bolts, Screws, and Studs: ISO 3506 Part 1.
13. Metric Anchor Stainless Steel Nuts: ISO 3506 Part 2.
14. Reinforcing Dowels: ASTM A615

### **2.02 Cast-In-Place Bolts:**

- A. Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform to ASTM A307, Grade A, and ASTM A449, ASTM A563, and ASTM F436, as applicable. Hot-dip galvanized bolts and studs including associated nuts and washers in accordance with ASTM A153.

### **2.03 Drilled-In Anchors:**

- A. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
  1. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and

minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

2. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
  - a) Hilti Kwik Bolt 3.
  - b) Hilti Kwik Bolt TZ (carbon steel and AISI Type 304 Stainless Steel).
- B. Screw Anchors: screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.
  1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8 $\mu$ m min.).
  2. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
    - a) Hilti Kwik-HUS-EZ.
    - b) Hilti Kwik-HUS EZ-I.
    - c) Hilti Kwik-HUS.
- C. Heavy Duty Metric Sleeve Anchors: Torque-controlled, exhibiting follow-up expansion under load, with provision for rotation prevention during installation. Type and size as indicated on Drawings.
  1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5 $\mu$ m min.).
  2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI Type 304 and Type 316 stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
  3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
    - a) Hilti HSL, HSLG, or HSLB.
    - b) Hilti HSL-3, HSL-3-G, or HSL-3-B (carbon steel).

- D. Heavy Duty Metric Undercut Anchors: Bearing-type. Installed anchor shall have a minimum tension bearing area in the concrete, measured as the horizontal projection of the bearing surface, not less than two times the net tensile area of the anchor bolt. The installed anchor shall exhibit a form fit between the bearing elements and the undercut in the concrete. Type and size as indicated on Drawings.
1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5 $\mu$ m min.).
  2. Exterior Use: As indicated on the Drawings, provide sherardized or stainless steel anchors. Sherardized anchors shall be manufactured from materials conforming to ISO 898 Part 1 and having corrosion resistance equivalent to ASTM A153 with sherardized dry diffusion zinc coating (50  $\mu$ m min.). Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI Type 316 stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
  3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
    - a) Hilti HDA.
- E. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.
1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) [or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038].
  2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
  3. Reinforcing dowels shall be A615 Grade 60.
  4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
    - a) Hilti HAS threaded rods with HIT-HY 200 Safe Set System using Hilti Hollow Drill Bit System for anchorage to concrete.

- b) Hilti HIT-Z anchor rods with HIT-HY 200 Safe Set System for anchorage to concrete.
  - c) Hilti HAS threaded rods with RE 500 SD Injection Adhesive Anchoring System for anchorage to concrete.
  - d) Hilti HAS threaded rods with RE 500 Injection Adhesive Anchoring System for anchorage to concrete.
- F. Capsule Anchors: Threaded steel rod, inserts and reinforcing dowels with 45 degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on Drawings.
- 1. Interior Use: Unless otherwise indicated on the Drawings, provide chisel-pointed carbon steel rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
  - 2. Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
  - 3. Reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.
  - 4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide the following:
    - a) Hilti HVA Adhesive System with HVU capsules.

### **PART 3 - EXECUTION**

#### **3.01 Installation:**

- A. Cast-In-Place Bolts: Use templates to locate bolts accurately and securely in formwork.
- B. Drilled-In Anchors:
  - 1. Drill holes with rotary impact hammer drills using carbide-tipped bits, hollow drill bit system, and or core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
    - a) Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.



- b) Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
  - c) Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
2. Perform anchor installation in accordance with manufacturer instructions.
  3. Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.
  4. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
  5. Capsule Anchors: Perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
  6. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

### 3.02 Repair Of Defective Work:

- A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, non-metallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

**3.03 Field Quality Control:**

- A. Testing: 10% of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If more than 10% of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.
1. Tension testing should be performed in accordance with ASTM E488.
  2. Torque shall be applied with a calibrated torque wrench.
  3. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed  $D/10$ , where  $D$  is the nominal anchor diameter.
- B. Minimum anchor embedment, proof loads and torques shall be as shown on the Drawings.

END OF SECTION 03250

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide cast-in-place concrete work as shown on the Drawings and as specified herein.

**1.03 Quality Assurance:**

- A. Pre-construction Meeting:

- 1. Arrange a pre-construction meeting with representatives of those involved with the concrete work and obtain consensus between the parties to achieve the best suited quality and workmanship for the various conditions of cast-in-place concrete for this project.

- B. Qualifications of Concrete Supervisor:

- 1. Appoint a competent person thoroughly familiar with the materials standards and specific requirements of this Section. Have this person present to direct and supervise while undertaking work governed by this Section.

- C. Codes and Standards:

- 1. Comply with CSA Standard A23.1, A23.2 and A23.3 – latest edition.
  - 2. Where provisions of pertinent codes and standards conflict with these Specifications or each other, comply with the more stringent provisions.

- D. Source Quality Control:

- 1. Qualifications of Concrete Supplier:

- a) Have concrete produced and delivered by a member of the Ready-Mix Concrete Association of Ontario holding a current Certificate of Conformance for Ready-Mix Concrete Production Facilities issued by the Association. Submit copy of Certificate to the Engineer.

- 2. Concrete Quality:

- a) Prior to any concrete operations, produce and evaluate concrete trial mixes in accordance with CSA-A23.1 Subsection 8.8.3. Evaluate the concrete workability, air content, finishability, setting time, temperature development, hardened air-void parameters, strength, shrinkage characteristics, and durability. Provide copies of test results to the Engineer.

- E. Field Quality Control:

- 1. Compressive Strength:

- a) Cast and cure a minimum of one concrete cylinder test specimen in accordance with CSA A23.2-3C for each:
    - i. 100m<sup>3</sup> of concrete placed
    - ii. Day of concreting operation
    - iii. Class of concrete placed
  - b) Conduct compressive strength testing on test specimens in accordance with CSA A23.2-9C.
2. Slump:
- a) Perform a concrete slump test in accordance with CSA A23.2-5C each time a compressive strength test is cast.
3. Finishing:
- a) Reference Samples – Formed Surface Finishes:
    - i. Cast site reference panels as described in CSA A23.1, Subsection 7.10.2 for review by the Engineer, for each of the concrete finishes as specified by design. The reference samples will be used as a basis to determine the level of quality of the concrete finish that concrete work within the project shall adhere to.
    - ii. The reference sample may be cast integrally within the concrete work to be performed. The location of such reference panel shall be agreed upon in the pre-construction meeting with the Engineer.
  - b) For special architectural finishes provide mock-up panels as described in in CSA A23.1, Subsection 8.3.3.

#### 1.04 Submittals:

##### A. Shop Drawings for Construction Joints:

1. Submit shop drawings showing locations of proposed construction joints and sequence of construction.

##### B. Mix Design:

1. Submit to the Engineer for review, mix designs for the various strengths of concrete required. Refer to the Table of Concrete Performance in this section.
2. Identify the type and source of raw materials used in the production of the concrete, including cement, water, fine and coarse aggregates, and admixtures on the mix design form.

##### C. Test Reports:

1. Submit the following test reports:

- a) Soundness - MTO LS-606
- b) Silt & Clay - CSA A23.2-3A
- c) Organic Impurities - MTO LS-610
- d) Sieve Analysis - MTO LS-602
- e) Fineness Modulus - ASTM C33
- f) Alkali - Aggregate Reaction - CSA A23.1 Annex B
- g) Cement - CSA A3001

D. Certificates:

- 1. Submit Certificate of Conformance for Ready-Mix Facilities.

E. Job Conditions:

- 1. Submit for review, details of materials and methods to be used during construction to meet the requirements the Job Conditions of this Section.

**1.05 Field Quality Control:**

A. Control of Slump:

- 1. Refer to Subsection 5.2.5.3.3 of CSA A23.1. Slump can be controlled on the job site by the addition of super-plasticizing admixtures only. Do not add water on site to increase slump. Record the amount of additional admixture added on the concrete delivery ticket.

B. Concrete Quality Control:

- 1. Be responsible for ensuring and demonstrating that the placed concrete meets the performance requirements specified.
- 2. Carry out sampling and testing in accordance with Section 4.4 of CSA A23.1.
- 3. When standard-cured cylinder test results fail to meet requirements set by such tests, Article 4.4.2.2.1.3, CSA A23.1 will apply, including the right to order the replacement of substandard concrete with concrete, meeting specification criteria. Bear the costs associated with failure to meet standard-cured cylinder test requirements including replacement of substandard concrete at the direction of the Engineer.

**1.06 Delivery, Storage and Handling:**

- A. Deliver ready-mix concrete in accordance with the requirements of CSA A23.1.

**1.07 Job Conditions:**

- A. Refer to CSA A23.1 for cold weather and hot weather requirements, and with the requirements outlined in Item 3.04 E - Curing and Protection of this Section.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Cement - CSA A3001, Type GU.
- B. Slag Cement - CSA A3001.
- C. Coarse Aggregate - CSA A23.1, non alkali-reactive.
- D. Fine Aggregate - CSA A23.1, non alkali-reactive.
- E. Aggregate Sources - Listed on the MTO Designated Sources of Materials list.
- F. Water: - Potable water free of deleterious substances.
- G. Admixtures - Air Entraining admixtures, Chemical admixtures, High Range Water Reducing admixtures and Mid Range Water Reducing admixtures, complying with requirements of CSA Standard A266.1 and manufactured by:
  - 1. BASF or,
  - 2. Grace Construction Products or,
  - 3. The Euclid Chemical Company
- H. Retardant Concrete
  - 1. Coating - Rugasol-S - As manufactured by Sika Chemical Corporation, or approved equal.
- I. Plastic, flexible elephant trunks - PVC Elephant Trunks, or equal.
- J. Curing Compound
  - 1. MasterKure by BASF.
  - 2. Clear Cure (solvent-based) by CPD Construction Products.
- K. Waterstops:
  - 1. Expansion Joints:
    - a) Sika Greenstreak PVC Waterstop.
    - b) Type 7C by Durajoint Concrete Accessories.
  - 2. Construction Joints:
    - a) Sika Greenstreak PVC Waterstop.
    - b) Type 5 by Durajoint Construction Accessories.
  - 3. Use prefabricated tees and crosses for intersections in waterstop.

## L. Joint Filler:

1. CERAMAR flexible foam expansion joint filler 20mm thick by W.R. Meadows of Canada

**2.02 Manufacture:**

- A. Concrete manufacturing to comply with CSA A23.1.

**2.03 Mixes:**

## A. Concrete Mixes:

1. Proportion concrete mix, in accordance with Alternative 1, Table 5 of CSA A23.1.
2. Produce concrete for walls and slabs with low shrinkage characteristics in accordance with CSA A23.1, Section 8.8. Limit shrinkage after 28 days to 0.040%.
3. Provide proof that the mix proportioning will result in meeting the requirements of the shrinkage limitation.
4. Adjustments made to the reviewed mix designs are subject to further review by the Engineer.

## B. Table of Concrete Performance:

1. Proportion normal density concrete to CSA A23.1, to give the following performance specified hereinafter in the Table of Concrete Performance.
2. Be responsible for designing and adjusting the concrete mix to suit placement procedures. Concrete mixes must still achieve the performance requirements outlined herein regardless of the method of placement being utilized.

**Table of Concrete Performance**

Mix Type	Mix. 1	Mix. 2	Mix. 3	Mix. 4	Mix. 5
Concrete Location	Columns & walls	Structural slabs	Curbs, & side walks	Topping & benching	Fill concrete
Min. Compressive Strength at 28 <sup>(1)</sup> days (MPa)	35	35	32	32	15
Exposure Class – except as otherwise noted on the drawings	C-1	C-1	C-2	C-2	N
Durability Requirement – Slag Cement Content (% of total Cementing Materials)	30%	30%	30%	30%	50%
Shrinkage Limit	0.04%	0.04%	N/A	N/A	N/A

<sup>(1)</sup> Specified Compressive Strength may be achieved at 56 days, if permitted, prior to concrete placement.

**PART 3 - EXECUTION****3.01 Examination:**

## A. Inspection:

1. Prior to the work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where concrete work may properly commence.
2. Verify that concrete will be placed in strict accordance design, pertinent codes and regulations, and the reviewed shop drawings.

**3.02 Waterstops:**

- A. Install waterstops in concrete joints in water retaining and below grade structures.
- B. Secure waterstop to reinforcing steel to prevent movement during concrete placing.
- C. Have a representative of the waterstop manufacturer supervise the initial installation and joint splicing to ensure conformity with installation requirements of the waterstop manufacturer.
- D. Joints in waterstop to be heat welded. Do not overlap waterstops.

**3.03 Preparation:**

- A. Do not start placing concrete until the Engineer has reviewed forms, foundations, reinforcing steel placement, concrete cover, expansion joints, construction joints, waterstop, and has reviewed the availability and suitability of equipment for conveying, spreading, consolidation, finishing and curing methods, and the measures needed for the proper protection of the placed concrete from the weather.

**3.04 Construction:**

## A. Placing:

Refer to Section 7.5 of CSA A23.1, and as follows:

1. Use plastic flexible elephant trunks to confine concrete to within 1.5 metres or less of the concrete in place.
2. Do not place concrete under water except where specified or permitted in writing by the Engineer.

## B. Construction Joints:

1. Form construction joints at locations required by design and on the reviewed shop drawings. Obtain the permission of the Engineer for additional construction joints deemed necessary for placing operations. Provide waterstops as specified.
2. Maximum spacing of construction joints in slabs and walls: 12 metres.
3. Treat the bond faces of construction joints as follows:



- a) Vertical Construction Joints:
  - i. Thoroughly clean and roughen surface of concrete to remove laitance.
- b) Horizontal Construction Joints:
  - i. Treat surface of the concrete with one of the following treatments:
    - Treatment as specified for vertical construction joints.
    - Treatment of bond faces with a retardant concrete coating. Remove the retarded surface mortar with a jet of water when the base concrete has firmly set.
  - ii. Before concrete installation is resumed, place a 60 mm layer of concrete without course aggregate over the entire bonding face of horizontal joints.

C. Tolerances for position of finished concrete elements:

1. Refer to Subsection 6.4.6 & Table 15 of CSA A23.1, and comply with the following:
  - a) Exposed concrete surfaces, variation from line and grade 1:600 12 mm max.
  - b) Exposed concrete surfaces, abrupt irregularities 3 mm max.
  - c) Buried concrete surfaces, deviation from line and grade 20 mm max.
  - d) Variations in cross-section dimensions of beams, slabs, walls, columns, etc. 8 mm max.
2. Where surfaces deviate from established lines and grades in excess of tolerances specified herein, correct deficiencies by grinding or by total replacement. Correction by patching or building up methods will not be allowed.

D. Concrete Finishing:

1. Finish formed & unformed concrete as specified in the Schedule of Concrete Finishes below.
2. Apply concrete floor sealer to interior floors not designated to receive other floor finish/treatment as specified in Section 03346 or otherwise indicated on the drawings.
3. Patch holes left from form ties and defects in the concrete that are beyond the acceptable level as agreed upon in the reference sample as specified hereinbefore.
4. Prepare and finish concrete surfaces to receive waterproofing in accordance with waterproofing manufacturer's instructions.

**Schedule of Concrete Finishes**

<b>Unformed Surfaces</b>	<b>Concrete Finish</b>	<b>CSA A23.1 – Reference Section</b>
Exterior slabs & walkways	Swirl-trowel finish or trowel finish plus fine brooming	7.7.6 (c) or (d)
Interior slabs	Hard, smooth dense trowel finish free from blemishes	7.7.4.3.1
Top of walls	Swirl-trowel finish or trowel finish plus fine brooming	7.7.6 (c) or (d)
Tank base	Hard, smooth dense trowel finish free from blemishes	7.7.4.3.1
<b>Formed Surfaces</b>	<b>Concrete Finish</b>	<b>CSA A23.1 – Reference Section</b>
Interior walls of fluid containing structures	Smooth-rubbed finish	7.10.4.2
Surfaces to be painted	Smooth-rubbed finish	7.10.4.2
Other formed surfaces	Smooth-form finish	7.10.2.6

**E. Curing and Protection:**

1. Refer to Section 7.6 and 7.8 of CSA A23.1.
2. As soon as the concrete is hardened and while the forms are still in place, loosen form ties and apply water to run inside the form to keep the concrete wet. After form removal, continue curing by water spray or water saturated fabric.
3. As an alternative to water curing, curing compounds may be used on exterior concrete slab surfaces provided:
  - a) finishing work is complete and the compound is compatible with the finish, and
  - b) no bonded topping or paint to be applied to the concrete surface.
4. Cure continuous for a total of seven (7) days at 10°C or for the cure time necessary to attain 70% of the minimum specified compressive strength.
5. Provide adequate winter protection to concrete structures. Prevent frost damage to concrete or sub grade. Provide details for the Engineer's review.
6. Provide adequate cover and/or wind breaks in hot weather conditions to prevent excessive evaporation of water in the concrete.

END OF SECTION 03300

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide sealer on all interior concrete floors not specified to receive other floor finish/treatments.

**1.03 Quality Assurance:**

- A. Qualification:
  - 1. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.

**1.04 Reference Standards:**

- A. Concrete floor finishing work in accordance with CSA-A23.1 except where specified otherwise.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Chemical Hardener: one-component liquid sodium silicate surface densifier.

**2.02 Acceptable Manufacturers:**

- A. First Named: Sikafloor 3S
- B. Acceptable Alternate: Eucosil by Euclid Chemical Canada

**PART 3 - EXECUTION****3.01 Floor Finish:**

- A. Concrete surface must be clean and sound. Remove dust, laitance, grease, oil, dirt, and curing agents.
- B. Apply floor hardener at rate of 4-5 m<sup>2</sup>/L to manufacturer's instructions. Cure to manufacturers recommendations (min. 4 – 6 hours).

**3.02 Application:**

- A. Apply directly from container, undiluted uniform coating at the rate of 4-5 m<sup>2</sup>/L. Brush material into the surface with a stiff-bristle floor-scrubbing machine until the product begins to gel.

- B. Wet material lightly with a water spray and rework into the concrete surface for 10-20 min. Rinse the floor and remove excess material with a squeegee and wet vacuum.
- C. Allow first coat to cure and install a second application. Second application installed min. 2 hours following the first application.

**3.03 Clean-up:**

- A. Wash off over-spray from glass, aluminum, or polished surfaces with water to avoid etching of surfaces. Do not allow floor sealer to dry before flushing excess from surfaces.

END OF SECTION 03346

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide non-shrink grout, mortar and concrete as shown on the Drawings and specified herein.

**1.03 Related Work:**

- A. Cast-in Place Concrete - Section 03300

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Proprietary non-shrink grout:
  - 1. IN-PAKT Pre-Mix by C.C. Chemicals Limited.
  - 2. Non-shrink Construction Grout (Pre-mixed) by CPD or approved equal.
- B. Aggregates – comply with material requirements of Section 03300.

**PART 3 - EXECUTION****3.01 Preparation:**

- A. Thoroughly roughen and clean surfaces of all laitance and dirt. Moisten immediately before placing grout.

**3.02 Proportioning:**

- A. Comply with manufacturer's recommendations.

**3.03 Placing, Finishing, Curing and Protection:**

- A. Comply with Section 03300 and manufacturer's recommendations.
- B. Finish grout surfaces to match adjacent concrete surfaces, and as specified on the Drawings.

END OF SECTION 03372

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 03000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide all labor, equipment and materials necessary to complete the repair work for the patching and injection of deteriorated and/or cracked concrete in the floors, roof and/or walls, and as shown on the Drawings and specified herein.

**1.03 Codes and Standards:**

- A. NSF/ANSI 61 Drinking Water System Components

**1.04 Quality Assurance:**

- A. Work to be performed by a firm having not less than 5 years successful experience in comparable concrete repair projects, and employing personnel skilled in the restoration process and operations indicated.
- B. Prepare samples of a typical crack and patch repair. Demonstrate methods and quality of workmanship for the repairs.

**1.05 Submittals:**

- A. Submit manufacturer's technical data for each product indicated including instructions for their installation. Include test reports and certifications substantiating that products comply with requirements.
- B. Submit written program for each repair process including protection of surrounding material. Describe in detail the material, methods and equipment to be used for each phase of the restoration work.
- C. Submit NSF/ANSI 61 certification for products and repair materials in contact with potable water.

**1.06 Warranty:**

- A. Submit a 5-year guarantee for the materials and workmanship of this Section.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Obtain materials for patching and crack repairs from a single source manufacturer to ensure material compatibility, quality, color, texture and detailing.
- B. Flexible Polyurethane Grout:
  - 1. Use SikaFix PU for sealing cracks not to exposed to potable water.

2. Use SikaFix HH LV for sealing cracks exposed to potable water. Supply certification of conformance with NSF/ANSI 61.

C. Repair Mortars:

1. SikaTop 122 Plus for horizontal surfaces.
2. SikaTop 123 for vertical and overhead surfaces.
3. Compressive strength at 28 days greater than 40 MPa.
4. Bond strength to substrate greater than 9 MPa at 24 hours and 19 MPa at 28 days.
5. Rapid chloride permeability less than 500 Coulombs after 14 days.

D. Bonding Agents:

1. Use paste made of neat Portland cement and water as bonding agent.

### **PART 3 - EXECUTION**

#### **3.01 Delivery, Storage and Handling:**

- A. Deliver materials to site in manufacturer's original unopened containers and packaging, bearing labels as to type and names of products and manufacturers.

#### **3.02 Site Conditions:**

- A. Thoroughly ventilate spaces where materials containing volatile solvents are being used. Use forced air ventilation to thoroughly dissipate solvents for a minimum period of 72 hours to such time that the product is thoroughly cured.

#### **3.03 Inspection:**

- A. Report, in writing, any defects in previously prepared work, or unsatisfactory site conditions. Proceed with work under this section only when such defects have been entirely corrected.
- B. The repair material manufacturer's technical representative is to provide periodic inspections of work in progress. As a minimum, manufacturer's technical representative is to be present to review surface preparation prior to placing patching material and again when patching work is approximately 50% complete. A final inspection is to be performed upon substantial completion of work.

#### **3.04 Surface Preparation:**

A. Crack Repairs:

1. Flush debris and deleterious materials out of crack prior to injecting flexible polyurethane grout.
2. Rout out all visible cracks and remove all loose edges.

**B. Surface Repairs:**

1. Remove all deteriorated, cracked, unsound or damaged concrete.
2. Conform to repair mortars manufacturer's requirements for surface texture and preparation.
3. High pressure wash using min. 4,000 to 6000 psi (28 MPa) to thoroughly clean the entire area to be repaired, patched and/or coated.

**3.05 Installation of Flexible Polyurethane Grout:**

- A. Conform to manufacturer's written instructions for installation of flexible polyurethane grout.
- B. Use injection ports inclined to intersect crack. Grind injection ports flush with concrete surface upon completion of crack injection.
- C. Remove excess flexible polyurethane grout from exposed surfaces.

**3.06 Installation of Repair Mortar:**

- A. Conform to manufacturer's written instructions for installation of repair mortar.
- B. Extend repair mortar with 10 mm pea gravel aggregate for patches greater than 38 mm in thickness, but do not exceed 100 mm in a single lift.
- C. Blend surfaces of patch with surface of existing concrete's finished surface with a smooth steel trowel or broom finish when existing surface is non-slip.
- D. Wet cure patches for a minimum of 7 days.

**3.07 Cleaning:**

- A. Clean-up:
  1. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION 03500



**DIVISION 4**

**MASONRY**

**INDEX**

SECTIONS

- Section 04000 – Masonry
- Section 04050 – Masonry Procedures
- Section 04100 – Masonry Mortar and Grout
- Section 04200 – Unit Masonry

END OF INDEX DIVISION 4

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Work Included:**

- A. The work covered by this Section includes, but is not necessarily limited to, the following:
- B. General masonry procedures and practices, concrete block, architectural concrete block/calcium silicate architectural blocks, clay brick masonry, reinforcing mortars and other related work.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Comply with product requirements outlined in the Standard Sections, and/or as specified on the Drawings. Select all other materials, not specifically described but required for the proper completion of work under this Division, subject to review of the Engineer.

**PART 3 - EXECUTION****3.01 General:**

- A. Comply with execution requirements outlined in the specification Sections, and/or as specified on the Drawings.

END OF SECTION 04000.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 04000 applies to and governs the work of this Section.

**1.02 Related Work:**

- A. Quality Control - Section 01400
- B. Cast-in-Place Concrete - Section 03300

**1.03 References:**

- A. CSA-A179-14 Mortar and Grout for Unit Masonry.
- B. CSA-A371-14 Masonry Construction for Buildings.

**1.04 Job Mock-Up:**

- A. Submit mock-ups in accordance with Section 01400 – Quality Control.
- B. Construct mock-up panel of exterior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar and workmanship.

**1.05 Source Quality Control:**

- A. Submit laboratory test reports certifying compliance of masonry units and mortar ingredients with specification requirements.
- B. For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption for units proposed for use.

**1.06 Samples:**

- A. Submit samples:
  - 1. Two of each type of masonry unit specified.
  - 2. One of each type of masonry accessory specified.
  - 3. One of each type of masonry reinforcement and tie proposed for use.
  - 4. Items required for testing purposes.

**1.07 Product Delivery, Storage and Handling:**

- A. Deliver materials to job site in dry condition.
- B. Keep materials dry until use, except where wetting of bricks is specified.

- C. Store under waterproof cover on pallets or plank platforms held off ground by means of timber planks or skids.

**1.08 Cold Weather Requirements:**

- A. Maintain temperature of mortar between 5°C and 35°C.

**1.09 Hot Weather Requirements:**

- A. Protect masonry from drying too rapidly by damp curing.

**1.10 Protection:**

- A. Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
- B. Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- C. Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Masonry materials are specified in related specifications sections.

**PART 3 - EXECUTION****3.01 Workmanship:**

- A. Conduct masonry work in accordance with CSA-A371-14.
- B. Build masonry plumb, level, and true to line, with vertical joints in alignment.
- C. Layout coursing and bond to achieve correct coursing heights, continuity of bond above and below openings.

**3.02 Tolerances:**

- A. Conform to tolerances in notes to Clause 5.3 of CSA-A371-14.

**3.03 Exposed Masonry:**

- A. Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

**3.04 Jointing:**

- A. Match existing.

- B. Allow joints to set to thumb print hard, then tool with round jointer to provide smooth, compressed, uniformly concave joints where concave joints are indicated. Do not over tool.
- C. Allow joints to set to thumb print hard, then rake joints uniformly and compress with square tool to provide smooth, compressed, raked joints of uniform depth where raked joints are indicated.
- D. Strike flush all joints in walls and joints in particular interior walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.

**3.05 Cutting:**

- A. Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.
- B. Make cuts straight, clean, and free from uneven edges.

**3.06 Building-In:**

- A. Build in items required to be built into masonry.
- B. Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- C. Brace door jambs to maintain alignment, vertical and horizontal. Fill spaces between jambs and masonry with mortar.

**3.07 Parging:**

- A. Apply parging in uniform coating not less than 10 mm thick, where indicated.

**3.08 Support of Loads:**

- A. Use 25 MPa concrete to Section 03300 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.
- B. Use grout to CSA A179 where grout is used in lieu of solid units.

**3.09 Provision for Movement:**

- A. Provide 3 mm space below stainless steel shelf angles.
- B. Provide 6 mm space between top of non-load bearing walls, partitions and structural elements. Do not use wedges.

**3.10 Loose Steel Lintels:**

- A. Install loose stainless-steel lintels. Centre lintels over opening width.

**3.11 Control Joints:**

- A. Provide continuous control joints (also refer to project drawings).

**3.12 Existing Work:**

- A. Make good existing work. As indicated in the project requirements /drawings and specifications Materials to match existing unless indicated otherwise.

**3.13 Testing:**

- A. Inspection and testing will be carried out by Testing Laboratory designated by Engineer.
- B. Cost of testing will be paid from cash allowance specified in Section 01400 - Quality Control.

END OF SECTION 04050.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 04000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Cementitious materials (Portland cement and lime), aggregates, colouring agents, additives and water.

**1.03 Reference Standards:**

## A. CSA standards:

- 1. A23.2-14 series - Methods of Test for Concrete;
- 2. A179-14 - Mortar and Grout for Unit Masonry;

## B. ASTM standards:

- 1. C 207-18 - Hydrated Lime for Masonry Purposes;
- 2. C 270-19a - Specification for Mortar for Unit Masonry.

## C. BIA standard (Brick Institute of America):

- 1. Technical Notes on Brick Construction No. 8A (1988)

## D. Standard Specifications for Portland Cement - Lime Mortar for Brick Masonry/ BIA Designation M 1

## E. National Building Code (NBC-2020) .1 Section 9.20 (loadbearing and non-loadbearing masonry); .2 Sections 9.20 and 9.22 (fireplaces and chimneys).

**1.04 Submittals – Product Data – Test Reports – Samples:**

- A. Submit three copies of the Technical Product Data Sheet/s of mortar mixture/s with related standard and mortar properties, compared descriptions, "standard/ mixture prepared in factory" in terms of compressive strength, water retention and air content; provide all test certificates required for mortar mixture lots delivered to the site and to be incorporated in the work.
- B. Submit three samples of each type of Mortar and of each colour specified by the Project Engineer; samples submitted in Transparent plastic extrusions, 12 mm x 12 mm x 100 mm length; identify each type of Mortar and the coloring agent/s contained in each extrusion.
- C. Submit Manufactures: Installation instructions.



**1.05 Laboratory Tests:**

- A. The Manufacturer of factory prepared and packaged dry components. Portland cement, hydrated lime [and coloring agents] to provide a certificate or Test Results concerning the lot(s) or part of lot from which the packaged materials originate; Tests shall have been carried in accordance with methods described in A179-14, article 8 and according to article 9 – Pre-qualification Tests and Acceptation Criteria of the same standard.

**1.06 Project/Site Conditions:**

- A. Cold weather masonry construction when daily temperature is:
1. Above 4°C: construct according to usual methods and cover walls with some plastic or canvas in order to prevent water penetration and wind action.
  2. Between 0°C and 4°C: heat the mixing water so that mortar temperature remains between 5° and 50°C until utilization. Cover walls and materials with some canvas or plastic in order to prevent them from wetting or freezing.
  3. Under 0°C: heat the mixing water so that mortar temperature remains between 5° and 50°C until utilization. Erect windbreaks when wind speed exceeds 25Km/h during construction. Cover the walls and materials with some plastic or canvas. Protect masonry against freezing, above 0°C, during at least 24 hours.
  4. Under -7°C: in addition to prescriptions listed in 1.6.1.1.3, heat masonry units to -7°C minimum.
- B. Place masonry elements on a dry surface and only use dry elements. Never wet the masonry elements unless specified otherwise or prescribed by the manufacturer.
- C. Hot weather masonry construction:
1. Cover the recently executed masonry works with a non-staining waterproof covering in order to prevent them from drying too rapidly.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Mortar and grout: Conform to CSA A179.
- B. Portland cement type 10, in accordance with CAN/CSA A3000-03.
- C. Hydrated lime type "S", in accordance with ASTM C207-19a.
- D. Mortar for use above grade: Type S, 0.5 parts Portland cement to 1 part masonry cement to 4 ± 0.5 parts sand, by volume.
- E. Mortar for use below grade: Type M, 1 part Portland cement to 1 part masonry cement to 5.5 ± 0.5 parts sand, by volume.
- F. Pigmented (Coloured) Mortar CSA A179M, Type S:

1. Elementis Pigment Co. Ltd. Colour selection subject to review by Architect/Engineer.
- G. Sand: fine grain aggregates, grading in accordance with A179-14; when 6 mm thick joints are specified, grains shall pass through a 1.18 mm sieve.
- H. Water: potable [clean, exempt of ice, oils, acids, alkalis, organic matter, sediments or any other harmful matter].
- I. Coloring pigments: pigments constituted of ground colored natural aggregates [or] [metallic oxide pigments], color by architect; the ratio of coloring agent/density of Portland cement shall not exceed 10%.
- J. Dirt resistant additives: aluminum tristearate, calcium stearate or ammonium stearate.

**2.02 Mortar Material Source:**

- A. All mortar types described below are based on material prepared by Daubois Inc. Any proposal for substitutes shall be forwarded to the Engineer for review with all required technical information (tests results, Technical Product Data Sheets).
  1. Cementitious materials, sand and coloring agent(s) shall be pre-mixed in factory and then mixed with water on site in order to obtain for each type of mortar the characteristics described in the manufacturer's Technical Product Data Sheet.

**2.03 Mortar for Exterior Masonry Work, Above Grade:**

- A. Loadbearing: Type S based on Proportion specifications.
- B. Non-loadbearing: Type N based on Proportion specifications.

**2.04 Mortar for Interior Masonry:**

- A. Loadbearing: type S, based on proportion specifications.
- B. Non-loadbearing: type N, based on proportion specifications.

**2.05 Grout for Reinforced Masonry:**

- A. 20 mPa.
- B. Grout: in accordance with properties descriptions stipulated in paragraph 7.2.3 of A179-14, having the required consistency and sufficient fluidity in order to completely fill in the cavities without excessive bleeding or segregation.

**2.06 Mortar for Brick Pointing:**

- A. Approved cement/lime/sand mix Type "O" "Restomix" based on Proportion specifications.

**2.07 Parging:**

- A. Parging mortar: Type S, conform to CSA A179.

**PART 3 - EXECUTION****3.01 Mixing:**

- A. Mortar mixes to be pre-blended to control colour and consistency devoid of contaminants.
- B. Do not use salt or antifreezes to thaw equipment.
- C. Prepare mortar(s) according to the instructions of the pre-mixed materials supplier concerning water/cementitious materials proportioning and sequencing of introduction in the mixture.
- D. Mix grout according to the instructions of A179-14.
- E. Total mixing time not less than three minutes or exceeding five minutes. Site coloured pigmented mortar mixing shall last 8 to 10 minutes to ensure the coloring agent's homogeneity within the mixture.
- F. Incorporate colour and admixtures into mixes in accordance with manufacturer's instructions.

**3.02 Mortar and Grout Laying Delay:**

- A. Mortar manufactured at the job site shall be used and placed in final position within 1.5 h after mixing when the air temperature is 25° C or higher and within 2.5 h after mixing when the air temperature is less than 25°C.
- B. Grout to be layed in place within 1-1/2 hour after mixing. Beyond this time limit, grout is to be discarded.

**3.03 Colour Uniformity:**

- A. In order to ensure the finished product's color uniformity, the contractor shall:
  - 1. Use water originating from the same source and use the same brand of binders and coloring agents throughout the entire project;
  - 2. Avoid adding water on site in order to modify mortar's workability or for tempering;
  - 3. Execute joint tooling within the same delay after the laying of mortar;
  - 4. Clean mixer thoroughly.

**3.04 Protection:**

- A. Partially completed masonry work shall be covered with waterproof and non-staining coverings that extend over walls and down sides sufficiently to protect from wind-driven rain until they are protected by flashings or other permanent construction.
- B. Protect masonry and adjacent work against damage. Protect finished work against mortar spattering. Use non-staining covers.
- C. Brace masonry work until lateral and permanent supporting work is complete.

**3.05 Cleaning:**

- A. Upon completion of the work, remove excess mortar. Once mortar has hardened sufficiently:
  - 1. Starting from the wall base bottom, dampen surface with clear water;
  - 2. Starting from the wall top, scrub with water and a stiff bristle hair brush;
  - 3. Rinse thoroughly with clear water as the cleaning work progresses.

NOTE: Acid not permitted.

END OF SECTION 04100.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 04000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide concrete block, architectural block, integral waterproofing, damp-proofing, installation of inserts, lintels, anchors for other trades and equipment, as shown on the drawings and specified herein.

**1.03 Related Work:**

- A. Masonry Mortar and Grout - Section 04100
- B. Calcium Silicate Stone Masonry - Section 04731
- C. Air/Vapour Barrier - Section 07195
- D. Building Insulation - Section 07200

**1.04 Quality Assurance:**

- A. Comply with the following CSA and ASTM standards:
  - 1. CSA A165.1 – Concrete Block Masonry Units.
  - 2. CSA A179 – Mortar and Grout for Unit Masonry.
  - 3. CSA A370 – Connectors for Masonry
  - 4. CSA A371 – Masonry Construction for Buildings
  - 5. CSA S304.1 --Masonry Design for Buildings
  - 6. Applicable codes and By-laws.
  - 7. ASTM A90 – Standard Test Method [MASS] for Coating on Zinc-Coated (Galvanized) Iron and Steel Articles with Zinc or Zinc-Alloy Coating.
  - 8. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on steel products.
  - 9. ASTM A580 – Standard Specification for Stainless Steel Wire.
  - 10. ASTM C568 – Standard Specification for Limestone Dimension Stone.
- B. Provide a copy of the latest edition of CSA A371 for reference during construction.
- C. Where provisions of pertinent codes and standards conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.

## D. Mock-ups:

1. Prior to proceeding with the work of this Section, construct a portion approximately 1 m<sup>2</sup> of each type of masonry wall to establish, for the Architect's review, the general construction and appearance of the masonry units.
2. Upon the Architect's review of the mock-ups, complete all required masonry construction in strict accordance with the standards reviewed in the mock-ups.
3. At acceptance of the completed work, remove mock-ups.

## E. Tolerances:

1. Build masonry true and plumb within the following tolerances:
  - a) Variation from true plane - 1:500
  - b) Variation from plumb - 1:500
  - c) Variation from plan position - 1:500, 20 mm max
  - d) Variation from grade - 1:500, 12 mm max

- F. The masonry contractor to demonstrate to the Engineer's satisfaction, they have executed at least three projects of similar size and complexity within the past five years.

**1.05 Submittals:**

## A. Samples:

1. Before any masonry materials are delivered to the job site, submit two (2) samples of each proposed masonry unit to the Architect for review.

## B. Certification:

1. Prior to delivery of concrete unit masonry to the job site, deliver to the Architect, a letter from the manufacturers of the concrete masonry units, certifying that all such units delivered to the job site are in strict conformance with the provisions of this Section of these Specifications.

## C. Cold Weather Requirements:

1. Submit to the Architect for review, a written submission indicating suitable precautions and methods of protection to be used for all masonry construction during winter months.

## D. Control Joint Schedule:

1. Submit to the Architect and Engineer for review, a written submission indicating locations and details for all control joints to be incorporated into the works.

**1.06 Delivery, Storage and Handling:**

- A. Deliver cement, lime, and mortar ingredients with manufacturers' seals and labels intact. Store on a dry floor in a weatherproof shed or room. Deliver mortar sand dry, and protect from elements and foreign matter.
- B. Deliver and handle masonry units by methods that will guard against soiling or chipping. Stockpile masonry units on platforms or other reviewed supports to keep units free from ground contact. Secure a waterproof covering entirely over each stockpile when masonry work is not in progress. Protect stockpiles at all times from weather, dirt and damage.
- C. Stained or chipped masonry units and other materials affected by inadequate protection shall be replaced.

**1.07 Job Conditions:**

- A. Store and install all materials so that they are protected from snow and ice and are free of all deleterious materials.
- B. When the air temperature is less than 5°C, heat sand and mixing water to produce mortar at a temperature of not less than 5°C or more than 45°C.
- C. When the air temperature is less than 5°C, enclose work and scaffolding in a weatherproof enclosure in which a minimum constant temperature of 5°C is maintained for 7 days after installation.
- D. Do not use any additives to lower the freezing point of mortar.
- E. Place masonry elements on a dry surface and only use dry elements. Never wet the masonry elements unless specified otherwise or prescribed by the manufacturer.
- F. Cover the top surface of all uncompleted masonry work exposed to the weather with waterproof covering, except when construction is in progress.
- G. During periods of hot dry weather, apply a very light fog spray during the first 24 hours after units are in place, for proper curing.
- H. Cover the recently executed masonry works with a non-staining waterproof covering in order to prevent rapid drying.

**1.08 Preparatory Meetings:**

- A. Convene a preparatory meeting one (1) week before the commencement of the work for this section.
- B. Require the presence of representatives from the inspection firms, the manufacturer, the installer and the parties which are directly affected by the work for this section.
- C. Review the installation conditions, the installation procedures and the coordination with the work of related sections.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Concrete Block
  - 1. Acceptable Manufacturers:
    - a) Richvale Block, Gormley, Ontario,
    - b) Brampton Brick, Brampton, Ontario
    - c) Permacon Ltd., Ontario Ltd.
- B. Hollow Concrete Block - H/15/A/M to CSA A165.1
- C. Solid Concrete Block - S/15/A/M to CSA A165.1
- D. Lightweight concrete block units to be manufactured with 83% recycled content.
- E. Exposed concrete block and other masonry units to receive a paint or special finish shall have smooth faces, no spalled or broken edges, corners or other imperfections on exposed faces. This supersedes Clause 8 – Visual Inspection of CSA A165.1.
- F. Include special units such as bullnose, square corners, jamb units, lintel units, base units, glass units, etc., for door openings, corners and as indicated on drawings.
- G. All blocks to be free of surface indentations, cracks or chipping. Do not install defective blocks.
- H. Masonry Portland Cement: CSA A3001
- I. Masonry Cement: CSA A3002
- J. Aggregates: CSA A82.56
- K. Hydrated Lime: CSA A82.43
- L. Water: Potable
- M. Reinforcing Steel: CSA G30.18, Grade 400, deformed.
- N. Masonry:
  - 1. Masonry construction – Conform to CAN/CSA S304 and A371.
  - 2. Concrete block to conform to CSA A165.1, with a min compressive strength of 12.5 MPa based on net area.
  - 3. Masonry mortar and grout – Refer to Section 04100.
  - 4. Concrete Grout (For reinforced load bearing masonry) – Refer to Section 04100 - Compressive strength of 20 MPa; Fill ALL masonry unit voids/cells. Grout may be



expanded with 10mm concrete aggregate in accordance with CSA A23.1 (Do not use masonry mortar).

5. All load bearing concrete block masonry to be reinforced as indicated on drawings and as described herein.
6. Provide minimum one course of solid masonry below all beams and lintels, minimum bearing length 200mm. provide a slip plane for the bearing at control joints.
7. Embed dowels and anchor bolts into masonry a minimum of 250 mm
8. Anchors into solid and grout filled block (cell) units - 'Hilti' - stainless steel, type Hilti HIT-HY 200.
9. Anchors into hollow block (cell) units - 'Hilti' - stainless steel, type Hilti HIT-HY 270 adhesive system with screen tubes.
10. Obtain the Engineer's permission for all openings/penetrations, sleeves and slots other than those shown on the structural drawings.
11. Provide lintels as specified on drawings, lintel schedule, over openings required for process, mechanical, and electrical, and where not shown on structural drawings.
12. No masonry work will be allowed when it is expected that the temperature will drop below 5°C within 48 hrs after laying, without acceptable heating in place.

O. Unit Masonry Reinforcement:

1. Concrete Block Substrate - (back-up walls) – horizontal reinforcement ladder type having two (or more) parallel rods 4.76mm diameter welded to 4.76mm cross rods forming a ladder design. Side rods notched or knurled. Design ladder reinforcement to suit concrete block width and to allow placement of side rod at the centre line of both face shells of the concrete block. Provide factory-fabricated units for corners and wall intersections.
2. Masonry joint reinforcing stainless steel-grade 304.
3. "Hohman & Barnard (H&B)" Extra heavy duty is an acceptable manufacturer. The following reinforcement to be used unless otherwise noted on the drawings:

a) Reinforcement for Non-Load Bearing Masonry Walls:

Non-load bearing block walls and composite walls to be reinforced horizontally with H&B masonry reinforcement as follows:

<u>Thickness</u>	<u>Description</u>	<u>Spacing</u>
140 mm	120 Truss Mesh	@ 400 mm
190 mm	120 Truss Mesh	@ 400 mm

240 mm                      130 Truss -Tr- Mesh    @ 400 mm

Vertical reinforcement is not required for non-load bearing walls unless noted otherwise on the project contract drawings.

b) Reinforcing for Load Bearing Masonry Walls and Shear Walls:

Load bearing concrete block walls and shear walls to be reinforced horizontally and vertically. For horizontal masonry reinforcement use 'Dur-O-Wall' as follows:

<u>Thickness</u>	<u>Description</u>	<u>Spacing</u>
190 mm	140 Truss Twin-Mesh	@ 400 mm
240 mm	240 Ladder Twin-Mesh	@ 400 mm
290 mm	240 Ladder Twin-Mesh	@ 200 mm

c) Provide 15M @ 600 vertical reinforcement unless shown otherwise on the drawings. Grout all voids in unit masonry solid with concrete grout.

- P. Control Joint Materials: “Hohman & Barnardl” Rapid Control Joint, control joint filler: purpose-made elastomeric durometer; hardness to ASTM D2240 of size and shape indicated.
- Q. Nailing inserts: 0.6 mm thick purpose-made stainless steel inserts for setting in mortar joints.
- R. Masonry flashing: Refer to Section 04150 – Masonry Accessories.
- S. Damp-proofing course, thru-wall flashing materials, and flashing mortar deflection mesh units: Refer to Section 04150 - Masonry Accessories.
- T. Air Vapour Barrier: Refer to Section 07195.
- U. Wall Insulation: Dow ‘SM’ extruded polystyrene, refer to Section 07200 - Building Insulation
- V. Masonry Weep / Vent-Hole Units: Williams-Goodco Units, injection moulded, constructed from polyvinyl chloride compound in an offset “T” shape.
- W. Masonry Cleaning Solution: As reviewed by the Project Engineer.

**2.02 Mortar:**

- A. Mortar and grout in accordance with Section 04100.

**PART 3 - EXECUTION****3.01 Examination:**

- A. Do not start operations without examining existing related works for any conflict with work done under this Division.
- B. Coordinate with mechanical and electrical sub-trades where this affects masonry work.

**3.02 Preparation:**

- A. Establish line levels and coursing and protect from disturbances.
  - 1. Prepare for building-in of all items whether supplied and installed by others or installed under this Section.
- B. Mixing Mortar:
  - 1. Mix in watertight, mechanical mixers. Measure ingredients accurately by volume. Add water as required for plasticity. Operate mixer at least 5 minutes or until all materials are homogeneously blended, then dump. Clean the mixer after each batch.
  - 2. Mix quantities of mortar, which can be used up within one hour. Work mortar over constantly with hoe and shovel until used up. Do not re-temper or use in any way, any mortar that has set.

**3.03 Installation:**

- A. General:
  - 1. Provide minimum bearing length of 200 mm for all lintels and beams and provide a slip plane for the bearing at control joints.
  - 2. Embed dowels and anchor bolts a minimum of 200mm into solid masonry.
  - 3. Obtain the Engineer's permission for all openings, sleeves and slots other than those shown on the structural drawings.
  - 4. Provide lintels as specified in the lintel schedule over all openings including those required for Process, Mechanical and Electrical not shown on structural drawings.
  - 5. No Masonry work allowed when it is expected temperature will drop below 5°C within 48 hrs, without acceptable protection in place.
  - 6. Lay all Masonry true to line, straight and plumb to the tolerances specified. Lay Masonry from face side. Check regularly with graduated rod.
  - 7. Solidly shore all lintels and steel spandrel or other beams supporting masonry above, before laying any masonry on them. Maintain shoring in place for not less than 10 days.

8. Do not lay more than 1600 mm in height of any wall in any one working day. Do not raise any part more than 600 mm above remainder at any one time.
9. Cut masonry accurately to fit snugly around pipes, conduit and ducts. Fill solidly and finish neatly all spaces around such work.
10. Adjust opening to present uniform appearance with minimum of cut units.
11. Coordinate with, mechanical, electrical and all other involved sub-trades where the work affects masonry work.

B. Installing Unit Masonry:

1. Lay blocks in running bond unless otherwise indicated on the drawings.
2. Lay solid units with full head and bed joints.
3. Lay first course of all block walls in a full mortar bed.
4. Lay hollow units, except first course, with face shell head and bed joints. In addition, lay the webs in a full bed in all courses of piers, columns and pilasters, and where adjacent to cells or cavities that are to be reinforced or filled with grout or concrete.
5. Defective and broken units shall be rejected.
6. For exposed plain and decorative blocks provide tooled concave joints.

C. Masonry Reinforcement:

1. Install Masonry connectors and reinforcement in accordance with CSA-A370 and CAN3-A371.
2. Install Masonry reinforcing in accordance with details shown on the Drawings, and as specified herein.
3. Comply with CSA-A371 for vertically reinforced grouted Masonry.
4. Install horizontal Masonry reinforcing in two consecutive block courses above and below openings in walls, extending not less than 900 mm each side of opening.
5. Install Masonry reinforcing in the first two block courses and in every second block course thereafter.
6. Install Masonry stainless steel veneer ties and shear block ties in accordance with CSA-A370 and CSA-371, unless indicated otherwise.
7. Install Masonry stainless steel veneer shear block ties and block connectors in the first and third block courses from the bottom and top of the wall, and in between every third block courses in between; and spaced horizontally at 800

mm o.c. – all in accordance with Fero Corporation manufacturer's recommendations.

8. Splice in horizontal joint reinforcement shall be lapped 150 mm minimum and fully embedded in mortar.

D. Lintels:

1. Provide lintel blocks over all concrete Masonry openings, except where steel lintels or bond beams are specified on the Drawings. Reinforce lintel blocks with 2-15M reinforcing bars embedded in 20 MPa concrete for the full height of one block course or as indicated in the drawings.

E. Air/vapor barrier: Refer to Section 04150 – Masonry Accessories.

1. Treat Masonry walls clean of all loose mortar and dust, left completely dry.
2. Trowel apply sealing seams at laps and masonry anchors.

F. Control Joints:

1. Provide control joints in Masonry in locations specified herein and as shown on the drawings. Locate control joints at intersecting non-load bearing walls, where non-load bearing walls abut load bearing walls, where walls abut vertical structural elements, and in continuous walls at a spacing of not more than 8 metres.

G. Damp-proof Course/Flashing:

1. Install damp-proof course or flashing as detailed on the Drawings and as follows:
  - a) Through exterior walls, completely around perimeter of building at top of foundation walls on one block course above grade.
  - b) Over heads of openings in exterior masonry walls extending to the top edge of steel lintels or up to at least one block course, whichever is the greater.
  - c) Extend flashing to the exterior face of the wall and to within 13 mm of interior face of wall. The flashing shall be to the full width of lintels plus 150 mm at either end, and lapped a minimum of 200 mm all joints. Seal laps with adhesive.

H. Other Requirements:

1. Do not tap or shift units after mortar has taken initial set.
2. Take special care to prevent mortar and other substances from staining exposed Masonry work or falling into cavity.
3. Make provision for cleaning out base of cavity upon completion.
4. Form exposed corners with bullnose units.

5. Install metal door frame in accordance with manufacturers' instructions to present a rigid, true, plumb installation. Fill space between hollow metal frames and masonry walls with mortar.
  6. Extend masonry partitions to underside of slab, deck, or structural member above and secure thereto by approved method.
  7. Lay one course of solid block along the top of all exterior and interior load bearing walls.
  8. Co-operate with other trades in the setting of buried conduits, plumbing, piping, anchor bolts, lintels, recesses, inserts, etc.
- I. Protection:
1. Protect the tops of all unfinished walls with weatherproof coverings at the end of each day's work, or upon stoppage of the work for any reason.
  2. Provide temporary support and bracing to all walls during construction to prevent damage due to wind load.
- J. Cleaning Masonry:
1. Surplus mortar to be removed immediately from floors, walls and other locations.
  2. At completion of pointing, remove all rubbish and surplus material and brush and clean all masonry with water and stiff fibre brush.
  3. If further cleaning of Masonry surfaces is required, follow recommendations of masonry manufacturer and treat a sample area of masonry for Engineer's review before proceeding with cleaning of all surfaces.
- K. Clean-up:
1. Throughout operations, keep the site clean and free of unnecessary debris. Upon completion of Masonry work, and before final acceptance, remove all falsework, rubbish and temporary buildings associated with masonry work.

END OF SECTION 04200.

**DIVISION 5**

**METALS**

**INDEX**

SECTIONS

Section 05000 – Metals  
Section 05120 – Structural Steel  
Section 05310 – Steel Deck  
Section 05500 – Metal Fabrications  
Section 05501 – Anchor Bolts  
Section 05502 – Miscellaneous Metal Fabrications  
Section 05512 – Metal Stairs  
Section 05521 – Metal Guardrails  
Section 05530 – Metal Gratings and Floor Plates

END OF INDEX DIVISION 5



**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern each Section of this Division.

**1.02 Work Included:**

- A. Fabrication, supply and installation of all loose and fabricated metal items.
- B. The protection of metalwork as specified, including shop and field painting, hot-dipped galvanizing, anodizing, and protective coatings.
- C. All shop and field cutting and connections as specified, including riveting, bolting and welding and the provision of holes and inserts for the installation of other work.
- D. Provide materials, products, accessories, and supplementary parts necessary to complete the assembly and installation of Work of this Division.

**1.03 General Requirements:**

- A. Conform to CSA S16, and the CISC Code of Standard Practice for steel design, fabrication, and construction.
- B. Conform to CSA S157 for aluminum design, fabrication, and construction.
- C. Coordinate work described in this Division with the Engineer, independent inspection, and testing agencies.

**1.04 Reference Standards:**

- A. Comply with the following versions, or where omitted the latest version, of the Codes and Standards for the work of this Division:
  - 1. Ontario Building Code 2012, including all amendments.
  - 2. CSA S16-19, Design of Steel Structures
  - 3. CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
  - 4. CAN/CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members
  - 5. CSA S157/S157.1-17 - Strength Design in Aluminum
  - 6. CSA W47.1, Certification of Companies for Fusion Welding of Steel
  - 7. CSA-W47.2 - Certification of Companies for Fusion Welding of Aluminum

8. CSA W48, Filler Metals and Allied Materials for Metal Arc Welding
9. CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum
10. CSA W59, Welded Steel Construction (Metal Arc Welding)
11. CSA-W59.2 - Welded Aluminum Construction
12. CSA W178.1, Certification of Welding Inspection Organizations
13. CSA W178.2, Certification of Welding Inspections
14. CISC/CPMA Standard 2-75, A Quick-drying Primer for Use on Structural Steel.
15. Canadian Institute of Steel Construction (CISC) Code of Standard Practice for Structural Steel
16. ANSI/NAAMM MBG 531, Metal Bar Grating Manual
17. ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
18. ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
19. ASTM A325/A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)
20. ASTM A570, Standard Specification for Hot Rolled Carbon Steel Sheet and Strip, Structural Quality
21. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
22. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
23. ASTM B 308/B 308M - Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
24. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
25. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
26. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire

27. ASTM B221/B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
  28. ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  29. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  30. ASTM A780/A780M Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
  31. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  32. ASTM A992/A992M, Standard Specification for Structural Steel Shapes
  33. ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
  34. SSPC, Standards of the Society for Protective Coatings
- B. Where provisions of pertinent Codes and Standards conflict with the Specifications and/or project drawings, comply with the more stringent provisions.

#### 1.05 Quality Assurance:

- A. Perform all work in this Division in accordance with the applicable versions of the codes and standards referenced within this specification section.
- B. Qualification:
1. The fabricator and installer/erector shall have a minimum of five (5) years proven experience in the specified type of work. Submit proof of qualifications upon request.
- C. Welding:
1. Welding companies to be certified by the Canadian Welding Bureau under the requirements of CSA W47.1 (steel) and W47.2 (aluminum).
  2. Submit proof of welding certification upon request.
- D. Design connections or other components of the work that are not detailed on the drawings under direct supervision of a Professional Engineer experienced in design of this work.
- E. Corroded, bent, warped or otherwise damaged and defective metal components will not be accepted and are to be replaced at no additional to the Owner.

**PART 2 - PRODUCTS****2.01 Materials:**

## A. General:

1. Use new materials and grades of metals and alloys to suit their application.
2. All materials under Work of this Division, including but not limited to, primers and paints are to have low VOC content limits.
3. Incorporate only metals that are free from defects that impair strength, durability, or appearance.
4. Install only new high-quality metals that are free from corrosion, waviness and buckles, and that are clean, straight, and with sharp defined profiles.

## B. Unless specified elsewhere, use the following materials for all Work of this Division:

## 1. Structural Steel:

- a) Rolled sections: CSA G40.20/G40.21 Grade 350W
- b) Hollow Structural Sections: CSA G40.20/G40.21, Class C, Grade 350W
- c) Angles and plates: CSA G40.20/G40.21, Grade 300W
- d) Structural pipe: ASTM A53, Grade B (seamless)
- e) Shear Stud Connectors: ASTM A108, 450 MPa minimum ultimate strength.
- f) Bolts: High strength bolts: ASTM A325
- g) Anchor rods: ASTM F1554 Grade 55, galvanized.
- h) Welding materials: Filler metals, rods, and electrodes for welding shall be stored and selected to match the base material in accordance with the requirements of CSA W59.

## 2. Miscellaneous Steel:

- a) Steel sections and plate: CSA G40.20/G40.21, Grade 300W
- b) Anchor rods: ASTM F1554 Grade 36, galvanized.
- c) Bolts: Carbon steel bolts: ASTM A307

- d) Welding materials: Filler metals, rods, and electrodes for welding shall be stored and selected to match the base material in accordance with the requirements of CSA W59.
3. Stainless Steel:
- a) Flat Plates – ASTM A240/240M, Type 316L
  - b) Angles – ASTM A276/276M, Type 316L
  - c) Hollow Tubes – ASTM A554, Type 316L
  - d) Bolts: ASTM F593 and F594, Group 2, Type 316
  - e) Anchor bolts: ASTM A320, Type 316
  - f) Welding Materials: Filler metals, rods, and electrodes for welding shall be stored and selected to match the base material in accordance with the requirements of AWS D1.6
4. Aluminum:
- a) Structural Aluminum channel, plate and angle: ASTM B 308, alloy 6061-T6.
  - b) Extruded Aluminum: ASTM B221/B221M, alloy 6061-T6.
  - c) Sheet Aluminum: ASTM B209/B209M, alloy 6061-T6.
  - d) Drawn Seamless Tubes: ASTM B210/B210M, alloy 6061-T6.
  - e) Bolts: ASTM F593 and F594, Group 2, Type 316
  - f) Anchor bolts: ASTM A320, Type 316
  - g) Welding Materials: Filler metals, rods, and electrodes for welding shall be stored and selected to match the base material in accordance with the requirements of CSA W59.2.
5. Cast Iron:
- a) Frames & Grates: OPSS.PROV 1850
6. Nuts and washers: To be of the same material, grade, and finish as the bolt/anchor unless otherwise specified.

## 2.02 Protective Coatings

- A. Where indicated on the drawings or in the specifications, use the following protective coatings for metals unless otherwise specified in Division 9:

## B. Galvanizing:

- a) Structural steel and steel fabrications:
  - i. Fabrications to have vent holes, drain holes, and welding details in accordance with ASTM A385/A385M.
  - ii. Hot-dip galvanize assemblies after fabrication in accordance with ASTM A123/123M.
- b) Hardware and fasteners: ASTM A153/A153M.
- c) Reinforcing steel bars: ASTM A767/A767M.
- d) Sheet Steel: ASTM A653/A653M.
- e) Hot Dip Galvanizing Repair: ASTM A780/A780M
  - i. The minimum average zinc coating thickness to meet or exceed 85 microns or an equivalent coating weight of 600 g/m<sup>2</sup>.

## C. Anodizing:

- a) Anodizing shall be Architectural Class 1 Anodic Coating 0.018 mm thickness, conforming to AA-C22A41.

## D. Painting:

- a) Steel Shop Paint:
  - i. Standard one coat primer CISC/CPMA Standard 2-75, unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, and grease.
  - ii. Do not paint when temperature is lower than 7°C.
  - iii. Clean surfaces to be field welded, do not paint.
  - iv. Apply paint under cover. Keep painted members under cover until paint has dried to the touch. Steel to be dry when painted and paint to be dry before loading for shipment.
  - v. Prepare paint material in accordance with paint manufacturer's published instructions. Comply with paint manufacturer's recommendations relative to equipment and application techniques.
  - vi. Apply one shop coat of paint, to a dry film thickness of 1.5 to 2.5 mils.
  - vii. Thoroughly work paint into all joints and open surfaces.

- viii. For shop coat and field touch-up: Clean and prepare surfaces in accordance with CISC/CPMA Standard 2-75.
  - ix. Use power tool cleaning to SSPC-SP3 unless otherwise specified on steel exposed to view.
- b) Zinc-rich Primer:
- i. Inorganic: CAN/CGSB-1-GP171, where no other top coating will be applied.
  - ii. Organic, ready mixed: CAN/CGSB-1.181, where additional coatings will be applied.
  - iii. Repair of galvanized coatings: ASTM A780/A780M
- c) Bituminous Paint:
- i. CGSB Specification 31-GP-3M, Alkali-resistant bituminous paint
- d) Protection of steel surfaces in contact with aluminum:
- i. One coat of a zinc chromate primer, followed by,
  - ii. one coat of paint containing 0.2 kg of aluminum paste pigment per litre.

### **PART 3 - EXECUTION**

#### **3.01 General:**

- A. Use tapered washers of similar material where mating surfaces are not square to axis of bolt.
- B. Minimum bolt and anchor bolt diameter on project to be 12mm, unless otherwise noted on the drawings or approved by the Engineer.

#### **3.02 Coordination:**

- A. Verify all existing conditions prior to fabrication and erection.
- B. Coordinate all work within this division with that of other trades on the project. Carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- C. Coordinate fabrication and installation with the work of other Divisions and verify product dimensions to ensure accurate installation.

**D. Discrepancies:**

1. In the event of discrepancies, immediately notify the Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.03 Welding:**

- A. Perform steel welding in conformance with CSA W59 and by a fabricator approved by the Canadian Welding Bureau under requirements of CSA W47.1.
- B. Perform aluminum welding in conformance with CSA W59.2 and by a fabricator approved by the Canadian Welding Bureau under requirements of CSA W47.2.
- C. Weld stainless steel according to applicable ASME standards.

**3.04 Galvanizing:**

- A. Items noted as galvanized or galvanizing on the drawings or in the specifications means hot-dipped galvanizing and requires the following:
  1. Galvanize steel members after fabrication in accordance with the standards noted in Part 2 of this Section.
  2. Detail components to be galvanized to suite maximum dimensions required by the galvanizer and to prevent warping or distorting during the hot-dipped galvanizing process.
  3. Unless noted otherwise, provide holes in both ends of hollow members to allow hot gasses to escape and to facilitate full coverage of galvanizing on the interior surfaces of the members.
  4. Where welding after galvanizing is necessary, the zinc within the weld affected area shall be removed by grinding.
  5. Repair galvanized coatings damaged by welding, cutting, rough handling during shipping or erection or from any other cause, using zinc-rich paints in accordance with ASTM A780/A780M. Dry film thickness on repairs to exceed the original coating thickness by 25%.

**3.05 Shop Painting:**

- A. Apply one shop coat of organic zinc primer to items to be field primed and painted.
- B. Paint on clean dry surfaces, free from rust, scale and grease. Do not paint when temperature is lower than coating manufacturer's recommendations.
- C. Apply steel shop paint on surfaces to be field welded.



- D. Stainless, aluminized, hot-dip galvanized, or electro-galvanized steels placed in contact with aluminum need not be painted.
- E. Shop paint surfaces of all aluminum in direct contact with concrete or cementitious materials with 2 coats of aluminum coloured bituminous paint.

**3.06 Delivery, Storage and Handling:**

- A. Ensure that metal fabrications are protected from damage before, during and after installation.
- B. Protect the installed work and materials of other trades.
- C. Store components above ground, protected from exposure to the elements and from physical damage caused by other construction activities.

**3.07 Cleaning:**

- A. Throughout operations, keep the site clean and free of unnecessary debris.
- B. All metal work to be clean and free of deleterious materials prior to installation.
- C. On completion of the work of this Division, thoroughly clean all exposed surfaces, and remove and dispose of all debris and excess materials from the project site.

END OF SECTION 05000

**PART 1 - GENERAL****1.01 Governing Condition:**

- A. Section 05000 applies to and governs the work of this section.

**1.02 Related work:**

- A. Section 05000 – General Requirements
- B. Section 01300 – Submittals

**1.03 Work Included**

- A. The Work includes but is not limited to the following:
  - 1. Fabricate, supply and erect Structural Steel as shown on the drawings and specified herein.
  - 2. Supply all associated accessories and steel components required to accommodate the complete installation of the steel structure(s) and components.
  - 3. Supply loose bearing plates and anchor rods for site placement.
  - 4. Design and detail connections not shown on the drawings for the work of this Section.

**1.04 Reference Standards:**

- A. Comply with the Codes and Standards referenced in Section 05000.

**1.05 Design**

- A. Connections:
  - 1. All connections to conform to CSA S16.
  - 2. Retain a Professional Engineer to be responsible for the design of connections not specifically designed and detailed on the drawings.
  - 3. For all framed beam shear connections, use end plate, single angle or double angle header connections or shear plates where practical.
  - 4. Connections to be design to eliminate field welding unless specifically noted on the drawings.
  - 5. Framed beam shear connections to be not less than one half of the depth of the connected member.

6. All connections to be designed and detailed to resist connection forces provided on the drawings. Where these forces are not provided or unless shown otherwise on the Structural drawings, connect all simply supported non-composite flexural members at each end for one half of the total uniformly distributed factored load of the laterally supported beam. For composite beams, increase connection load at each end to 75 % of the total uniformly distributed factored load on the steel section only.
7. Design connections for the factored moment where shown on the drawings.
8. Design connections for eccentricities where shown on the drawings.
9. For spandrel beams, provide full depth web connection or top and bottom flange clips .
10. Provide reinforcement of unconnected sides of HSS members.
11. Bolted connections to be:
  - a) Slip-critical for all bracing members.
  - b) Bearing-type for all other connections, unless otherwise indicated on the drawings.
12. Use of oversized holes are to be subject to the approval of the Engineer. Such connections are to be detailed as slip-critical.
13. Vertical and Horizontal Bracings:
  - a) Connect all tension and compression members for the axial force shown on the drawings plus the shear force due to direct member loading, if applicable.
14. Prior to erection diagram review, the fabricator is to be provided the necessary information to locate punched or drilled holes from 14 mm to 24mm diameter for other trades to attach blocking or other material where shown on drawings.
15. Cutting of holes in any structural steel member in the field is not permitted without the written approval of the Engineer.
16. Structural steel members are not to be spliced unless approved by the Engineer in writing. Except for splices shown on drawings, do not splice vertical and horizontal members unless necessary to accommodate shipping lengths or material availability. Ensure that splice connections develop the factored load at the splice location of the member unless otherwise indicated on the drawings.
17. Design HSS connections in accordance with AISC's Design Guide 24 Hollow Structural Section Connections and/or CIDECT publication Design Guide for Rectangular Hollow Section (RHS) Joints Under Predominantly Static Loading.

18. Detail connections of steel members so as not to interfere with architectural clearance lines or finishes that are shown on design drawings.
19. Provide special connections and /or splices specific to this contract where shown on the drawings.

**1.06 Quality Assurance**

- A. Comply with the requirements of Section 05000.

**1.07 Submittals**

- A. Comply with the requirements of Section 01300.
- B. Fabrication and erection drawings prepared under the supervision of and sealed by a Professional Engineer. At a minimum, the drawings are to be properly dimensioned and indicate:
  1. Connection details indicating capacities.
  2. Openings, fasteners, spacing, locations of structural members, profiles, attachments, sizes, connections, loads, and cambers.
  3. The size, spacing and location of structural steel members, connections, attachments, reinforcing and anchorage. Include necessary plans, sections, elevations and details; indicate size and type of fastening, and for welded connections use welding symbols in accordance with Appendix D of CSA Standard W59 and clearly indicate net weld lengths.
  4. Necessary information for setting items of structural steel supplied under this Section that are to be built or drilled into the work of other Sections, as and where shown on the Contract drawings.
  5. Steel lintels, bearing plates and other structural shapes, which are embedded in masonry or cast-in-place concrete and not connected to structural steel.
- C. Submit fieldwork details with complete information for modifying fabricated members.
- D. Submit inspection reports described in the Inspection and Testing requirements of this Section.
- E. Mill Test Certificates / Affidavit:
  1. Submit a certified copy of Mill Test Certificates or provide an affidavit, based on material testing, stating that the materials and products that have been used in fabrication are new and conform to the applicable material or product requirements called for by these specifications and drawings.

**PART 2 - PRODUCTS****2.01 Materials**

- A. Supply all structural steel framing and components in accordance with the Structural Steel requirements of Section 05000.

**2.02 Fabrication**

- A. Conform to CSA S16, CSA W59 and the reviewed shop drawings.
- B. Clearly mark pieces by stamping or painting to prevent obliteration during shipping and handling for identification of individual pieces, in accordance with identification schedules on the shop drawings, to clearly indicate the location of each piece in the Work for installation.
- C. Shop welding to conform to welding requirements as specified in CSA W59.
- D. Do not fabricate steel members until Shop Drawings have been returned. Any work done prior to return of Shop Drawings will be at the contractor's risk and may be rejected by the Engineer.
- E. The minimum size of welds to be as required in CSA W59:
  - 1. For cold-rolled steel a minimum of 3 mm;
  - 2. For hot-rolled steel, a minimum of 5 mm unless a larger size is required for the specific joint by CSA W59.
- F. Do not splice steel members unless required and approved by the Engineer.
- G. Complete all welded shop connections prior to galvanizing.
- H. Orientate straight beams which have cambers, within allowable mill tolerances, so that the resulting camber is up.
- I. Seal HSS connections by continuous welds.
- J. Provide 19 mm diameter weep holes in HSS columns or sealed tubes subject to exterior exposure.
- K. Provide masonry connectors on the face of steel columns adjacent to block walls as shown on the Contract Drawings.
- L. When requested by the Engineer, coordinate a shop inspection of material before it is shipped to the site.
- M. Shop applied Stud Shear Connectors: Remove paint, rust, mill scale, dirt, sand, grease and other deleterious materials from the surface of the steel prior to welding. Weld in accordance with CSA W59. Determine the proper weld set-up as per CSA W59.

### 2.03 Coatings

- A. Hot-dip galvanize all members indicated on the drawings after fabrication in accordance with the Galvanizing requirements of Section 05000.
- B. Leave all structural steel members that will be treated with spray-applied fireproofing unfinished.
- C. Paint all structural steel not otherwise designated to receive any other coating, after fabrication in accordance with the Steel Shop Paint requirements of Section 05000.
  - 1. Do not paint:
    - a) Contact surfaces of slip-critical connections.
    - b) Portions of surfaces that are to receive field welds.
    - c) Portions of steel members, which are to be encased in or in contact with cast-in-place concrete.
    - d) Members that are to be galvanized.
    - e) Members to receive sprayed-applied fire protection, unless paint is compatible.
    - f) Members where special paints are to be applied.

## **PART 3 - EXECUTION**

### 3.01 General

- A. Erect structural steel as indicated on the Shop Drawings.
- B. Do not field cut members without the Engineer's prior approval.
- C. Temporary bracing to be in accordance with CSA S16 or this specification. Bracing members shown on drawings are not to be assumed adequate for erection purposes.
- D. The structure is designed to support the final design loads in its completed state. Provide additional support for the structure if required due to the construction sequence or methods of fabricating, handling and erecting.
- E. Framing around openings.
  - 1. Provide structural steel members, where shown, at perimeter of openings through metal decking. Member sizes are as shown on the drawings.
- F. Where structural steel members specified on the drawings are not available, contact the Engineer for acceptance of any and all substitutions.

**3.02 Examination**

- A. Where connections are made to existing work, verify dimensions, elevations and conditions prior to fabrication. Report discrepancies to the Engineer.
- B. Contractor to provide a survey of the position of anchor rods and surfaces and conditions upon which work of this section depends. Any deviations found from structural or architectural drawings are to be submitted to the Engineer.

**3.03 Site Preparation, Handling and Storage**

- A. Protect structural steel from damage before, during and after installation. Protect the installed work and materials of other trades.
- B. The steel fabricator is responsible for maintaining cleanliness of steel until it is delivered onto the site.
- C. Store materials on site for as short a time as possible and such that members do not acquire permanent camber or deflection.
- D. Store steel on timbers, or other support clear of the ground.
- E. Store fastener components according to CSA S16.

**3.04 Erection**

- A. Erection of structural steel to be in accordance with CSA S16, the Shop Drawings, CISC Code of Standard Practice and the applicable provincial construction safety act and its regulations.
- B. Do not cut holes in the field unless sizes and locations are accepted by the Engineer in each case. Accepted field cutting and welding to be undertaken by this section.
- C. All high-strength bolts are to be installed to a snug tight condition except where designed to be slip-critical.
- D. For slip-critical connections, bolts are to be tensioned using turn-of-nut method.
- E. Erect individual members of the structural steel to the tolerances given in CSA S16.
- F. Set column base plates on leveling plates which are to be set with grout at the required elevation by others and are to be level to within 1.5 mm across the plate. Leveling plates are to be used under base plates when base plates are less than 0.26 square meters in area. Set column base plates on leveling nuts / shims to the required elevation ready for grouting when base plate area exceeds the above.
- G. Do not make permanent connections until as much of the structure as will be stiffened thereby has been suitably aligned.
- H. Report ill-fitting connections to the Engineer before taking corrective measures.

- I. Remove paint from surfaces that are to receive welds.
- J. Do not weld in an ambient temperature below -10°C (14°F). Preheat according to CSA W59 requirements.
- K. Remove slag from all completed welds so that they may be visually inspected.
- L. After erection, touch-up bolts, welds, burned or scratched surfaces with shop primer prior to applying finished coatings.
- M. All welds on galvanized members, and where galvanizing has been damaged during erection and handling, are to be touched up with zinc rich paint in accordance with ASTM A780/A780M.

**3.05 Inspection and Testing**

- A. Weld Inspection (by Fabricator):
  - 1. All welds to be visually inspected by the fabricator in accordance with CSA S16.
- B. Third-Party Inspection
  - 1. A third-party inspector is to be retained by the Owner to carry out the inspection types and frequencies of all structural steel in accordance with CSA S16 Annex P to Inspection Class 2 (IC2).
  - 2. All third-party welding inspection practice and acceptance criteria shall conform to CSA S16, CSA W59, CSA W178.1, and CSA W178.2.
  - 3. The cost of any follow-up inspection or testing required to rectify deficient work is to be borne by the Contractor.
  - 4. Provide the third-party inspector access to all places work is being done to facilitate their inspection.

END OF SECTION 05120



**PART 1 - GENERAL****1.01 Reference:**

- A. Section 05000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide Steel Deck units as shown on the drawings and specified herein.

**1.03 Standards References:**

- A. Canadian Standards Association (CSA)
  - 1. CAN/CSA-S136.16, Cold Formed Steel Structural Members
  - 2. CSA W47.1-19, Certification of Companies for Fusion Welding of Steel Structures.
  - 3. CSA W55.3-08 (R2023), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - 4. CSA W59-18 (R2023), Welded Steel Construction, (Metal Arc Welding) [Metric].
- B. Canadian General Standards Board (CGSB).
  - 1. CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- C. American Society for Testing and Materials (ASTM).
  - 1. ASTM A653 / A653M, Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
- D. Canadian Sheet Steel Building Institute (CSSBI).
  - 1. CSSBI 10M, Steel Roof Deck.

**1.04 Shop Drawings:**

- A. Submit shop drawings, erection and shoring drawings.
- B. All submitted drawings to be sealed by a Professional Engineer.
- C. Submit design calculations if requested by Engineer.
- D. Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Zinc (Z) coated steel sheet: to CSSBI 101M structural quality Grade A, with Z275 coating, 0.76 mm base steel thickness.
- B. Primer: zinc rich, ready mix to CAN/CGSB-1.181.
- C. Closures: Compressible, die-cut EPT foam to match metal profile.

**2.02 Types of Decking:**

- A. Pre-finished Steel Roof Deck: 0.76 mm minimum base steel thickness, 38 mm deep profile, non-cellular, interlocking side laps. VicWest RD938, or approved alternate, in pre-finished Colour Series. Colour to be selected by the Engineer from manufacturer's standard colour range.
- B. Pre-finished Steel Floor Deck: 0.91 mm minimum base steel thickness, 38 mm deep composite floor deck profile, to be manufactured with integral lugs on the vertical face of the flutes, to achieve proper composite action, with non-cellular, interlocking side laps. Provide floor deck type VicWest (Hi – Bond) HB938, or approved alternate, in pre-finished Colour Series. Colour to be selected by the Engineer from manufacturer's standard colour range.

**2.03 Fabrication:**

- A. Roll form deck to required uniform radii.

**PART 3 - EXECUTION****3.01 General:**

- A. Structural steel work: in accordance with CAN/CSA-S136 and CSSBI.
- B. Welding: in accordance with CSA W59, except where specified otherwise.
- C. Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

**3.02 Erection:**

- A. Erect steel deck as indicated and in accordance with CSSBI 10M and in accordance with reviewed erection drawings.
- B. Lap ends: to 50 mm minimum.
- C. Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

**3.03 Openings and Areas of Concentrated Loads:**

- A. No reinforcement required for openings cut in deck which are smaller than 150 mm square.
- B. Frame deck openings with any one dimension between 150 mm to 300 mm as recommended by manufacturer, except as otherwise indicated.
- C. For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

**3.04 Connections:**

- A. Install connections in accordance with CSSBI recommendations as indicated.

END OF SECTION 05310.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 05000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. The Work includes but is not limited to the following:
  - 1. Stainless steel railings – floor mounted and wall mounted.
  - 2. Metal bollards.
  - 3. All other miscellaneous metal work shown on the drawings.

**1.03 Quality Assurance:**

- A. Where provisions of pertinent codes and standards conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.

**1.04 Submittals:**

- A. Shop Drawings:
  - 1. Submit fabrication and erection drawings. All connection details to indicate capacities. Shop drawings to be sealed by a Professional Engineer.

**1.05 Coordination:**

- A. Advise the Engineer of discrepancies with details of other trades. Do not proceed with fabrication until all discrepancies have been resolved.

**1.06 Delivery, Storage and Handling:**

- A. Protection:
  - 1. Ensure the metal fabrication is protected from damage before, during and after installation. Protect the installed work and materials of other trades.

**1.07 Inspection and Testing:**

- A. The Owner will appoint an independent company to carry out shop and field inspection to ensure that materials and workmanship conform to these Specifications.

**PART 2 - PRODUCTS****2.01 Material:**

- A. Steel Sections and Plates: to CAN/CSA-G40.21, Grade 350W.

- B. Steel Pipe: to ASTM A53 extra strong, galvanized finish.
- C. Stainless Steel: Grade 316, brushed #4 finish, supplied by North American sources only.
- D. Welding Materials: to CSA W59.
- E. Welding Electrodes: to CSA W48 Series.
- F. Bolts and Anchor Bolts: to ASTM A307. Stainless Steel AISI 316 for stainless steel or aluminum materials.
- G. Grout: non-shrink, non-metallic, flowable, 15 MPa (at 24 hours), pull-out strength 7.9 MPa. Euclid, W.R. Meadows, Sika, Dayton, or approved equivalent.

### 2.02 Fabrication:

- A. Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- B. Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- C. Where possible, fit and shop assemble work, ready for erection.
- D. Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
- E. Stainless steel welding by inert gas shielded tungsten-arc welding GTAW (TIG) or inert gas shielded metal arc welding SMAW; in accordance with CSA W59-M.

### 2.03 Finishes:

- A. Galvanizing: hot dipped galvanizing with zinc coating 600 g/m<sup>2</sup> to CAN/CSA-G164.
- B. Shop coat primer: to CAN/CGSB-1.40.
- C. Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.
- D. Bituminous paint: to CAN/CGSB-1.108.

### 2.04 Shop Painting:

- A. Apply one shop coat of primer to metal items, with exception of galvanized, stainless steel, aluminium or concrete encased items.
- B. Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.
- C. Clean surfaces to be field welded; do not paint.

- D. After fabrication, thoroughly commercial blast clean all ferrous metals exposed in finish or exterior. In concealed areas, clean, brush scrape and remove rust, grease and extraneous matter from surface and solvent clean.

### **2.05 Cleaning and Polishing (Aluminum and Stainless Steel):**

- A. Thoroughly clean welds and surrounding substrate area of weld spatter, flux or scale by wire brushing, grinding and polishing. When wire brushing and grinding, use shield over adjacent finished surfaces to protect same, or provide limiting stops on grinder to avoid canting of grinding wheel. When polishing, use new belts.
- B. Remove excess weld by grinding. Grind, polish, and passivate welds exposed to view in finished construction to match finish of parent material.

### **2.06 Railings – Galvanized Steel or Stainless Steel:**

- A. Supply and install tubular railings as detailed on the project drawings.
- B. Provide expansion sleeves to allow 12 mm movement at all expansion joints and at 8 metre on-centre maximum.

### **2.07 Metal Bollards:**

- A. Construct metal bollards as detailed on the Project drawings.
- B. Bollard cover to be Bollard Guard by Innoplast ([www.innoplast.com](http://www.innoplast.com)) or approved equivalent. Yellow with red reflective tape.

## **PART 3 - EXECUTION**

### **3.01 Erection:**

- A. Do welding work in accordance with CSA W59, unless specified otherwise.
- B. Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- C. Provide suitable means of anchorage acceptable to Engineer, such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- D. Exposed fastening devices to match finish and be compatible with material through which they pass.
- E. Provide components for building by other sections in accordance with shop drawings and schedule.
- F. Make field connections with bolts to CAN/CSA-S16.1, or weld. No field welding of galvanized components is permitted.
- G. Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

- H. Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- I. Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
- J. Isolate metals using Bituminous paint where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry or concrete.

END OF SECTION 05500.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 05000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide anchor-bolts complete with washers and nuts. Anchor bolts type 316 stainless steel.

**1.03 Related Work:**

- A. Cast-in-Place Concrete - Section 03300

**1.04 Standards References:**

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM B 209 -Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 2. ASTM B 221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 3. ASTM B 308/B 308M - Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- B. American Welding Society (AWS):
  - 1. AWS A 5.10 - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.
  - 2. AWS D 1.2 - Structural Welding Code - Aluminum.

**1.05 Submittals:**

- A. Product Data:
  - 1. Manufacturer's product information and installation manual.
  - 2. Submit complete Installation instruction manual as published by the Pre-engineered stair manufacturer to complete this section of work.
- B. Shop Drawings: Anchor bolts, elevations, details, methods of installation and anchoring:
  - 1. Show members, sizes and thickness, anchorage locations and accessory items.
  - 2. Furnish setting diagrams for anchorage installation as required.



3. Shop drawings to include calculations stamped by a structural engineer registered in the jurisdiction in which the project is located.

C. Verification Samples: For each finished product specified, one sample, representing actual product.

#### **1.06 Quality Assurance:**

A. Manufacturer to have a minimum of 10 years' experience in the design, engineering and fabrication of anchor bolts.

B. Regulatory Requirements: Comply with applicable provisions of Ontario Building Code as applicable for anchor bolts.

C. Tolerances: Coordinate fabrication and installation of systems with adjacent building construction and verify product dimensions to ensure accurate installation.

#### **1.07 Delivery, Storage and Handling:**

A. Packing and Shipping: Deliver components, clearly labeled for building location.

B. Storage and Protection: Store components above ground, protected from exposure to the elements and from physical damage caused by other construction activities. Rusted, bent, warped or otherwise damaged units will not be accepted.

#### **1.08 Project Site Conditions:**

A. Field Measurements: General Contractor to provide guaranteed field measurements if schedule does not allow for physical dimensioning. Otherwise field verify floor to floor and horizontal dimensions of spaces where anchor bolts will be installed prior to fabrication under this specification section.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers:**

A. Acceptable Manufacturer: As approved by project Engineer prior to bid date.

### **2.02 General:**

A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 6 mm. Minimum anchor bolt diameter shall be 12 mm. Anchor bolts for equipment mounting and vibration isolation systems shall be provided as required.

B. Tapered washers shall be provided where mating surface is not square with the nut.

C. Expansion, wedge, or adhesive anchors set in holes drilled in the concrete after the concrete is placed will not be permitted in substitution for anchor bolts except where otherwise specified. Upset threads are not acceptable.

**2.03 Materials:**

- A. Anchor bolt materials shall be as specified in Table A.

**Table A – Anchor Bolt Materials**

Material	Specification
Steel bolts	ASTM A307, Grade A
Fabricated steel bolts	ASTM A36
Stainless steel bolts, nuts, washers	ASTM A320, Type 316
Expansion anchors	HILTI-BOLT, or equal
Wedge anchors	ITT or equal.
Adhesive anchors	HILTI-Epoxy Bond or equal

**2.04 Design:**

- A. Anchor bolts for equipment frames and foundations to be designed in accordance with the project location seismic zone requirements.

**2.05 Product Data:**

- A. The following review information to be provided for all anchor systems (non cast-in-place):
1. Data indicating load capacities.
  2. Chemical resistance.
  3. Temperature limitations.
  4. Installation instructions.
  5. Evaluation report for expansion and wedge type anchors.

**PART 3 - EXECUTION****3.01 General:**

- A. Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings, or isolators. Grouting of anchor bolts with non-shrink or epoxy grouts as required.

**3.02 Cast-In-Place Anchor Bolts:**

- A. In accordance with Section 03300, anchor bolts to be embedded in concrete, placed accurately, and held in correct position while the concrete is placed or, if specified, recesses or block outs, formed in the concrete and the metalwork grouted in place. The surfaces of metalwork in contact with concrete thoroughly cleaned.
- B. After anchor bolts have been embedded, protect threads by grease and the nuts run on.

**3.03 Adhesive Anchor Bolts:**

- A. Use of adhesive or capsule anchors are subject to the following conditions:
1. Use limited to locations where exposure (on an intermittent or continuous basis) to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is extremely unlikely.
  2. Use limited to applications where exposure to fire, or concrete or rod temperature above 120°F is extremely unlikely. Because of the above concerns, overhead applications (such as pipe supports) are not permitted.
  3. Anchor threaded or deformed full length of embedment, free of rust, scale, grease, and oils.
  4. Embedment depth as per manufacturer's recommendations. Adhesive capsules of different diameters may be used to obtain proper volume for the embedment, but no more than two capsules per anchor may be used. When installing different diameter capsules in the same hole, the larger diameter capsule to be installed first. No extension or protrusion of the capsule from the hole is acceptable.
  5. All installation recommendations by the anchor system manufacturer to be followed carefully.
  6. Holes to have rough surfaces.
  7. Holes to be cleaned with compressed air and be free of dust or water prior to installation.
  8. Anchor to be left undisturbed and unloaded for the full adhesive curing period.
  9. Concrete temperature (not air temperature) to be compatible with curing requirements of adhesives. Do not place anchors in concrete below -4° C.

**3.04 Expansion Anchors:**

- A. The contractor provides the Engineer with independent current evaluation reports for the particular brand of expansion anchors to be used.

END OF SECTION 05501.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 05000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Supply and install all miscellaneous metal work including:
  - 1. Hatches Frames
  - 2. Anchors/Fasteners/Support Brackets
  - 3. Railings
  - 4. Platforms/Landings
  - 5. Ladders and Safety Cages
  - 6. Stainless steel Corner Guards

**1.03 Related Work:**

- A. Cast-in-place Concrete - Section 03300
- B. Structural steel - Section 05120
- C. Aluminium Ladders - Section 05516
- D. Tubular Aluminum Guardrail - Section 05521
- E. Aluminum Grating - Section 05531
- F. Aluminum Access Hatches - Section 05560
- G. Aluminum Checker Plate - Section 05561
- H. Painting/Protective Coatings - Section 09900

**1.04 Quality Assurance:**

- A. Qualification:
  - 1. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer shall have a minimum of 5 years proven experience in this type of work.
- B. Qualifications of Welders:
  - 1. Use only certified Welders for all welding.

- C. Welding work in accordance with CSA W59.
- D. Codes and Standards:
  - 1. Latest edition of the Ontario Building Code.
  - 2. Where provisions of pertinent codes and standards conflict with these Specifications and Drawings or each other, comply with the more stringent provisions.

**1.05 Submittals:**

- A. Shop Drawings:
  - 1. Submit shop and installation drawings to the Engineer for review prior to commencement of fabrication.
  - 2. Show the sizes and location of all members and necessary details. Provide templates and show dimensions for setting anchor bolts, sleeves, frames and fastenings.

**1.06 Delivery, Storage and Handling:**

- A. Deliver, store and handle all material in a manner which prevents damage to its fabricated form.

**1.07 Job Conditions:**

- A. Give timely and accurate instructions to other trades for locations, levels, holes, connections and setting of anchor bolts, sleeves and frames.
- B. Examine site conditions and take site measurements to ensure accurate and proper fit, and clearance of in-place obstructions.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. General:
  - 1. Conform to the latest edition of reference standards. Use all new materials and grades of metals and alloys to suit their application.
- B. Steel:
  - 1. CSA G40.21-M, Grade 350W, except where otherwise specified on the Drawings.
  - 2. Steel pipe: to ASTM A53 – Grade B, seamless.
  - 3. Welding materials: to CSA W59.

4. Arc and Resistance Welding electrodes and equipment: CSA W48.1 and CSA W55.3.

C. Aluminum:

1. Supply all aluminum in alloy 6061-T6, except where otherwise specified on the Drawings.
2. Paint surfaces of all aluminum in direct contact with concrete or concrete masonry with 2 coats of bitumastic paint.

D. Stainless Steel:

1. Stainless steel plate, tube and pipe to A.I.S.I, Type 316-L Seamless with No 4 finish.

E. Concrete Anchors:

1. HILTI HIT-HY 200 MAX system adhesive type anchors, sizes as shown on drawings.
2. Grout: non-shrink, non-metallic, non staining flowable, 40 MPa.
3. HILTI HIT-HY 20 system for anchorage into masonry.
4. For overhead anchorage installation use HILTI HSL stainless steel anchors.

F. Bolts/Anchors:

1. High Strength Bolts: ASTM A325.
2. Anchor bolts: CSA G40.21-M, Grade 350W
3. Stainless steel bolts ASTM A193 B8/B8M, Class 1 Type 316
4. Use tapered washers of similar material where mating surfaces are not square to axis of bolt.

G. Paint/Protective Coatings

1. As specified in Section 09900.

H. Aluminum Ladders:

1. As specified in Section 05516 and on drawings.

I. Aluminum Handrail:

1. As specified in Section 05521 and on Project drawings.

J. Aluminum Grating:

1. As specified in Section 05531 and on Project drawings.

K. Aluminum Access Hatches:

1. As specified in Section 05560 and on Project drawings.

L. Aluminum Check Plate:

1. As specified in Section 05561 and on Project drawings.

M. Other Materials:

1. All other materials, not specifically described but required for a complete and proper installation of miscellaneous metals, to be new, free from rust, best quality of their respective application, and subject to the approval of the Project Engineer.

**2.02 Fabrication:**

A. General:

1. Fit and shop assemble the various items of work.
2. Fabricate the work true to dimensions, square, plumb, level, free of defects. Accurately fit joints and intersecting members with adequate fastening.
3. Construct the work free from distortion and defects detrimental to the appearance and performance.
4. Provide mechanical fastenings of the same material and finish as the base material on which they occur unless required otherwise for structural or safety reasons. For aluminum fabrications use stainless steel fasteners.

**2.03 Welding:**

- A. Perform steel welding in conformance with CSA W59 and by a fabricator approved by the Canadian Welding Bureau under requirements of CSA W47.1.
- B. Perform aluminum welding in conformance with CSA W59.2 and by a fabricator approved by the Canadian Welding Bureau under requirements of CSA W47.2.
- C. Weld stainless steel according to ASME standards.

**2.04 Galvanizing:**

- A. Hot-dip galvanize all miscellaneous metal work when indicated on drawings, in accordance with CSA G164, to a minimum coating weight of 600 g/m<sup>2</sup>. Hot Dipped galvanized steel to receive a paint finish shall be unpassivated type.

- B. Repair galvanized coatings damaged by welding, cutting, rough handling during shipping or erection or otherwise, using zinc-rich paints. Dry film thickness on repairs to exceed the original coating thickness by 25%.

**2.05 Lintels:**

- A. Provide hot dip galvanized beams and stainless-steel angles for masonry lintels. Provide 200 mm minimum bearing at each end of lintel span.
- B. Weld or Bolt 'back-to-back' angles to profiles as indicated on the project drawings.

**2.06 Corner Guards:**

- A. Stainless Steel angle: 75 x 75x 6 mm thick x 1500 mm height as indicated complete with anchors. Guards are to be installed at all vertical exposed corners where 'bull nose' block is not installed.

**2.07 Kick Plates around Screen Channel Openings:**

- A. Kick plates: LLV 152 x 90 x 9.5 angles each 100mm long or as long as required to cover the gap between the screen and grating.

**2.08 Shop Painting:**

- A. With the exception (concrete encased), apply one shop coat of organic zinc primer to items to be field primed and painted.
- B. Paint on clean dry surfaces, free from rust, scale and grease. Do not paint when temperature is lower than coating manufacturer's recommendations.
- C. Shop primer paint on surfaces to be field welded. Apply approved zinc shop primer.

**PART 3 - EXECUTION****3.01 Examination:**

- A. Inspection:
  - 1. Before installing any work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation can properly commence.
  - 2. Verify that miscellaneous metal work may be installed in strict accordance with all pertinent codes and regulations, the reviewed shop drawings, and the original design.
- B. Discrepancies:
  - 1. In the event of discrepancies, notify the Engineer immediately.



2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.02 Installation:**

- A. Install the work of this Section using skilled craftsmen in accordance with the best practice and according to project Manufacturers' recommendations.
- B. Install the work plumb, level and structurally free from defects detrimental to the finished appearance.
- C. Insulate, where necessary, to prevent electrolysis due to metal to metal contact or contact between aluminum and masonry or concrete. Use bituminous paint, butyl tape, fibre or plastic pads. When using bitumastic paint apply a minimum of two coats on the aluminum surface.
- D. Provide suitable means of anchorage. Cast in or adhesive anchors are acceptable means of anchorage. Do not use expansion or shield type anchors.
- E. Make field connections with high tensile bolts or welding.
- F. Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.
- G. Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection.
- H. For the kick plates around the screen channel openings, provide 1 angle for each side of each screen channel. Anchor the short leg of each angle to the concrete floor using 2-16mm dia. Hilti Has rods complete with Hilti Hit-Hy 200 adhesive, minimum embedment 150mm.

**3.03 Clean-up:**

- A. Throughout operations, keep the site clean and free of unnecessary debris. On completion of the work of this Section, thoroughly clean all exposed surfaces.

END OF SECTION 05502

## **1 General**

### **1.1 Governing conditions**

- .1 Section 05 00 00 applies to and governs the work of this Section.

### **1.1 Related section**

- .1 Section 03 30 00 – Cast-in-Place Concrete
- .2 Section 04 22 00 – Unit Masonry
- .3 Section 05 00 00 – General Requirements
- .4 Section 05 12 00 – Structural Steel
- .5 Section 05 50 00 – Miscellaneous Metal Fabrications General Requirements
- .6 Section 05 50 10 – Anchor Bolts
- .7 Section 05 52 10 – Metal Guardrails
- .8 Section 06 20 00 – Finish Carpentry
- .9 Section 09 90 00 – Painting/Protective Coatings

### **1.2 Work included**

- .1 Provide custom prefabricated or field assembled metal stair and guardrail system including Structural channel, HSS, plate and angle sections as detailed on the Contract Drawings.
- .2 Comply and coordinate work with all pertinent requirements of Sections 05 50 00 – Miscellaneous Metal Fabrications and Section 05 52 10 – Metal Guardrails.

### **1.3 Standard references**

- .1 Comply with the latest applicable versions of the Codes and Standards referenced in Section 05 00 00.

## 1.4 Performance requirements

- .1 Structural Performance of Stairs: Design, fabricate, supply and install all metal stair structures and associated components that have not been specifically detailed on the Contract Drawings to withstand the following loads without exceeding the allowable design working stress of materials, including anchors and connections. Apply each load to produce the maximum stress in each component:
  - .1 Treads and Platforms of Metal Stairs: Capable of withstanding a superimposed deadload of 1.0kPa in combination with a uniform load of 4.8kPa, or a concentrated load of 1.3kN applied on an area of 2580mm<sup>2</sup>. Concentrated and uniform loads need not be assumed to act concurrently.
  - .2 Stair Framing: Capable of withstanding stresses resulting from loads specified in addition to stresses resulting from railing system loads.
  - .3 Limit deflection of treads, platforms and framing members to L/360
- .2 Structural Performance of Handrails and Railings: Comply with the requirements in Section 05521 – Metal Guardrails

## 1.5 Quality assurance

- .1 Comply with the requirements of Section 05 00 00.

## 1.6 Submittals

- .1 Comply with the requirements of Section 01 30 00.
- .2 Product Data:
  - .1 Manufacturer's product information and installation manual.
  - .2 Submit complete Installation instruction manual as published by the Pre-engineered stair manufacturer to complete this section of work.
- .3 Prior to fabrication, submit shop drawings sealed by a Professional Engineer Licensed in the Province of Ontario for review. Drawings are to be in accordance with the requirements of this specification section and any details shown on the Contract Drawings. At a minimum, the shop drawings will be properly dimensioned and include the following:
  - .1 Stair plans, elevations and details.
  - .2 Methods of installation and anchoring.

- .3 Member profiles, sizes and thicknesses.
  - .4 Material grades
  - .5 Size, type, and material of fasteners
  - .6 Anchorage locations and accessory items.
  - .7 Connection details – bolted and welded. Use standard welding symbols and indicate net weld lengths.
  - .8 Setting diagrams for anchorage installation as required.
  - .9 Calculations when requested by the Engineer.
- .4 Verification Samples for Tread: For each finished tread product specified, one sample, representing actual product.

## **2 Products**

### **2.1 Acceptable manufacturer for aluminum stair systems**

- .1 MSU Mississauga Limited.

### **2.2 Materials**

- .1 Comply with the requirements of Section 05 00 00.
- .2 Reinforcement for pan stairs and landings: 102x102 MW18.7/18.7, unless noted otherwise on Contract Drawings or required by design.

### **2.3 Fabrication**

- .1 General
  - .1 All member sizes and thicknesses to be as detailed on the Contract Drawings, or as determined by structural design calculations.
  - .2 Risers: Open risers unless noted otherwise on Contract Drawings.
  - .3 Fit and shop assemble components in largest practical sections, for delivery to site.
  - .4 Use same material and finish as parts being joined, use 316L stainless steel between dissimilar metals and non-corrosive fasteners at all connections and joints.
  - .5 Provide fasteners of sufficient strength to support connected members and loads, and to develop full strength of parts fastened or connected.

- .6 Construct stairs and rails with all components necessary for support and anchorage, and to provide a complete installation.
  - .7 Fabricate components with joints tightly fitted and secured.
  - .8 Continuously seal joined pieces by continuous welds.
  - .9 Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline.
  - .10 Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
  - .11 Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
  - .12 Accurately form components required for anchorage of stairs, landings, and railings to each other and to building structure.
- .2 Pan Stairs and Landings
- .1 Fabricate landings and stairs with open risers and treads of metal pan (field concrete poured infill) construction, ready to receive concrete.
  - .2 Metal stair pans to be 38mm deep. Use minimum 6mm thick metal sheet.
  - .3 Metal landing pans to be 76mm deep. Use minimum 8mm thick metal sheet.
  - .4 Secure tread pans to stringers with clip angles, bolts or welds in place. Welds to stringers to be made from topside of tread pans.
  - .5 Poured concrete to comply with the requirements of Section 03 30 00 – Cast-In-Place Concrete.

### 3 Execution

#### 3.1 Coordination

- .1 Examine Work in place to verify that it is satisfactory to receive the Work of this Section. Field verify floor to floor and horizontal dimensions of spaces where stairs will be installed prior to fabrication of stairs under this section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

### 3.2 Installation

- .1 Install stairs, landings and handrails in accordance with manufacturer's instructions. Install square, plumb, straight, and true to line and level, with neatly fitted joints and intersections.
  - .1 All welds ground smooth.
  - .2 Do not cut or alter structural components without written authorization.
  - .3 Field welding and joining to conform to CSA W59 and CSA W59.2.
  - .4 Installation to be secure and rigid.
- .2 Provide anchors, hardware, hangers, plates and angles required for connecting stairs to structure.
- .3 Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- .4 Obtain written approval from the Engineer of record prior to site cutting or creating adjustments not scheduled.
- .5 Touch-up field welds and abraded areas by application of same coating used for shop primer.

### 3.3 Delivery, storage and handling

- .1 Packing and Shipping: Deliver stair and rail components, clearly labeled for stair type and building location.

### 3.4 Cleaning

- .1 After stairs are completely installed, remove all construction debris and rubbish from area. Clean surfaces of stairs.

### End of Section

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Section 05000 applies to and governs the work of this Section.
- B. Section 05500 applies to and governs the work of this Section.

**1.02 Related Sections:**

- A. Section 05000 – General Requirements
- B. Section 05500 – Metal Fabrications
- C. Section 05000– Anchor Bolts
- D. Section 03372 – Non-shrink Grout

**1.03 Work Included:**

- A. Fabricate, supply and install all metal guardrails, handrails, toe-boards, balusters, fittings and other associated accessories as detailed in the Contract Drawings and Specifications.

**1.04 Reference Standards:**

- A. Comply with the latest applicable versions of the Codes and Standards referenced in Section 05000.

**1.05 Performance Requirements**

- A. All metal guardrails shall be supplied to conform to applicable sections of the following codes:
  - 1. Ontario Building Code 2012, including all amendments.
  - 2. Occupational Health and Safety Act for Industrial Establishments
- B. Structural Performance: Design, fabricate, supply, and install all metal guardrail systems and associated components that have not been specifically detailed on the Contract Drawings to withstand the effects of gravity loads in combination with the following live loads:
  - 1. Handrails:
    - a) Uniform load of 0.7 kN/m applied in any direction, and
    - b) a concentrated load not less than 0.9 kN applied at any point and in any direction.

- c) Uniform and concentrated loads need not be assumed to act concurrently.
2. Guardrails:
- a) Uniform load of 0.75 kN/m applied at any point, in any direction, and
  - b) a concentrated load of horizontal load 1.0 kN applied at any point, and in any direction.
  - c) Uniform and concentrated loads need not be assumed to act concurrently.
3. Individual elements within the guard (solid panels & pickets):
- a) Designed for a load of 0.5 kN applied over an area of 100 mm by 100 mm located at any point in the element or elements so as to produce the most critical effect.
- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from change in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

#### 1.06 Quality Assurance:

- A. Comply with the requirements of Section 05000.

#### 1.07 Submittals:

- A. Submit under provisions of Section 01300.
- B. Prior to fabrication, submit shop drawings sealed by a Professional Engineer for review. Drawings are to be in accordance with the requirements of this specification section and the guardrail details on the Contract Drawings. Shop drawings to be properly dimensioned and include the following information:
  - 1. Layouts shown in plan, section and elevation views
  - 2. Member profiles, size and material grades
  - 3. Connection details – bolted and welded.
  - 4. Details indicating type, size and length of all welds.
  - 5. Anchorage and/or attachment to other work
  - 6. Accessories



7. Size, type, and material of fasteners

## **PART 2 - PRODUCTS**

### **2.01 Aluminum Guardrails:**

#### **A. Materials:**

1. Supply all metal guardrail components and related hardware in accordance with the Aluminum requirements of Section 05000.
- B. Provide the following minimum cross-section for each component, unless shown otherwise on the drawings:
  1. Horizontal rails: 43 mm O.D. Schedule 40 tube
  2. Vertical posts: 43 mm O.D. Schedule 80 tube
  3. Vertical pickets: 12 mm diameter solid rod
  4. Toe-boards: 6.4 mm thick x 127 mm high
  5. Safety chains: Chain links shall be 19 mm long with 4.8 mm cross-sections, stainless steel.
  6. Grout for base plates: Non-shrink grout in accordance with Section 03372.
- C. Satin anodize all handrails after fabrication. Anodizing shall be Architectural Class 1 Anodic Coating 0.018 mm thickness, conforming to AA-C22A41.

### **2.02 Fabrication:**

- A. Expansion Joints: Provide tight fitting, semi concealed internal pipe sleeves that allow for 12mm expansion at expansion joint locations. Where joints are not shown on the Drawings, provide joints at 8 m maximum spacing.
- B. Accurately cut, form and machine all metal guardrail components.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Provide top rail 1070 mm above the floor on which it is installed. Provide an intermediate rail midway between the top rail and floor where pickets are not required or indicated on the Contract drawings.
- E. Provide angles, anchors, fasteners, hardware and accessories required for connecting railings to structure.

- F. Provide vertical posts at a maximum spacing of 1200mm on-centre, unless noted otherwise on the drawings. Provide posts at corners or on both sides within 300 mm of corner.
- G. Provide pickets at a maximum 100 mm centre to centre spacing at locations indicated on the drawings.
- H. Provide toe-boards (kickplates) for metal guardrails at all mezzanines, landings and service platforms or walkways, unless the railing is set on a concrete curb with a minimum height of 127 mm above the finished floor surface. Toe-boards are to be fastened to pre-welded brackets on vertical posts, and stiffened to prevent warping or buckling between supports.
- I. Do not field weld.
- J. All shop welds to be ground smooth and be free of sharp edges, burrs, or other details that may be hazardous during use of the metal guardrail system.
- K. Base all dimensioning required on accurate field measurements. Responsibility for field measurement is the Contractors.
- L. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
- M. Interior Components: Continuously seal joined pieces by continuous welds.
- N. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline.
- O. Accurately form components to suit stairs and landings, to each other, and to other building structures.
- P. Provide safety chains at openings in handrail where indicated on drawings. The chains shall be fixed to the handrail at one end and provided with a safety snap at the other.

### **PART 3 - EXECUTION**

#### **3.01 Installation:**

- A. Set posts in line with others in same section as well as those in adjacent runs, for uniform appearance when viewed from any direction.
- B. Anchor railings to structure through surface mounted plates. Do not core drill floors for posts.
- C. Install railings to manufacturer's instructions, where applicable.
- D. Install components plumb and level, accurately fitted, free from distortion or defects.

- E. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- F. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

END OF SECTION 05521

**PART 1 - GENERAL****1.01 Governing Condition:**

- A. Section 05000 applies to and governs the work of this Section.
- B. Section 05500 applies to and governs the work of this Section.

**1.02 Related Sections:**

- A. Section 05000 – General Requirements
- B. Section.05500 – Metal Fabrications

**1.03 Work Included:**

- A. Fabricate, supply and install all metal gratings, supports, fasteners and anchors, as detailed on the Contract Drawings and as specified.
- B. Fabricate, supply and install of all metal floor plates and frames as detailed on the Contract Drawings and as specified.

**1.04 Performance requirements:**

- A. Ontario Building Code 2012, including all amendments.
- B. Structural Performance: Design, fabricate, supply, and install all gratings, floor plates and associated components that have not been specifically detailed on the Contract Drawings to withstand the effects of gravity loads in combination with the following specified live loads and deflection limits, unless otherwise indicated on the drawings:
  - 1. Uniform live load: 9.6 kPa
  - 2. Concentrated load: 1.3 kN applied over an area of 200 x 200 mm
  - 3. Concentrated load and uniform load not required to be taken simultaneously.
  - 4. Limit the deflection to the lesser of 3mm or 1/360 of the span.
  - 5. Select bearing bar depth and thickness, and provide stiffeners as required to suit loading, span and live load deflection limit.

**1.05 Quality Assurance:**

- A. Comply with the requirements of Section 05000.

**1.06 Submittals:**

- A. Submit under provisions of Section 01300.

- B. Submit product data.
- C. Prior to fabrication, submit detailed shop drawings sealed by a Professional Engineer for review. At a minimum, the shop drawings are to be properly dimensioned and indicate:
  - 1. Layout, location and number of gratings and/or floor plates
  - 2. Material grades
  - 3. Profiles, sizes and thicknesses for supports or reinforcing members
  - 4. Loading and deflection design criteria.
  - 5. Anchorages and connection details

## **PART 2 - PRODUCTS**

### **2.01 Aluminum Grating:**

- A. Materials:
  - 1. Supply all grating components and related hardware in accordance with the Aluminum requirements of Section 05000.
- B. Approved Products:
  - 1. Borden Type B Series, serrated, banded gratings, as manufactured by Borden Metal Products Limited, or
  - 2. Owner approved equivalent.

### **2.02 Galvanized Steel Grating:**

- A. Materials:
  - 1. Supply all grating components and related hardware in accordance with the Galvanized Steel requirements of Section 05000.
- B. Approved Products:
  - 1. Heavy Duty Borden Type B Series, serrated, banded gratings, as manufactured by Borden Metal Products Limited, or
  - 2. Owner approved equivalent.
- C. Supports: Minimum 6.4mm thick equal-leg angles along full perimeter to suit the depth of grating.

- D. Grating bars: Minimum individual bearing bar size to be 38mm deep by 4.7mm thick, unless noted otherwise on Contract Drawings.

**2.03 Aluminum Floor Plate:**

- A. Materials:
  - 1. Supply all floor plate components and related hardware in accordance with the Aluminum requirements of Section 05000.
  - 2. Floor plates to be fabricated with raised lug checkered pattern.

**2.04 Fabrication:**

- A. Fabricate grating and floor plates to sizes required to accommodate the specified design loads.
- B. Band all grating, and supply anchoring clips to prevent shifting and warpage. Band all openings in grating requiring more than 3 bearing bars, or a side and end bar to be cut.
- C. Provide a continuous neoprene gasket around the perimeter of floor plate covers and fasten down to frame with machine screws.
- D. For gas tight applications, floor plate covers shall be bolted down with full perimeter gasket configured to provide a gas tight seal after installation.
- E. Where indicated on the Contract Drawings, provide hinges, locks and other items as required. Panels detailed with hinges to be complete with lift handles and hold open arms. Hinges to be heavy duty of the concealed type.
- F. Provide additional reinforcement around objects that penetrate through grating profiles and floor plates. Coordinate location of penetrating object with other disciplines. The space between the profile of the grating/floor plate and penetrating object to be kept to a practical minimum.

**PART 3 - EXECUTION****3.01 Installation:**

- A. Install components in accordance with the manufacturer's instructions.
- B. Install all grating panels with carrier or spacer bars lined up to maintain a continuous appearance and fastened securely to all supports.
- C. Install grating and frames flush with surface of surrounding floor.
- D. Install supporting frames by casting directly into the concrete.
- E. Where concrete support is not provided to the edge of the grating or floor plate panel, provide additional framing.

- F. Install floor plates flush with the floor or curb, free of warpage, and in a manner to show continuous appearance. Provide flush headed metal fasteners to hold plates to frames.
- G. Permanently secure all non-hinged grating panels and floor plates to prevent movement.

**3.02 Delivery, Storage and Handling:**

- A. Packing and Shipping: Deliver components, clearly labeled for location.

END OF SECTION 05530

# **DIVISION 7**

# **THERMAL AND MOISTURE PROTECTION**



**INDEX**

SECTIONS

Section 07000 – Thermal and Moisture Protection  
Section 07195 – Air Vapour Barrier  
Section 07200 – Building Insulation  
Section 07535 – SBS Modified Bitumen Roofing  
Section 07620 – Metal Flashing and Trim  
Section 07840 – Firestopping  
Section 07920 – Sealants

END OF INDEX DIVISION 7

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Work Included:**

- A. All labour, materials and equipment necessary to complete thermal insulation, sub-grade level, wall systems, roofing and related work.
- B. Supply and install all manufactured items relating to the scope of the sub-grade level, wall systems, roofing work including insulation/vapour barrier, plumbing roof drain assemblies vent stacks, roof top equipment supports and flashings roof parapet flashing materials.
- C. All shop and field cutting and connections, of sub-grade level, wall systems roofing and related items.

**1.03 Codes and Standards:**

- A. Where provisions of pertinent codes and standards conflict with these specifications and drawings, comply with the more stringent provisions.

**PART 2 - PRODUCTS****2.01 General:**

- A. Comply with product requirements specified and as required. Select all other materials, not specifically described but required for the proper completion of work under this Division.

**PART 3 - EXECUTION****3.01 General:**

- A. Comply with specified and required execution requirements.

END OF SECTION 07000

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 07000 applies to and governs the work of this Section.

**1.02 Work Included**

- A. Provide air and vapour barrier as shown on the drawings and specified herein.

**1.03 Quality Assurance:**

- A. Applicator to be familiar with and fully equipped to apply air/vapour barrier membranes and familiar with good construction practices.
- B. Applicator to be approved by the Membrane Manufacturer and acceptable to the project Engineer for installation of the air/vapour barrier membranes.

**1.04 Delivery, Storage and Handling:**

- A. Materials to be delivered to site in original undamaged packaging indicating the product name and manufacturer.
- B. Store roll materials on end in original packaging.
- C. Store adhesive vapor barrier membranes at temperatures of 5°C and above to facilitate handling. Keep solvent away from open flame or excessive heat.
- D. Protect rolls from direct sunlight until ready for use.

**1.05 Site Conditions:**

- A. No installation work to be performed during rain, wet surfaces, inclement weather and frost covered surfaces.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Air / Vapour Barrier membrane: Henry/Bakor Corp. Air Block 21 Non-permeable synthetic Rubber-Based solvent-type insulation adhesive, trowel consistency or approved Non-permeable Blue-Skin TWF SBS rubberized asphalt.
- B. Thermoplastic Rubber Sealant: Bakor Sealant HE925 BES
  - 1. Air/Vapour barrier to provide a continuous monolithic membrane barrier.
  - 2. Inspect all surfaces to receive membrane. Repair defects which may impair the performance of the membrane.

3. Before covering the membrane, inspect the surfaces thoroughly and repair defective areas. Repair punctures in the membrane with a patch large enough to completely cover (min 20mm lap) damaged areas. Seal edges of patch with approved adhesive.
  4. Fill all joints, gaps and cracks wider than 3 mm with adhesive and reinforce with 300 mm strip of membrane, prior to the application of the full membrane. Ensure continuity of the air vapour barrier membrane at all detail areas.
  5. Apply primer with a brush, spray or roller and allow to dry. Prime only areas that can be barrier membrane covered in a working day.
  6. Use a trowel or caulking gun, apply a bead of mastic to all membrane lap termination joints.
- C. Fasteners: Zinc coated split clips manufactured by Ramset Fasteners Ltd insulated according to manufacturer's recommendations.
- D. Substrate Cleaner: Mineral spirits or Xylol.

### **PART 3 - EXECUTION**

#### **3.01 Preparation:**

- A. Ensure all surfaces are clean, dry and free of oil, grease, dirt, excess mortar or other contaminants.
- B. Concrete Block Masonry and Poured Concrete to be cured for a minimum of 14 days and must be dry before the Air/Vapour Barrier (Air-Bloc 21) is applied.
- C. Fill any large voids or spalled areas to provide an even wall plane.
- D. Cracks in masonry and concrete to be sealed with a strip of Blueskin AG lapped a minimum of 75 mm on both sides of crack.

#### **3.02 Transition Membrane Application:**

- A. Apply transition membrane to all connections of masonry block to steel or concrete; concrete and all beams, columns, window and door frames, etc. using strips of Blueskin AB lapped a minimum of 75 mm on both substrates, ends, side laps and centered over joints.
- B. Unroll sheet membrane into adhesive applying hand pressure.
- C. Seal laps by pressing in place by hand pressure.
- D. Membrane to be mechanically fastened through a metal bar to all wall openings including window, door, louvre sections or an acceptable designed sealant joint provided using Blueskin sealant HE925 BES for hidden joints and Bakor Pro-Seal sealant for exposed joints.

**3.03 Mechanical Fasteners:**

- A. Mechanical fasteners to be used in conjunction with the adhesive for installation of plywood.

**3.04 Air Vapour Barrier at Masonry Joints:**

- A. Coordinate installation with masonry knock-out panel joints, refer to the drawings.

**3.05 Air Vapour Barrier at Deflection Joints:**

- A. Air/Vapour barrier to be continuous at all joints left for structural deflection at the top of walls.
- B. Coordinate with lateral wall support angles.

END OF SECTION 07195

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 07000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide:
  1. Rigid extruded Styrofoam insulation in exterior 'rain screen - cavity walls.
  2. Rigid extruded Styrofoam insulation to exterior face of poured concrete walls and horizontal concrete slabs as shown as shown on drawings.
  3. Semi rigid mineral wool insulation in spaces, and openings shown on the drawings.
  4. Air vapour barrier application, as shown on drawings and specified herein.
  5. Drainage board applications, as shown on drawings and specified herein.

**1.03 Qualifications:**

- A. Employ only skilled mechanics having experience in the work specified, and having an understanding of the design principles of the thermal and vapour barriers, which they are providing.

**1.04 Submittals:**

- A. Submit a 2 year guarantee of the materials and workmanship in the work of this Section.

**1.05 Codes and Standards:**

- A. Insulation to be applied as specified in the "Code of Energy Conservation in New Buildings", Draft, January 1977, or the latest revision thereof.

**1.06 Delivery and Storage:**

- A. Store packaged materials in their original wrappings or containers with manufacturer's labels and seals intact. Store flammable materials outside the building and protect from all weather hazards and open flame. Abide by all fire protection regulations imposed by the authorities having jurisdiction, and take precautionary measures to avoid fire.
- B. Do not store insulation in direct contact with ground, road surface, or floors. Place suitable forms or skids under the insulation to protect the insulation from dampness. Cover material with approved secure tarpaulins.
- C. Provide heated storage for adhesives such that their consistency is suitable for each application.

**1.07 Protection:**

- A. Protect surfaces, in particular building cladding finish, from being marred or contaminated by the materials, by means of protective covers, boards, tapes or other approved means.
- B. Supervise the work of other Sections where such work is closely associated with the work of this Section and report any damage done to the work of this Section.
- C. Protect the work of this Section from wind damage during installation.
- D. Thoroughly ventilate the workplace area where adhesives containing volatile solvents are used.

**1.08 Air/Vapour Barrier:**

- A. The drawings do not indicate every situation where a vapour barrier is required. It is a requirement in the design of the building to provide an integral monolithic impermeable vapour barrier that resists the diffusion of water, vapour and movement under the action of a difference in vapour and air pressure, at the inner face of the insulation. Ensure that the continuity of the vapour barrier is maintained over the entire insulated area and that it extends across all junctions between different materials. Co-ordinate and co-operate with other trades to achieve this requirement.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Roof Insulation – Refer to Roof Membrane specifications in Division 7.
- B. Cavity Wall Insulation:
  - 1. Extruded polystyrene conforming to CAN/CGSB 51.20, type 3 Dow Chemical Co. “cavity-mate”, Styrofoam ‘SM ‘.
- C. Below Grade Poured Concrete Wall/Slab Insulation:
  - 1. Extruded polystyrene conforming to CAN/CGSB 51.20, type 3 Dow Chemical Co., Styrofoam ‘SM ‘.
- D. Apply poured concrete insulation indicated on drawings. Extruded polystyrene minimum 50 mm thickness, unless noted otherwise herein or on the drawings.
- E. Loose Mineral Fibre Insulation:
  - 1. Mineral fibre insulation – “ROXUL”.
  - 2. Conform to CSA-A101 ASTM-X612, density 32 kg/m<sup>3</sup>.
- F. Air /Vapour Barrier sheet membrane and adhesive: Refer to Division 4 Masonry.

G. Insulation for piping and ductwork. Refer to Division 15 Mechanical specifications.

H. Fasteners:

1. Stainless steel split clips manufactured by Ramset Fasteners Ltd. Apply at a rate of 4# fasteners per 600 mm x 200 mm board. 6# per 1200x1200mm board.

### **PART 3 - EXECUTION**

#### **3.01 Installation:**

A. Air/Vapour Barrier Membrane:

1. Install the air/vapour barrier providing a continuous monolithic membrane barrier.
2. Inspect all surfaces to receive membrane. Repair defects which may impair the performance of the membrane.
3. Apply primer with a brush, spray or roller and allow to dry. Prime only areas that can to be covered in a working day. Primed areas not covered with the air barrier must be reprimed.
4. Side laps - minimum 50 mm, end laps 150 mm minimum. Stagger end laps a minimum of 45 mm.
5. Use a small hand roller, roll the membrane face immediately after each length of membrane is applied.
6. Use a trowel or caulking gun, apply a bead of mastic to all membrane lap termination joints.
7. Before covering the membrane, inspect the surfaces thoroughly and repair defective areas. Repair punctures in the membrane with a patch large enough to completely cover (min 20mm lap) the damaged area. Seal edges of patch with approved adhesive.
8. Fill all joints, gaps and cracks wider than 3 mm with adhesive and reinforce with 300 mm strip of membrane, prior to the application of the full membrane. Ensure continuity of the air vapour barrier membrane at all detail areas.

B. Cavity Wall and interior wall/ceiling insulation:

1. Ensure cavity surfaces are clean, dry and free from mortar projection.
2. Insulation board sizes modular to suit masonry block sizes modules, nominally 600 mm x 1200 mm.
3. Insulation adhesive acts as an air/vapour barrier. Trowel apply a continuous coating of adhesive at a uniform minimum thickness of 3.2 mm to the substrate and to all insulation board edges. Tape joints in substrates receiving air/vapour



barrier adhesive. Tape junctions of dissimilar substrates receiving air/vapour barrier adhesive. Apply more adhesive over tape before embedding insulation.

4. Apply membrane to prepared substrate according to manufacturers' recommendations and to all back-up masonry construction joints – horizontal and vertical.
5. Membrane shall be overlapped a minimum of 50 mm on end and side laps.
6. Adhesive shall be applied in full coat using a 30 mm sawtooth notched trowel at the rate of 1.5 l/m<sup>2</sup>.
7. Unroll sheet membrane into adhesive, applying hand pressure.
8. Seal laps by pressing in place by hand pressure.
9. Cut membrane neatly around ties to form a tight seal. Seal around tie with adhesive.
10. Keep air space in cavity minimum 25 mm clear of obstruction. Press insulation boards firmly to substrate. Cut insulation as required and fit snugly to stud framing strapping, pipes, ducts, obstructions, openings and corners. Butt insulation boards tightly and stagger joints. Cut out back of board insulation as required to accommodate substrate irregularities and build up over cut out areas on the other side as required to ensure thermal barrier uniformity. Keep air space in cavity minimum 25 mm clear of obstruction.
11. Seal edges at spandrels and walls to prevent air penetration.
12. All breaks, tears and holes where wall reinforcement passes through insulation shall be sealed to provide a monolithic vapour barrier.

C. Loose Mineral Fibre Insulation:

1. Pack insulation into crevices, between concrete masonry, metal, cartentry, frames about lintels, ducts, etc. and as required by good practice.

D. Below Grade Insulation:

1. Apply where indicated on the drawings.

E. Insulation:

1. Do not install more insulation at one time than can be covered in the same day. Seal edges of insulation at the end of each working period.
2. Press insulation board firmly to substrate, cut as required and fit tight to strapping, pipes, ducts, obstructions, openings and corners. Butt-joint insulation board tight and stagger joints. Cut out back of insulation board as required to accommodate substrate irregularities, build up over cut out areas to maintain thermal barrier uniformity.

3. Prevent air penetration, seal all edges.
4. Fit boards around pipes, ducts, openings and corners, reinforcing and bonding ties, and other obstructions.
5. Conform with manufacturer's recommendations for storage and use of vapour barrier sheet. Butt insulation boards together and stagger joints. Apply firm hand pressure to level insulation boards.
6. Use the largest module of insulation possible where cutting is necessary, to reduce the number of joints. Patch holes and tears with the same insulation material.
7. Permanently seal vapour barrier at points where impaled by screws, masonry reinforcing, or other fastening devices.
8. Ensure that insulation application surfaces are clean, dry and free from projections.
9. Lay multiple layers with joints offset from underlying layer. Insulation fastened through the top layer at the prescribed rate of fasteners, other boards in the assembly may require "position" fastening.
10. Pack loose insulation in crevices between exterior concrete, between deck flutes around ducts at holes, and other locations where exposed to minimize infiltration.
11. Pack into voids around mechanical and electrical pipes and ducts where they pass through walls and slabs.

**3.02 Adjust and Clean:**

- A. On a daily basis as the work progresses and upon completion, clean-up and remove from the site the rubbish and surplus material resulting from the work of this Section.

END OF SECTION 07200

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 07000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide 4 ply modified bitumen membrane roofing as shown on the drawings and specified herein.

**1.03 Referenced Standards:**

- A. Roofing and sheet metal work to be performed in conformance with the roofing product manufacturer's written recommendations, the requirements of ULC laboratories Class C, and the Canadian Roofing Contractor's Association (CRCA).
- B. Conform to CGSB 37-GP-56M-80, Roofing Membrane Modified, Bituminous, Prefabricated, and Reinforced.
- C. Conform to CAN/CGSB-51-26-M86, Thermal Insulation, polyisocyanurate, Board, Faced.
- D. LEED® - Roofing System Components - Leadership in Energy and Environmental Design - LEED® Canada - NC Version 1.0, Canada Green Building Council, December 2004. Conform to re-cycled content and energy star rating.
- E. Conform to FM -Factory Mutual Research Corporation, Current Edition, including Approved Guide, Roof Coverings.
- F. Conform to CAN/ULC S702-97 Mineral Fibre Insulation for Buildings.

**1.04 Compatibility:**

- A. All roofing materials to be provided by the same manufacturer. Provide written confirmation to the Engineer/Architect that all roofing materials and components are compatible.

**1.05 Technical Documents:**

- A. Submit two (2) copies of the roofing product manufacturer's most current technical data sheets. These documents to describe the materials' physical properties, and manufacturer's installation recommendations.

**1.06 Quality Assurance and Environmental Management:**

- A. Manufacturer of elastomeric bitumen products to provide ISO 9001 and ISO 14001 Certification.

**1.07 Contractor Qualifications:**

- A. Roofing contractor to hold a current roofing contractor CRCA operating license.

- B. Roofing contractor to be registered with SOPREMA's PAQ + S. Provide the Engineer/Architect with a roof product manufacturer's certificate to this effect before start of roofing work.
- C. Only qualified, certified installers employed by a company with appropriate equipment to execute the roofing work.

#### **1.08 Manufacturer's Representative:**

- A. The roofing product manufacturer to delegate a representative to visit the work site at the start and at intervals during the roofing installation. The roofing product manufacturer to provide the Engineer/Architect with written reports on the roofing installation.
- B. Facilitate work site access to roofing product manufacturer representative.

#### **1.09 Pre-installation Meeting:**

- A. Contractor schedule a pre-installation meeting prior to start of roofing work, with the roofing contractor's representative, roofing product manufacturer and the Engineer/Architect. Review installation procedures and job site conditions. Roofing product manufacturer to submit a written report on the meeting to the Contractor and Engineer/Architect.

#### **1.10 Storage and Delivery:**

- A. All materials to be delivered and stored in conformance with the requirements described in the manufacturer's Manual; all materials to remain in their original packaging, displaying the manufacturer's name, product name, weight, and reference standards, including other indications or references considered standard.
- B. At all times, materials are to be protected and stored in a dry and properly ventilated area, away from flame or spark and sheltered from the elements or harmful substances. Only materials for same-day use to be removed from the storage area. In cold weather, materials to be stored in a heated area at a minimum temperature of + 10°C and removed prior to application. Materials not stored in a heated environment to be pre-conditioned before installation. Consult product manufacturer's "Roofers' Guide" on membrane application procedures.
- C. Store adhesives and emulsion-based waterproofing mastics at a minimum +5°C. Store adhesives and solvent-based mastics at sufficiently high temperatures to ensure ease of application.
- D. Store materials delivered in rolls upright; store flashings to avoid creasing, buckling, or other possible damage.
- E. Rooftop material loads – confirm material weight/location is acceptable with Engineer/Architect, prior to bulk storage of roof material on the structural roof deck.

#### **1.11 Fire Protection:**

- A. Before work starts, conduct a site inspection to establish safe working practices and ensure all procedures and proposed changes are approved to minimize the risk of fire.
- B. Conform to safety measures described in the roofing product Specifications Manual and CRCA roofing association recommendations.
- C. At the end of each workday, use a heat detector gun to identify any smouldering or concealed fire. Roofing workers to remain on location a minimum of one hour after roof torch application.
- D. Do not apply the torch to wood or other combustible, flammable surfaces.
- E. Throughout the roofing installation, maintain a clean site. Provide approved 'ABC' fire extinguisher within 6 meters of each roofing torch. Conform to safety measures described in technical data sheets. Do not place torches near combustible or flammable products.

**1.12 Warranties:**

- A. Roofing product manufacturer to issue a written document in the owner's name, valid for a fifteen 15 year period, starting from the date of acceptance, stating they will repair any defect in the roofing membrane system restoring the roofing system to a dry and watertight condition, to the extent that membrane system material manufacturing or installation defects caused defect, water infiltration. During the warranty period, the warranty to cover the entire cost of the repair(s). The warranty to be transferable, at no extra cost.
- B. Contractor to provide a warranty for the project, valid for a period of two (2) years covering labour, materials and workmanship for entire area of roofing.

**1.13 Scope of Work:**

- A. Work of this section includes installation of a 4-ply Modified Bitumen membrane roofing system over a metal roof deck, including but not limited to the following (to match existing):
  - 1. Self-adhesive vapour retarder
  - 2. Mechanically fastened mineral wool rigid board insulation
  - 3. Torch-on Base Sheet Membrane
  - 4. Self-adhesive Base Sheet Flashing
  - 5. Torch-on Cap Sheet Membrane and Cap Sheet Flashing

**PART 2 - PRODUCTS****2.01 Product:**

- A. Membrane Roof – 4 ply modified bitumen system.

**B. Acceptable Manufacturer:**

1. First named: Soprema Roofing
2. Acceptable alternate: IKO Roofing

**2.02 Primer:****A. Stabilized bituminous emulsion primer for adhesion of membranes.**

1. Heat welded membranes: ELASTOCOL 500 by Soprema Inc.
2. Solvent free installation, ELASTOCOL 350 by Soprema Inc.
3. Self-adhesive membranes: ELASTOCOL STICK by Soprema Inc.
4. Solvent free installations, ELASTOCOL STICK H20 by Soprema Inc.

**2.03 Vapour Retarder for Metal Roof Deck:**

- A. Product: SOPRAVAP'R by Soprema Inc.
- B. Self-adhesive air/vapour barrier membrane composed of bitumen modified with thermoplastic polymers and high-density polyethylene film. The width of the membrane 1.14 metres to allow the membrane to fit on the top flute of structural steel deck. The self-adhesive under face covered with a silicone release sheet. Water vapour permeability: 0.92 ng/Pa s m<sup>2</sup> (0.016 Perm).

**2.04 Insulation Adhesive for Metal Roof Deck:**

- A. Product: DUOTACK Insulation Adhesive by Soprema Inc.
- B. Low-rise two-part urethane adhesive with no solvent. Allowing a rapid complete cure with no temperature restrictions. VOC-free.

**2.05 Roof Insulation:**

- A. "Soprarock DD" rigid, dual density mineral wool as manufactured by Soprema Canada..., CFC and HCFC free insulation. Recycled content: 54% Post-industrial
- B. Compliance: CAN/ULC-S0704 Insulation Type: 3
- C. Compressive Strength:
  1. Top layer 25%: ASTM C165 - 252 kPa (37.0 psi)
- D. Insulation Board Dimensions: 1220 x 600 or 1220 mm
- E. Conform to ASTM C 518 'R' value 4

- F. Thickness: As indicated on drawings. Maximum 25 mm insulation thickness reduction roof outlet - drain location. Maximum surface area of roof outlet insulation thickness reduction: 750 mm x 750 mm

### **2.06 Flame Stop Membrane:**

- A. Product: SOPRAGUARD tape by Soprema Inc.
- B. Self-adhesive membrane composed of glass mat reinforcement and SBS modified bitumen designed to prevent flame from penetrating void / spaces, openings while installing heat-welded membranes.

### **2.07 Roof Membrane:**

- A. Roof membrane Base Sheet:
  - 1. Product: SOPRAPLY BASE-520 by Soprema Inc.
  - 2. Roofing membrane with glass & polyester reinforcement and elastomeric bitumen. Both sides covered with a thermofusible plastic film. Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.
- B. Roof membrane Base Sheet Flashing:
  - 1. Product: SOPRAFLASH FLAM STICK by Soprema Inc.
  - 2. Roofing membrane with glass mat reinforcement and SBS modified bitumen. The top face covered with a thermofusible plastic film, the under side self-adhesive. Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.
- C. Roofing membrane Cap Sheet and Cap Sheet Flashing
  - 1. Product: SOPRASTAR WF by Soprema Inc.
  - 2. Roofing membrane with composite of fibreglass & polyester reinforcement and SBS modified bitumen top face engineered multi-ply.

### **2.08 Waterproofing Mastics:**

- A. Product: SOPRAMASTIC by SOPREMA. 5% Post-Industrial recycled content
- B. Mastic made of synthetic rubbers, plasticized with bitumen and solvents.

## **PART 3 - EXECUTION**

### **3.01 Surface Examination and Preparation:**

- A. Surface examination and preparation to be completed in conformance with recommendations in the roof product manufacturer's Manual, including fire safety precautions.

- B. Do not begin work before surfaces are smooth, dry, and exempt of ice and debris. Use of calcium or salt for ice or snow removal is not permitted.
- C. Do not install roof materials during rain or snowfall.

**3.02 Installation - General:**

- A. Prepare surfaces and complete waterproofing work in conformance with roofing product manufacturer's requirements, and the Material Installation requirements.
- B. Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.
- C. Complete roofing work in a continuous fashion as surfaces are prepared and conditions permit.
- D. Ensure watertight conditions for roofs at all times, include protection during installation work by other trades and progressive protection as work is completed (e.g. vents, roof drains, roof top equipment etc.)

**3.03 Preparatory Cleaning:**

- A. The work site to be cleared of debris and other materials that hinder the roof installation, performance or present a fire hazard.

**3.04 Installation Equipment:**

- A. Use torches and roof installation equipment approved by roof product manufacturer.

**3.05 Vapour Retarder – Metal Roof Decks:**

- A. Beginning at the bottom of the slope, without adhering the membrane, unroll onto the substrate for alignment. Do not immediately remove the silicone release sheet.
- B. Align the roll parallel to the corrugations of the steel deck. Make sure the membrane overlaps are supported along their entire length.
- C. Peel back one end of the silicone release sheet and adhere this part of the membrane to the substrate. Peel back the remaining release sheet at a 45° angle to avoid wrinkles in the membrane.
- D. If the membrane is not properly aligned, do not try to adjust it. Instead, cut the roll and start again, making sure that it is properly aligned and that it overlaps the end of the misaligned piece by 150 mm.
- E. Overlap adjacent membranes by 75 mm. overlap end laps by 150 mm. stagger end laps by at least 300 mm.
- F. When the vapour barrier is installed directly on the steel deck, place a thin sheet of metal under the end lap of the vapour barrier.



**3.06 Insulation Steel Decks:**

- A. Attach insulation mechanically in conformance with manufacturer's recommendations and Factory Mutual standards 1-60. Mechanically fastened insulation in place with 4 fasteners per 1220 mm x 1220 mm board.
- B. For multiple layers of insulation, stagger all joints between layers.
- C. Install only as much insulation as can be covered in the same day.
- D. Around roof drains lower insulation by 25 mm to create a sump 750 mm x 750 mm maximum in area. Bevel the edge of the insulation on a 45° angle.

**3.07 Membranes:**

- A. Install membrane in strict conformance with SOPREMA installation instructions. Refer to SOPREMA master specifications manual, and the current edition of the Material Installation Guide.

**3.08 Base Sheet:**

- A. Unroll base sheet flashing at drain level with first side lap lined up with drain centre (parallel to roof edge).
- B. Torch membrane entirely onto prepared substrate. Overlap side laps by 75 mm along lines provided to this end, and overlap end laps by 150 mm. Stagger end joints by a minimum of 300 mm.
- C. Torch sufficiently and continuously to avoid wrinkles, air pockets or fishmouths. In cold weather, adjust welding time to obtain homogenous seam (it may be necessary to slow down in certain cases or in colder weather)

**3.09 Asphalt Primer:**

- A. Roofing substrates of wood, metal, concrete, masonry or water-resistant gypsum board surfaces will receive a coat of asphalt primer at a rate of 0.2 to 0.3 l/m<sup>2</sup> (none required for factory-painted metals). All surfaces to be primed must be free of rust, dust or any residue that may hinder adherence. Cover primed surfaces with roofing membrane as soon as possible. Application temperature limit -10°C.

**3.10 Installation of Base Sheet Flashing:**

- A. Apply primer to the substrate at a rate of .25 L/m<sup>2</sup>. Primer should be dry before installation of Base Sheet
- B. Install base sheet flashing in one- (1) metre widths to cover roofing substrate over 100 mm. Overlap side laps by 75 mm. Stagger side laps by at least 100 mm from base sheet overlaps on roof to avoid excessive layering.
- C. Apply base sheet flashing directly onto substrate by removing silicone paper cover sheet. Proceed from top to bottom. Once in place, apply pressure manually in a uniform

fashion to obtain homogenous adherence over entire surface. Seal seams with rubber roller. Nail outside edge at 300 mm o/c. Burn off plastic film of base sheet before adhering base sheet flashing over it.

- D. Seal overlaps at the end of the workday.
- E. Conform to detail SOP07.

### 3.11 Roofing Cap Sheet:

- A. Once base sheet is applied and no defects are apparent, proceed with cap sheet installation.
- B. Unroll the membrane. Relax membrane for 15-20 minutes. Membrane should appear “limp”. The temperature of the cap sheet to be at, or near, the same as the base sheet.
- C. Re-roll the relaxed membrane using a 950 mm (37.5”) long, 100 mm (4”) diameter section of PVC pipe.
- D. Set membrane in place over the base sheet starting at the lowest point on the roof. Offset head laps a minimum of 600 mm and side laps a minimum of 305 mm from those occurring in the base ply membrane. Subsequent rolls to be aligned 165 mm end laps and 76 mm side laps. Avoid overheating.
- E. Joints between two layers to be staggered at least 300 mm.
- F. Back-roll membranes loosely from each end.
- G. Create two equivalent sub-rolls with 900 mm left flat in the center of the sheet. Keep rolls aligned.
- H. Pulling each sub-roll with a roll puller, heat weld the membrane using a sweeping “box” torching technique (see Soprema Roofer’s Guide for details) simultaneously softening the bitumen of both the base and cap membranes to create a 100% heat-fused bond. Do not overheat the membranes. Turn flame from adjacent sheets to avoid discoloring reflective finish.
- I. A neater, cleaner installation can be achieved (i.e., bitumen bleed-out is more uniformly controlled and less chance of heating the adjacent sheet film) if the three 75 mm side laps are sealed using hot air welding techniques (either electric or torch).
- J. Seal end laps using hot air. The white film must be removed at all end laps to ensure a 100% bond of bitumen-to-bitumen. Prepare end laps by carefully scoring the reflective film of the installed membrane at 152 mm from the up-slope end. Use only sharp utility knife blades. Avoid cutting through the membrane reinforcement – score only the film. Should the reinforcement be accidentally cut, completely remove that 150 mm end.
- K. Lightly warm the surface of the scored film to be removed (using a torch or hot air tool) to loosen the bond between the film & bitumen and carefully peel off the film. Use extra heat as necessary. Do not discolor or burn adjoining areas.

- L. Heat-weld the 150 mm end lap, overlapping onto the film edge approximately 13 mm. Ensure that the two membranes are completely heat fused, without air pockets, wrinkles, fishmouths or tears and that the 13 mm overlap protects the cut film edge from delamination. Install with continuous bleed-outs of 3 mm. Bleed-outs greater than 6 mm are not acceptable.
- M. Once installed, check all seam laps using the edge of a round nosed trowel. Correct defects.

### 3.12 Cap Sheet Flashing:

- A. The same scoring & sealing techniques specified above apply when flashings are tied-in to SOPRASTAR FLAM WF installations. When SOPRASTAR FLAM WF membrane is installed as the flashing cap ply, heat or hot-air welding of the side laps is required.
- B. Conform to Soprema detail SOP07.

### 3.13 Patching Procedure:

- A. If the reflective film surfacing is damaged and in need of repair, the following is the recommended repair procedure:
- B. Remove the reflective film a minimum of 75 mm (3") in all directions from the affected area (minimum patch size would be a 6" circle).
- C. The patch must extend a minimum of 13 mm (½") beyond the area where the film was removed.
- D. Cut the patch material out of SOPRASTAR FLAM WF.
- E. Heat, or hot air weld, the patch to the affected area.

### 3.14 Roof Drains:

- A. Conform to SOPREMA detail SOP12.
- B. Conform to SOPREMA detail SOP 16.

### 3.15 Roof Vents:

- A. Conform to SOPREMA detail SOP14.

### 3.16 Roof Top Equipment Curbs:

- A. Conform to SOPREMA detail SOP08.

END OF SECTION 07535

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 07000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide pre-finished metal flashing and trim as shown on the drawings and specified herein.

**1.03 Related Work:**

- A. Sealants - 07920

**1.04 Quality Assurance:**

- A. The contractor shall be a member, in good standing of the Ontario Industrial Roofing Contractors Association.
- B. Work shall be performed only by skilled applicators, operating the necessary equipment to execute the scope of this project. In accordance with C.R.C.A. standards.
- C. Roofing system components -Recycled content and energy star rating - Conform to LEED® Leadership in Energy and Environmental Design - LEED® Canada – Current NC Version, Canada Green Building Council, December
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship:
  - 1. Do not proceed with remaining work until workmanship, colour, and sheen are reviewed by Engineer/Architect.
  - 2. Refinish mock-up area as required to produce acceptable work.

**1.05 Warranty:**

- A. A minimum period of ten (10) years.
- B. The product manufacturer to supply the project Owner with a signed document, certifying that the flashing and trim is warranted to be free of manufacturing defects for a period of Ten (10) years from the date of completion.
- C. Flashing to be watertight.
- D. Provide all applicable material and material/labour warranties offered by the material manufacturers.
- E. Carry out repair work required under the warranty in accordance with the recommendation of the Engineer/Architect.

**1.06 Job Conditions:**

- A. Ensure that all surfaces to receive primer or membrane are clean, level, smooth, solid and dry before commencing work each day.
- B. Do not work during inclement weather conditions.
- C. Temperatures during application shall not be less than the minimum recommended by the material manufacturer.
- D. Stop work when temperature remains consistently below - 18°C, especially when wind chill effect would tend to set bitumen before proper adhesion takes place.
- E. Use only dry materials and apply only during weather that will not introduce moisture into roofing system.

**1.07 Protection:**

- A. Protect surrounding surfaces from bitumen splatter, cover walls in hosing and pumping areas with tarpaulin.
- B. Locate any kettles so exhaust does not enter buildings or discolour surfaces of structures.
- C. Protect finished roofing at work areas or access to work areas with minimum 13 mm “Plywood” or approved equal underlaid with 12 mm insulation board extending 900 mm beyond work area.
- D. Prevent bitumen, or like material, precipitation and debris entering openings and drains during work.

**1.08 Delivery and Storage:**

- A. Deliver and store materials to manufacturer’s instructions.
- B. Do not store materials on roof.
- C. Store materials under cover on elevated platforms, protected from water and construction activities.
- D. Deliver and store materials in original packages with labels intact.
- E. Remove and replace damaged, wet or broken materials.
- F. Stand rolled materials on end, and protect edges.
- G. Cover gravel during inclement weather.
- H. Store materials away from open flame or ignition sources.
- I. Do not transport any materials through the building.

**1.09 Codes and Standards:**

- A. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) – Architectural Sheet Metal Manual.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Sheet metal flashing and trim: 0.76 mm (22 gauge) pre-painted sheet. Finish series 8000 'Colorite'. Colour Vicwest to match existing
- B. Sheet metal flashing (18 gauge) pre-painted steel finish Series 8000 'Colourite' Colour Vicwest to match existing
- C. Cleats and Starter strips: same metal and thickness as sheet metal specified make cleats at least 40 mm wide and interlocked with metal flashing. Starter strips shall be continuous.
- D. Screws, Nails, Bolts, and other Fastenings:
  - 1. Non-corrosive type, compatible with metals being used. Fasteners shall have the same metal finish as the sheet metal being used. Size of fasteners shall suit the applicable conditions and shall be subject to the Architect's/Engineer's review.
- E. Vent Stack covers aluminum as supplied by lexsuco or approved equal. Sleeves 4.8 kg/m<sup>2</sup> copper.
- F. Solder best grade new 50/50 material. Flux resin type.
- G. Back paint for metal quick dry BR 1070 as supplied by Domtar Construction Materials, or other approved manufacturer.
- H. Sealant - refer to Section 07920.
- I. Fibregum shall be heavily fibrated cut back type plastic asphaltic compound complying with C.G.S.B. 37-GP-5.
- J. Cant strips shall be as specified in Division 06200 and to suit specified roofing system.
- K. Downspouts / Accessories – Painted Metal:
  - 1. Downspouts: HSS section
    - a) Size/Profile: 127 mm x 76 mm x 4.78 mm
  - 2. Downspout brackets: screw type – S.S.
  - 3. Downspout elbows, deflector, connector radiused/angled to match downspout cross section:

- L. Downspouts gutters and scuppers fabricated to suit drawing details. Provide downspout scupper box profiles shop drawings ledge caps and associated accessories. Submit shop drawings for Engineer/Architect's review prior to fabrication.
- M. Gutters and Scuppers: 3 mm steel painted finish – match profiles indicated on drawings.

## 2.02 Fabrication:

- A. Fabricate metal flashings, and other sheet metal work to applicable details for all work.
- B. Form pieces in maximum lengths. Make allowance for expansion at joints.
- C. Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- D. General Metal Fabrication: Shop-fabricate work to the greatest extent possible. Comply with details indicated on Drawings, and with applicable requirements of SMACNA. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems
- E. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams. Form seams and solder tin edges to be seamed.
- F. Expansion and Contraction:
  - 1. Provide for thermal expansion and contraction, and building movement in completed work, without over-stressing the material, breaking connections, or producing wrinkles and distortion in finished surfaces. Make watertight and weather-resistive.
  - 2. Where subject to thermal expansion and contraction, attach members with clips to permit movement without damage, or provide slotted or oversize holes with washers only, as acceptable to Engineer/Architect.
  - 3. Make lock seam work flat and true to line, and sweat full of solder, except where installed to permit expansion and contraction.
    - a) Lap flat lock seams and soldered lap seams according to pitch, but in no case less than 76 mm. Make seams in direction of flow.
- G. Sealant Joints: Where movable, non-expansion type joints are indicated, or required for proper performance of work, form metal to provide for proper installation of sealant per SMACNA standards.
- H. Metal Separation: Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with bituminous coating or other permanent separation as recommended by manufacturer.

## I. Soldering:

1. Clean material and tin prior to soldering. Solder with heavy coppers of blunt design, properly tinned before use.
2. Solder slowly with well-heated coppers. Heat seams thoroughly and completely fill with solder.
3. Make exposed joints on finish surfaces full flowing and smooth.
4. Wash acid flux with soda solution after soldering, and remove soldering flux on exposed surfaces.

## J. Accessories:

1. Accessory items shall be furnished by manufacturer; color to match specified profile unless noted otherwise.
2. Provide matching accessories such as extenders, brick/wall caps, gutters and downspouts, or other special fabrications from the manufacturer; color to match specified profile unless noted otherwise.

**PART 3 - EXECUTION****3.01 Examination:**

- A. Examine work on which work of this Section is supported or comes into contact and do not proceed unless surfaces and conditions are acceptable.
- B. Prior installation, the installing contractor shall inspect the structure to determine suitability for attachment of the fascia/coping/flashing system thereto.
  1. All horizontal wood nailers to receive the fascia/coping/flashing shall be pressure treated with preservative. Install horizontal, true and level, free of protruding knots, splinter or other irregularities.
  2. Nailers Attachment: Comply with Factory Mutual Loss Prevention Data Sheet 1-49 recommendations for the attachment of nailers and spacing of fasteners.

**3.02 Installation:**

## A. Flashing:

1. Metal work to be watertight under all service and weather conditions.
2. Back paint with bituminous paint, sheet metal that comes into contact with another kind of metal or masonry or concrete.
3. Install metal counter flashing in accordance with the best trade practice and to C.R.C.A. standards. Extend flashing down to and turn out onto the surface of the roof.



**B. Vent Pipes and Flashing:**

1. Solder copper sleeves into place with horizontal metal flanges extending a minimum of 200 mm all around the base of flashing.
2. Set flanges in a trowel coat of fibregum and “strip in” flange with 3 plies of roofing felt.

**C. Flash and counter flash sleepers for mechanical equipment as detailed or as required.****D. Membrane Underlayment:**

1. Install underlayment to all surfaces to be covered with sheet metal flashings.
2. Ensure substrate is cleaned of all dirt and debris and is free from frost or moisture.
3. Prime surfaces as recommended by membrane manufacturer.
4. Install underlayment in longest practical lengths to minimize end laps.
5. Roll membrane immediately after placement to ensure complete contact with the substrate. Use size and type of roller specified by the membrane manufacturer.

**E. Pitch Pans:**

1. Form pitch pans from galvanized metal
2. Upstand shall be minimum 4 inches (100 mm) above the finished roof. Flanges shall be minimum 4 inches (100 mm) with solid corners.
3. Pan size shall be minimum 2 inches (50 mm) wider than the roof penetration.
4. Install pan such that the penetration is centered and not touching the sides.
5. Strip in flanges of pitch pan with specified flashing materials.
6. Fill pans with specified filler.

**F. Cleaning:**

1. Remove all debris from the roof on a daily basis and dispose of in a proper manner.
2. Ensure all sheet metal cuttings and screws are removed from the roof surface to prevent damaging the roof membrane.

**G. Completed work shall be true to line without buckling, creasing, warp or wind in finished surfaces. "Oil-canning" surfaces are not acceptable.**

- H. Isolate dissimilar metals, masonry or concrete from metals using bituminous paint, tape or slip-sheet. Use gasketed fasteners where required to prevent corrosive actions.
- I. Allow sufficient clearances for expansion and contraction of linear metal components. Secure metal using continuous cleats, clips and fasteners as required by the system. No exposed face fastening shall be accepted.

**3.03 Protection:**

- A. Protect installed products until completion of project.
- B. Maintain prefinished surfaces in undamaged condition until date of substantial completion. Repair or replace damaged components, any touch-up to be indistinguishable from undamaged surface/finish.
- C. Upon completion of work, a final inspection by the Municipality's representative shall be made. Any necessary corrective actions will be noted and the installing contractor shall make corrections within five (5) working days. Upon acceptance of the project, any applicable warranties shall be presented to the Municipality's representative.

END OF SECTION 07620

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 07000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide fire stopping systems as shown on the drawings and specified herein including:
  - 1. Penetrations for passage of duct work, cable, cable tray, conduit, piping, electrical busways and raceways through fire rated walls, floor, ceiling slab assemblies and service shafts.
  - 2. Openings between structurally separated sections of walls floor and ceiling assemblies.
  - 3. Gaps between top of walls, ceiling and roof slab assemblies.
  - 4. Expansion joints in fire rated floors, walls and roof slabs.
  - 5. Openings and penetrations in fire rated walls, including walls incorporating fire rated doors, windows, louvers and other wall openings.
  - 6. Openings around structural members penetrating fire rated floors, walls and roof slabs.

**1.04 Referenced Standards:**

- A. Standard Method of Fire Tests of Through Penetration Fire Stops, ULC-S115-M or CAN4-S115-M, Test Requirements.
- B. Underwriters Laboratories of Canada (ULC) CAN4-S115-M under their designation of ULC-S115-M publishes the results in Fire Resistance Ratings Directory.
- C. Tests for Fire Resistance of Building Joint Systems, UL 2079, Test Requirements.
- D. Standard Test for Resistive Joint Systems, ASTM EI966 under designation UL 2079.
- E. Ontario Building Code, Canadian National Building Code.
- F. NFPA 101-Life Safety Code.
- G. Canadian Electrical Code.

**1.05 System Description:**

- A. Performance Requirements: Provide firestop systems which have been manufactured and installed to maintain performance criteria stated by manufacturing without defects, damage or failure.

**1.06 Submittals:**

## A. Product Data:

1. Materials list of items to be provided under this specification section;
2. Manufacturer's specifications and other data required to confirm compliance with the specified requirements;
3. Shop Drawings: Submit shop drawings showing layout, profiles and product components. Include ULC/ULc system designations or other code compliant independent laboratory system classifications.
4. Certification from sealant manufacturers that their products are suitable for the use indicated and comply with specification requirements.

**1.07 Quality Assurance:**

A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

## B. Applicator Qualifications:

1. Applicator to have a minimum three years' experience in installing materials of types specified and have successfully completed at least three projects of similar scope and complexity.
2. Applicator to designate a single individual as project foreman who shall be on site at all times during installation.

## C. Single source responsibility for firestopping materials:

1. Obtain firestop materials from single manufacturer for each different product required.
2. Manufacturer instruct applicator in procedures for each material.

## D. Regulatory Requirements:

1. Firestop System installation must meet requirements of CAN4-S115-M, ASTM E-814, ULc 1479 or ULc 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
2. Proposed firestop materials and methods to conform to applicable governing codes having local jurisdiction.
3. For those firestop applications that exist for which no tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar independently tested system designs will be submitted to local authorities having jurisdiction for their review and approval prior to installation.

Manufacturer's engineering judgment drawings must follow requirements set forth by the International Firestop Council.

**1.08 Delivery, Storage and Handling:**

- A. Deliver the materials to the job site in the manufacturer's containers, containing the appropriate classification label, with all labels intact and legible at time of use.
- B. Store materials in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
- C. Before handling, read product data sheets and material safety data sheets. Do not use damaged or expired materials.

**1.09 Warranty:**

- A. Deliver to the Engineer signed copies of the following written warranties against material failure:
  - 1. Manufacturer's standard warranty covering firestop materials.
  - 2. Applicator's standard warranty covering workmanship.

**PART 2 - PRODUCTS****2.01 Acceptable Manufacturer:**

- A. First named: Tremco - Fire Stop System Products
- B. Acceptable alternate: Hilti - Fire Stop System Products

**2.02 Materials:**

- A. Fire-stopping and smoke-seal systems: Conform to CAN4-S115 or ASTM E814
  - 1. Asbestos-Free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN4-S115 or ASTM E814, not to exceed opening sizes for which they are intended, in accordance with ULC (Guide 40-419.13), cUL ; WH Design Numbers, or other design numbers acceptable to local authority having jurisdiction.

**2.03 Source Quality:**

- A. Source Quality: Obtain firestop system products from a single manufacturer.
- B. Manufacturer's field services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installations.

**PART 3 - EXECUTION**

**3.01 Examination:**

- A. Site Verification of Conditions: Verify substrate conditions previously installed under other sections, are acceptable for product installation packaging instructions.
  - 1. Examine areas and conditions under which work is to be performed. Identify and advise on conditions detrimental to proper and timely completion.

**3.02 Preparation:**

- A. Surface Preparation: Prepare surface to receive firestop system products in accordance with manufacturer's surface preparation requirements/instructions.
  - 1. Verify penetrations and joints are correctly sized.
  - 2. Secure all pipes, conduit, cable, and other items which penetrate firestop materials.
  - 3. Comply with manufacturer's instructions relative to temperature and humidity conditions, before, during and after installation of firestopping materials.
  - 4. Do not proceed until unsatisfactory conditions have been corrected.

**3.03 Installation:**

- A. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
- B. Seal all joints to ensure an air and water resistant seal, capable to withstand compressions and extension due to thermal, wind or seismic joint movement.
- C. Consult with mechanical engineer, project manager prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

**3.04 Field Quality Requirements:**

- A. Examine sealed penetration and joint areas to ensure proper installation before concealing or enclosing areas.
- B. Keeping areas of work accessible until inspection by applicable code authorities.
- C. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

**3.05 Identification:**

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, printed vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: “Warning: Through-Penetration Firestop system – Do Not Disturb”
2. Contractor name, address, and phone number
3. Designation of applicable testing and inspection agency
4. Installation date
5. Firestop materials manufacturer’s name

END OF SECTION 07840

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 07000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide sealants as shown on the drawings and at the following locations:
  - 1. Metal flashings and trim.
  - 2. Door, Louvre frames.
  - 3. Pipes, Ducts contact and other items passing through floor, walls, ceiling slabs and roofs.
  - 4. Junction between dissimilar materials, interior and exterior not specified elsewhere.

**1.03 Related Work:**

- A. Metal Flashing and Trim - 07620
- B. Hollow Metal Doors and Frames - 08110

**1.04 1.04 Qualifications:**

- A. Application of sealants shall be by approved and recognized skilled applicators in strict accordance with manufacturer's printed directions, using pressure gun and equipment approved by the sealant manufacturer.

**1.05 Delivery, Storage:**

- A. Deliver materials in original sealed containers with labels unbroken and in warm dry conditions.

**1.06 Job Conditions:**

- A. Do not apply materials when ambient air temperature and surface temperatures are below 4°C.

**1.07 Protection:**

- A. To prevent contamination of adjacent surfaces, mask areas adjacent to joints with masking tape. Remove tape immediately when joint has been completed.

**1.08 Extended Warranty:**

- A. Total warranty period: Five (5) years.



- B. Submit extended warranty to the Region covering defective materials and workmanship for a period of four years from the end of the standard one-year warranty.
- C. The following is judged defective: leakage, hardening, cracking, and crumbling, melting, shrinkage, running of sealants, loss of adhesion or staining of adjacent work or surfaces.

## **PART 2 - PRODUCTS**

### **2.01 Materials:**

- A. Sealant cartridge labels indicating conformance to reference specifications are acceptable as verification contents meet the specified project requirements. Colour to be selected by the project Engineer/Architect from the Manufacturer's standard colour range.
- B. Sealant for interior and exterior locations - Two (2) part component Non-Sag polytremdyne "dymeric" sealant, conforming to CAN 2-19-24-M90 manufactured by Tremco Manufacturing Co. (Canada) Ltd. Colour selected to match background and reviewed by the project Engineer/Architect.
- C. Sealant for interior and exterior fire separation locations – Sika Flex 2C NS/EZ, Two (2) part component Non-Sag polyurethane based elastomeric fire rated joint sealant, conforming to CAN 2-19-24-M90 manufactured by Sika Manufacturing Co. (Canada) Ltd. Colour selected to match background and to be approved by the project Engineer/Architect.
- D. All external walls, doors, windows, louvres, frames – install low density/expansion ("energy") polyurethane insulation foam 'void fill'
- E. Closed cell P.V.C. foam rope packing, Ethafoam as distributed by Superior Concrete Accessories or other approved manufacture. Packing to be compatible with sealant and 50% greater width than joint width.
- F.
  - 1. Alcohol or Toluol cleaners or primers, or as recommended by the caulking and sealant manufacturer.
  - 2. Primer - specifically designed for use with caulking compounds on surfaces encountered, and as specified by the compound manufacturer, to assure adhesion of compound and to prevent staining of substrate material.
- G. One part silicone, CGE "silpruf", conforming to CGSB 19-GP-16, manufactured by Canadian General Electric Co. Ltd. Colours as selected by the project Region.

## **PART 3 - EXECUTION**

### **3.01 Location:**

- A. Seal with 'dymeric' sealant at dissimilar materials, including the following 'interior and exterior' locations:
  - 1. Metal to metal.

2. Around pipes and service penetrations, roof and roof flashings.
  3. Perimeter of all component frames and supports, including doors, windows and louvres.
  4. Concrete to metal.
  5. At junctions, full height of intersecting interior masonry walls including at angular corners. Vertical joints on both sides will be raked out to a depth of 13 mm under Masonry Section 04000.
  6. Perimeter junction of hollow metal frames and screens occurring in Unit Masonry Construction, on both sides to walls.
- B. Seal with Sikaflex 2C at the following locations:
1. Structural expansion joints.
  2. Other applications specified on the structural drawings.

### 3.02 Preparation:

- A. Clean all joints and spaces of all dirt, grease, oil, loose mortar, protective coatings, etc.
- B. Wipe metal surfaces with an approved cleaner and dry with clean cotton.
- C. Use pressure air stream to remove dust and water.
- D. Fill all spaces wider than 6 mm and deeper than 12 mm with packing to within 12 mm of the surface.
- E. Prime surfaces in accordance with sealant manufacturer's recommendations.

### 3.03 Application:

- A. Work of this Section to include all caulking, except where specified under the work of other Sections, to make the structure weather and airtight, as indicated typically on drawings, and as specified
- B. Prime surfaces to receive sealants as required by substrate and manufacturer's specifications to provide positive and permanent adhesion, and to prevent staining.
- C. Pack joints tightly with sealant backing set at depth specified for sealant. Fill other voids with filler.
- D. Sealant depths in concrete and masonry - 6 mm for joints up to 12 mm wide; 10 mm for joints between 12 mm and 20 mm wide; 10 mm to 12 mm for joints between 20 mm and 25 mm wide; 20 mm for joints between 25 mm to 50 mm wide. In non-porous materials such as metal and glass, and between metal and masonry, sealant depths are to be not less than 6 mm and the joints not less than 6 mm wide.

- E. Fill joints to specified or indicated depths with caulking or sealant compound. Perform work using pressure guns and other equipment as provided by manufacturer. Finish joints so that they are smooth, and free from ridges, wrinkles, air pockets, and embedded foreign materials.
- F. Tool caulking into crevices to assure positive adhesion to side surfaces.
- G. Provide a smooth even finish, free from ridges, wrinkles, air pockets and embedded foreign matter.
- H. Mask off surfaces subject to staining and remove marking as work progresses.
- I. Caulk joints in site painted materials after adjacent surfaces have been painted.

**3.04 Clean-up:**

- A. Do not use chemicals, scrapers, or other tools which would damage surfaces of caulked materials when excess compounds or droppings are removed. Work damaged by cleaning shall be made good under work of this Section.
- B. Remove excess material immediately, clean off surrounding surfaces and leave the whole in a neat clean condition.

END OF SECTION 07920

# **DIVISION 8**

## **DOORS AND WINDOWS**

**INDEX**

SECTIONS

Section 08000 – Doors and Windows

Section 08110 – Hollow Metal Doors and Frames

Section 08710 – Door Hardware

END OF INDEX DIVISION 8

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Work Included:**

- A. The work of this Section includes, but is not necessarily limited to:
  - 1. Exterior/Interior Hollow Metal Doors and Frames.
  - 2. Door Hardware.

**1.05 Submittals:**

- A. Submit manufacturer's drawings for doors, frames, hardware, windows, and glazing. Show thickness of metals, construction details, attachments and reinforcing for hardware and other pertinent assembly information. Verify dimensions on site before fabricating.
- B. Submit samples of all items, indicated in the specification sections enclosed herein.

**PART 2 - PRODUCTS****2.01 General:**

- A. Comply with product requirements outlined in the Standard Sections, and/or as specified on the project Drawings. Select all other materials, not specifically described but required for the proper completion of this Division, subject to the approval of the project Engineer/Architect.

**PART 3 - EXECUTION****3.01 General:**

- A. Comply with execution requirements outlined in the Standard Sections, and/or as specified on the project Drawings.

END OF SECTION 08000

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 08000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide Hollow metal doors, frames and hardware as shown on the Drawings and specified herein. On existing structures
- B. This work includes coordination of new opening cut on existing wall to accommodate new door and frame.

**1.03 Related Work:**

- 1. Door Hardware - Section 08710
- 2. Painting - Section 09900

**1.04 Quality Assurance:**

- A. Qualification:
  - 1. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.
  - 2. Manufacturer to be certified by the Canadian Steel Door and Frame Manufacturers' Association, and applicable "Manufacturing Standard for Doors and Frames".

**1.05 Acceptable Manufacturers:**

- A. S.W. Fleming Co. Ltd., Ajax, Ontario.
- B. Allmar International , Richmond Hill/Markham, Ontario
- C. Daybar Industries Ltd. Mississauga, Ontario.

**1.06 Delivery and Storage:**

- A. Prevent rust and other damage to materials during delivery and storage and store in dry conditions, under cover.
- B. Stack on wood bearers, properly supported to prevent twisting, warping and other deformation.

**1.07 Schedules:**

- A. Check Door Schedule and Details for door numbers, types, sizes, thickness, frame types and all other relevant information.
- B. Refer to Hardware Schedule for types of hardware to be installed.
- C. Door sizes shown on the Door Schedule are nominal only. Make allowance for clearances.

**1.08 Shop Drawings:**

- A. Show full details of all specified items noting gauges, anchors, jointing and chores.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Doors to be fabricated from tension leveled steel conforming to ASTM A924-97(M-97), galvanized conforming to ASTM A653-97(M-97), Commercial Steel (CS), Type B, the steel coating designation A40 (ZF120), product known as paintable Galvanneal.
- B. Nominal Gauges referenced throughout this specification are summarized below, in accordance with National Gauge Standard Tolerances.

Gauge	10	12	14	16	18	20	22
Imperial	.138"	.105"	.075"	.060"	.048"	.036"	.030"
Metric (SI)	3.5 mm	2.7 mm	1.9 mm	1.6 mm	1.2 mm	0.9 mm	0.8 mm

- C. Gauges (minimum):

- 1. Doors: 16 gauge – 1.6 mm
- 2. Frames: 14 gauge – 1.9 mm

- D. Door Core:

- 1. Fiberglass: Loose batt type, density: 24 kg/m<sup>3</sup> (minimum), conforming to ASTM C665 and CSA A101-M83.

**2.02 Fabrication:**

- A. Doors flush type 45 mm with provision for glazed and/or louvered openings as indicated on the project drawing design schedule.
- B. Doors internally reinforced with 20 gauge continuous interlocking steel stiffeners 150 mm on center, securely welded to each face sheet at 150 mm on center, with voids



between stiffeners filled and sound deadened with 24 kg/m<sup>3</sup> loose batt type fiberglass insulation material.

- C. Door edges continuously welded full height of door, filled and ground smooth, with no visible seams.
- D. Doors beveled on both lock and hinge edges.
- E. Top and bottom of doors provided with protection welded, inverted 16 gauge, 1.6 mm end channels.

### 2.03 Reinforcement:

- A. Doors blanked, reinforced, drilled and tapped for fully template mortised hardware.
- B. Hinge reinforcing 10 gauge 3.5 mm steel, high frequency type.
- C. Cylindrical lock, ASA strike and flush bolt reinforcing 12 gauge 2.7 mm minimum.
- D. Mortise lock and surface mounted hardware reinforcing 16 gauge 1.6 mm minimum.
- E. Integral 14 gauge 1.9 mm continuous steel closer reinforcing channel at top of door.
- F. Flush bolt: 16 gauge - 1.6 mm
- G. Door closer/holders: 12 gauge - 2.7 mm
- H. Push bars: 16 gauge - 1.6 mm
- I. T-strap anchors: 16 gauge - 1.6 mm
- J. Stirrup-strap anchors  
50 mm x 250 mm minimum 16 gauge - 1.6 mm
- K. Jamb floor anchors: 16 gauge - 1.6 mm
- L. Jamb spreaders: 16 gauge - 1.6 mm
- M. On exposed surfaces where zinc has been removed during fabrication, doors to receive a factory applied touch-up primer.
- N. Remove all wraps/covers upon delivery at building site, store in a dry location, vertical position, space with blocking to permit air circulation between doors. Cover to protect from damage.
- O. Install doors in accordance with NAAMM-HMMA 840, "Installation Guide for Doors and Frames". For fire rated conform to doors NFPA 80.
- P. Prior to site touch-up, exposed surfaces of steel to be cleaned. Finish paint as specified.

- Q. Exposed surfaces scratched or otherwise marred during shipping, handling or installation to be touched-up with a rust inhibitive primer.
- R. Finish paint doors/frames in accordance with Section 09900.
- S. Door Bumpers: Glynn Johnson rubber type #64.
- T. Door-shop primers, conform to Primers: CGSB 1-GP-40M and CGSB 1-GP-178Ma.
- U. Exterior doors to be provided with flush steel (top of door) caps.

**2.04 Fabrication:****A. General:**

- 1. Construct in accordance with details and reviewed shop drawings, fully welded construction with no visible seams or joints on faces or vertical edges.

**B. Doors:**

- 1. Mortise, reinforce, tap and drill doors and reinforcements to receive hardware, using templates provided by hardware supplier. Mounting heights: as specified in Section 08710.
- 2. Exterior hollow metal doors to be completely watertight.

**C. Frames:**

- 1. Install 3 bumpers on strike jamb or frame.
- 2. Protect strike, hinge and overhead concealed door closer reinforcements completely by guard boxes welded to frame.
- 3. Weld in 2 channel spreaders per frame, to ensure proper frame alignment.
- 4. Where frames terminate at finish floor, provide floor plates for anchorage to structural slab.
- 5. Cut mitres accurately and weld continuously on inside of frame profile.
- 6. Grind welded corners to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- 7. Provide 3 'T' strap adjustable jamb anchors per jamb for frames up to 2100 mm high to be installed in masonry walls or anchored to structural frames.
- 8. Provide one additional anchor per jamb for each 300 mm increase in height of door frames over 2100 mm.
- 9. Exterior doors/frames insulate with fiberglass or low density spray urethane foam or mineral wool.

**2.05 Finishing:**

- A. Doors and frames: Apply site primer finish coats of rust inhibitive as per Paint/Protective Coatings Schedule. Section 09900.

**2.06 Fire Doors and Frames:**

- A. Supply fire door and frame assemblies hardware preparation to conforming to specified fire resistance rating. Install appropriate metal U.L.C. label. (Do not paint label.)
- B. Review Hardware Schedule. Advise if scheduled hardware fails to comply with U.L.C. requirements.

**PART 3 - EXECUTION****3.01 Examination:**

- A. Inspection:
  - 1. Prior to work of this Section, inspect the installed work of all other trades. Verify that all such work is complete to the point where door and frame installation may properly commence.
  - 2. Verify units are installed in accordance with all pertinent regulatory codes, referenced standards, and project design criteria.
- B. Discrepancies:
  - 1. Notify the Engineer/Architect immediately in the event of discrepancies.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.02 Fitting and Hanging Doors:**

- A. Hang doors with 1.6 mm clearance at head and jamb.

**3.03 Finish Hardware:**

- A. Refer to Section 08710.
- B. Obtain necessary templates for drilling, tapping and other preparatory work necessary to accommodate door and frame hardware.

END OF SECTION 08110

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 08000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide door hardware as shown on the Drawings and specified herein.

**1.03 Related Work:**

- A. Hollow Metal Doors and Frames - Section 08110

**1.04 Quality Assurance:**

- A. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.
- B. Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- C. Canadian General Standards Board (CGSB):
  - 1. CAN/CGSB-69.34-93/ANSI/BHMA A146.18, Materials and Finishes.
  - 2. CAN/CGSB-69.17, Bored and Preassembled Locks and Latches.
  - 3. CAN/CGSB-59.20-M90/ANSI/BHMA A156.4, Doors Controls (Closers).
  - 4. CAN/CGSB-69.18-M90/ANSI/BHMA A156.1, Butts and Hinges.
  - 5. CAN/CGSB-69.19-93/ANSI/BHMA A156.3, Exit Devices.
  - 6. CAN/CGSB-59.29-93/ANSI/BHMA A156.13, Mortise Locks and Latches.

**1.05 Qualification:**

- A. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.

**1.06 Reference Standards:**

- A. Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction), prepared by Canadian Steel Door and Frame Manufacturers' Association.

**1.07 Submittals:**

- A. Submit a comprehensive itemized schedule of hardware for each door to the Engineer/Architect for review.
- B. The schedule to include a complete list of hardware illustrations.
- C. Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- D. Submit samples of each type of hardware specified.
- E. Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

**1.08 Requirements of Regulatory Agencies:**

- A. Install ULC listed and labelled hardware for fire rated door frame locations.

**PART 2 - PRODUCTS****2.01 Materials Door/Doorframe:**

- A. Door closers, locksets, latch sets, and hinges: Stainless steel core and finish.
- B. Bolts, screws, expansion shields and other fasteners required for application of finish hardware to be of size and type to fit requirements and of same material and finish as exposed parts of such hardware.
- C. Exposed screws and bolts countersunk oval heads, and bolts, provided with cap nuts. Finish countersunk part of screws and bolt holes smoothly without sharp edges.
- D. Bolts and screws to be provided with Phillips heads.
- E. Lock strikes ASA with lip.
- F. Door closers to have back-checking features of size to operate each respective door efficiently.
- G. Closers on steel doors to be through bolted.

**2.02 Keying System:**

- A. Keying System to be coordinated between Owner and contractor.
- B. All access controlled doors to be configured to allow manual key entry. The Contractor is responsible for ensuring the door hardware, electric door strikes, exit devices, etc., are compatible to provide this function.
- C. Master key all locks. Coordinate with the project Engineer/Architect, Master Keying to operate in accordance with the New /Existing Project Plant: Master Key System.

- D. Multi-Lock key systems – Supply and Installation: 'Les French' Locksmith Co. Peterborough
- E. All keys to be stamped “Restricted Do Not Duplicate” and identified with a unique number, approved by the Owner.
- F. The system shall be proprietary. The Region to provide the manufacturer a list of authorized persons and their signatures who are to order additional material or duplicate keys. Orders not bearing authorized signatures not to be provided.

**2.03 Templates:**

- A. Deliver sufficient templates to enable door and door frame manufacturers to fabricate and reinforce their materials to accommodate finish hardware.

**2.04 Hardware:**

- A. Hinges: Stanley
  - 1. Exterior doors: Heavy duty Stainless Steel, continuous full mortise with adjustable full-wrap edge guard, type 652HD (32D).
    - a) Provide 2 pairs of hinges for each door up to 2.6 metres height
    - b) Provide 3 pairs of hinges for each door 2.6 metres high and above.
- B. Cylinders:
  - 1. Stainless steel cylinders will be coordinated between Owner and contractor.
  - 2. Rim Cylinders: Medeco Series 10T0400 DB 26.
  - 3. Key-In-Knob Cylinder: Medeco Series 20T8006 DB 26
  - 4. Cylinders Commercial Grade 1 hardware.
  - 5. There shall be no springs or pins which could cause malfunction in the presence of dirt, moisture, poor weather conditions, corrosion or freezing.
  - 6. Cylinder to allow only the correct key to align the gates on all the discs and allow the locking bar to disengage the cylinder from the housing.
  - 7. Control keys to have the ability to be mastered.
- C. Lock and latch sets (mortised):
  - 1. CGSB 69- GP-13M and CGSB 69-GP-14M, designed for function and keyed as stated in schedule, having latch bolt throw and dead bolt throw, with knobs, knob trim escutcheons roses, stainless steel finished.

2. Locksets: Exterior and Interior locksets Yale Heavy Duty 5400LN “AU” design or Schlage Heavy Duty “ND” series “Rho” design complete with strike. Locksets Stainless Steel finish.
3. Latchets: Interior latch sets Yale Heavy Duty 5300LN “AU” design, or Schlage Heavy Duty series, “Sat” design, complete with strike. Latch sets Stainless Steel finish.
4. Mortise dead lock: Stainless steel conform to CGSB 69-GP-13M/14M function, stainless steel finish.
5. Cylinders: Stainless steel finish locksets; for installation in deadlocks provided to doors listed in hardware schedule.

D. Astragals:

1. All building perimeter doors to be equipped with hardened metal astragals to prevent tampering with latch hardware.

E. Panic and Exit Devices:

1. Panic exit devices for regular and fire rated doors to be approved for use by the Underwriters’ Laboratory and the local authorities as Fire Exit Hardware.
2. Panic exit devices to be stainless steel rim type Yale 7100 and 7100F or Von Duprin 98 TP and 98 TP-F.
3. Panic exit devices: Design with removable stainless steel cover plates concealing mechanism and fasteners, equip with dogging device.
4. Rim device for single doors prepared for outside cylinder.
5. Rim device for single doors with thumb latch and handle prepared for outside cylinder.
6. Rim device as 4A rim device, except mortise. Type 4D as 4B rim device, except mortise Type 4E.
7. Rim device for pair of doors with vertical rods.
8. Rim device for pair of doors with vertical rods and outside control to take cylinder.
9. Rim device for narrow style doors prepared for outside cylinder.
10. Concealed device for narrow style doors with vertical rods.
11. Concealed device for narrow style doors with vertical rods and outside control to take cylinder.

F. Strikes: box type, lip projection not beyond jamb ASA dimensions.

## G. Door Closers and Holders:

1. Door closers: to CGSB Standard size as per recommended by manufacturer for door size listed in drawings, with back checking action, equipped with hold-open arm, equipped with fusible link for (fire doors) finished with lacquer with chromium plating and equipped with parallel arms/brackets.
2. Supply brackets where necessary or recommended by the manufacturer.
3. Install one closer for each door leaf.
4. Exterior doors: Norton Door Controls Unitrol Series UNI-7500H or LCN P4040H with GJ100 LP by Glynn Johnson. (Hold open arm not permitted on fire rated doors.)

## H. Push Plates:

1. Stainless steel to CGSB 69-GP-6M, bevelled edges.
2. Push plates stainless steel 100 mm x 410 mm, .050 gauge. By Canadian Builders Hardware Mfg. Inc.

## I. Door Pulls:

1. Stainless steel to CGSB 69-GP-6M, pull size, 200 mm plate stainless steel material.
2. Door pulls Canadian Builders Hardware Mfg. Inc. No. 9123 – Stainless Steel.

## J. Kick Plates:

1. Provide on both sides of each door.
2. 1.3mm (18ga) stainless steel type 304, #4 finish, conform to CGSB 69-GP-6M, bevelled edges.
3. Fasteners to be stainless steel screws. Predrill and counter sink for screw fixing.

## K. Door Bolts:

1. For all double door systems, the inactive leaf to contain a “locking bolt” flush mounted in the door frame top and bottom. The unit complete with strike plate. Bolts mounted in the door end so that not visible when closed.
2. Door bolts: Hager Hinge Canada Ltd. Type No. HA1250 (Stainless Steel C32D).
3. Surface bolts: conform to CGSB 69-GP-6M stainless steel including stainless steel finish mortised keeper.
4. Flush bolts: conform to CGSB 69-GP-6M, Type 6 stainless steel 150 mm long x 28 mm bolt throw. Bolts in inactive leaf door panel only.



5. Lever extension flush bolts: conform to CGSB 69-GP-6M +Amdt-May-79, stainless steel 19 mm back set, include mortise keeper.
6. Mortise door bolt: stainless steel conform to CGSB 69-GP-6M thumb turn, mortised stainless steel keeper.

**L. Door Holder**

1. Floor type: conform to CGSB 69-GP-6M non-automatic spring actuated roller.
2. Overhead type: conform to CGSB 69-GP-6M parallel arm, surface mounted.

**M. Door Stops:**

1. Floor mounted dome door stops type CBH-101 (Cast Alum.), supplied by Canadian Builders Hardware Mfg. Inc.
2. Overhead mounted door stops (use where floor mounted dome stops cannot be used), Rixson heavy duty 6 Series or GJ100 LP by Glynn Johnson.
3. Door stop: conform to CGSB 69-GP-6M finish stainless steel, wall or floor mounted as drawing schedule.

**N. Door bottom seal:**

1. Operable adjustable door seal of aluminium frame and vinyl weather seal, recessed in door bottom, closed ends, automatic retract mechanism when door is open.

**O. Thresholds:**

1. To CGSB 69-GP-6M, Type 6 wide x full width of door opening, stainless steel extruded mill finish, serrated top surface, with interlocking lip and door cap.
2. Door thresholds: CT-10, 127 mm wide with type CT-7 door attachment, manufactured by K.N. Crowder Manufacturing Ltd.

**P. Weather-Stripping Door Frame:**

1. Adjustable perimeter door frame neoprene weather-stripping K.N. Crowder, Model # W-42.
2. Automatic door bottom seal units/mortised door base application – K.N. Crowder, Model # CT-53.

**Q. Fastenings:**

1. Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
2. Exposed fastening devices to match finish of hardware.

3. Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
4. Use metal fasteners compatible with metal material through which they pass.

**2.05 Hardware Finish:**

- A. Hardware finish should match the finish of the Lockset. Coordinate all of various manufactured items furnished under this section.

**PART 3 - EXECUTION****3.01 Installation Instruction:**

- A. Supply door and frame manufacturers with complete instructions and templates for preparation of their work to receive specified hardware.
- B. Furnish manufacturers' instructions for proper installation of each hardware component.
- C. Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- D. Where door stop contacts door pulls, mount stop to strike bottom of pull.

**3.02 Mounting Height - Hardware:**

- A. Hardware to be set at the following heights or as recommended by the manufacturer.
  1. Panic Device: mount 1040 mm from finished floor to centerline of strike.
  2. Locksets, Latchsets: mount 990 mm from finished floor to centerline of strike.
  3. Door Pulls: mount 1070 mm from finished floor to centerline of pull.
  4. Push Plates: mount 1220 mm from finished floor to centerline of plate.
  5. Hinges: mount upper edge of top hinge 130 mm below head of frame; locate lower edge of bottom hinge 250 mm above finished floor, space center hinge equal distance between top and bottom hinges.

**3.03 Hardware Schedule:**

- A. Refer to Contract Project drawings.

END OF SECTION 08710

**DIVISION 9**

**FINISHES**

**INDEX**

SECTIONS

Section 09000 – Finishes

Section 09673 – Resinous Flooring Decorative Broadcast

Section 09790 – Chemical Resistant Wall and Floor Treatment

Section 09900 – Painting Protective Coatings

END OF INDEX DIVISION 9

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Work Included:**

- A. The work of this Section includes, but is not necessarily limited to, the supply of all labour, materials and equipment for:
  - 1. Supply and application of all paint and finish coating products, as specified for walls, floors, ceilings, equipment, piping, etc.
  - 2. Repair or replacement of all finished surfaces damaged by construction under this Contract.
  - 3. All finishing materials and products as hereinafter specified and as shown on the project contract drawings.

**1.03 Delivery, Storage and Handling:**

- A. Deliver, store and handle equipment so as to prevent damage. Do not remove materials from crates or other protective covering until ready for installation.
- B. Store materials in a weather-tight building raised clear of the ground so that the materials are protected from weather, dampness and deterioration.

**PART 2 - PRODUCTS****2.01 General:**

- A. Comply with product requirements outlined in the Standard Sections, and/or as specified on the Drawings. Select all other materials, not specifically described but required for the proper completion of this Division, subject to the review of the Engineer/Architect.

**PART 3 - EXECUTION****3.01 General:**

- A. Comply with execution requirements outlined in the Standard Sections, and/or as specified on the project contract drawings.

END OF SECTION 09000

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 09000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide Epoxy Resin Flake Broadcast System as shown on the drawings and specified herein.

**1.03 Quality Assurance:**

- A. Qualification:
  - 1. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.
- B. Comply with the application instructions furnished by the Epoxy Flooring Manufacturer.

**1.04 Samples:**

- A. Submit Manufacturer product data sheet including required installation preparation and application methods.

**PART 2 - PRODUCTS****2.01 Floor Surfacing:**

- A. Concrete surface preparation to manufacturer's instructions
- B. Concrete Crack Filler/Patching Mortar and Crack Repair– Stonset PM5
- C. Primer – Standard

**2.02 Epoxy Resin Flake Broadcast System:**

- A. Stonhard Primer - Appropriate Primer for sealing and bonding to the substrate.
- B. Stonshield Aggregate - Coloured quartz broadcast
- C. Stonshield Undercoat - Three-component, high solids, epoxy undercoat consisting of resin, curing agent and filler.
- D. Stontec Flakes - Colored flakes
- E. Stonkote CE4 - Two-component, high solids, high performance, UV resistant, clear Epoxy Sealer
- F. Limitations:

1. Minimum/Maximum substrate temperature 15°C/30°C
2. Moisture content of the substrate must be < 4% when coating is applied or use Stonhard Standard Primer.
3. Do not apply to porous surfaces where moisture vapour transmission will occur during application.
4. Materials mechanical mix only.

**G. Application:**

1. Stonhard Standard Primer:
  - a) Application Method: Squeegee and roller.
  - b) Number of Coats: (1) One.
  - c) Aggregates: Broadcast quartz into wet primer coat.
2. Body Coat(s):
  - a) Application Method: Notched squeegee.
  - b) Thickness of Coats: 25-30 mils with standard primer coat
  - c) Number of Coats: (1) One.
3. Broadcast:
  - a) Number of Coats: (1) One.
4. Topcoat:
  - a) Number of Coats: (1) One.
  - b) Total nominal thickness of the complete flooring system: 2 mm

**PART 3 - EXECUTION****3.01 Surface Preparation:**

- A. Thoroughly clean and roughen concrete slab to manufacturers recommendations prior to floor system application.
- B. Concrete floor cracks across the floor surface to be routed out and repaired before flooring is applied. Apply application of Five Star LV Adhesive by Stoncor to cracks.
- C. Chases and false joints to be made as per manufacturer's recommendations.

**3.02 Application – General:**

- A. Maintain a temperature between 16°C and 30°C during application and for 48 hours thereafter.
- B. Mix and apply the undercoat and Stontec Flakes to manufacturer's instructions.
- C. Mix and apply the sealer to manufacturer's instructions.
- D. Apply material using tools/methods approved by manufacturer.

**3.03 Site Conditions:**

- A. Materials to be stored and applied at a minimum temperature of 16°C.
- B. Do not store outdoors or close to any heat source.
- C. Minimum surface temperature is 16°C
- D. Do not apply over wet substrate.
- E. Do not apply to porous surfaces exhibiting moisture-vapour transmission during application.

**3.04 Substrate Requirements:**

- A. Surfaces must be sound and clean and free from all traces of loose material, laitance, oil, grease and bond inhibiting materials. Surface must be open-pore and textured. Dampen surface to be repaired with clean potable water. Substrate to be saturated surface dry (SSD) prior to application.
- B. Prepare concrete by mechanically abrading as recommended by manufacturer. Ensure all surface sealers, curing agents and concrete laitance are removed. Repair all cracks, holes and uneven surfaces.

**3.05 Coved Base:**

- A. Apply flooring system to wall surfaces to form base with cove of 25 mm radius, 100/200 mm height. as indicated on project drawings. Round interior and exterior corners.

**3.06 Clean-up:**

- A. Remove surplus material/packaging off-site.
- B. Clean floors, methods for cleaning, tools as recommended by manufacturer.

END OF SECTION 09791



**PART 1 - GENERAL****1.01 Reference:**

- A. Section 09000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide chemical resistant coatings to walls, floors and surfaces (for sodium hypochlorite containment and Aluminum Sulfate) as shown on the drawings and specified herein.

**1.03 Related Work:**

- A. Examine all of the contract documents for requirements which affect the work of this section. Other specification sections, which directly relate to the work of this section include, but are not limited to the following:

- 1. Cast-in-place Concrete - Section 03300
- 2. Unit Masonry - Section 04200

**1.04 Codes and Standards**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (use 50 mm (2") Cube Specimens
- B. ASTM C321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars
- C. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic Cement Mortars
- D. ASTM C596 - Standard Test Method for Drying Shrinkage of Mortar Containing Portland cement.
- E. ASTM 944 - Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method.

**1.05 Quality Assurance:**

- A. Work of this section to be carried out by an approved installer of the material/product specified herein. The installer to possess a minimum of 5 years proven experience in this type of work.
- B. Comply with application instructions provided by the product manufacturer.

**1.06 Submittals:**

- A. Submit manufacturer's printed product literature, specifications, and datasheet. Include product characteristics, performance criteria, and limitations.

**1.07 WARRANTY**

- A. Manufacturer's standard limited warranty unless indicated otherwise.

**PART 2 - PRODUCTS****2.01 Chemical Resistant Coating:**

- Coating must be compatible with the use of Aluminum Sulfate
- A. Polymer-modified cement waterproofing:
  1. W. R. MEADOWS, Nano-Shield OSP
  2. Tnemec, CHEMBLOC Series 252SC

**2.02 Materials - General**

- A. NANO-SHIELD OSP- supplied as a one component dry premix packaged in 22.7 kg (50 lbs.) bags manufactured by W. R MEADOWS.
- B. CEM-KOTE BARRIER COTE 100 - supplied as a Kit comprising of dry Component A + Liquid Component B, as manufactured by W. R. MEADOWS.
- C. REINFORCING FABRIC HD - supplied in rolls 9 ½" (24.1 cm) wide for crack treatment, or 48" (122 cm) wide for application on the entire surface, supplied by W. R. MEADOWS.
- D. CEM-KOTE FLEX ST - supplied as a Kit comprising of dry Component A + Liquid Component B, as manufactured by W. R. MEADOWS.
- E. GEM-PLAST™ TC - thin set concrete restoration mortar, manufactured by W. R. MEADOWS.
- F. FIBRE-PATCH™ OV/FIBRE-PATCH ST or MEADOW-CRETE® OV/MEADOW-CRETE H - restoration mortar for coving of corners, thin to thick repairs, OV (overhead, vertical) and ST/H (horizontal), manufactured by W. R. MEADOWS.
- G. FIBRE-PRIME™ or PATCH-PRIME™ - cement-based rustproofing manufactured by W. R. MEADOWS.

**PART 3 - EXECUTION****3.01 Inspection**

- A. Inspect surfaces to which chemical resistant treatment will be applied.
- B. Report to the Consultant, in writing, any defects in previously prepared work or unsatisfactory site conditions. Proceed with work under this section only when such defects have been entirely corrected.
- C. Starting work under this section means acceptance of the surface and previously prepared work.

**3.02 Preparation**

- A. Surface Preparation:

1. High-pressure wash [5000 - 7000 psi (24.1 – 48.3 MPa)] with sand brought to the nozzle, or wet or dry sandblast to thoroughly clean the surface and remove soft concrete surface and any bond inhibiting material, such as form oil. Wash the surface thoroughly with water prior to the application and allow it to dry off to achieve saturated surface damp condition. When in doubt do a bond test to assure proper surface preparation is being done, or if any additional cleaning is required. When dealing with oil contaminated concrete surfaces, each individual project and the surface preparation must be discussed and approved by manufacturer.

B. Surface Repair:

1. All active water leaks must be stopped using FIBRE-PATCH WP (water plug).
2. Use GEM-PLAST TC Premix or MEADOW-PATCH® T1 to patch honeycombing and air pockets.
3. Use FIBRE-PATCH OV Premix, MEADOW-CRETE OV, or MEADOW-CRETE H (overhead & vertical) for deeper patching. The surface of FIBRE-PATCH OV should be left rough (bristle finish) and washed thoroughly with high-pressure water before application of NANO-SHIELD OSP.
4. Remove all loose rust from any exposed reinforcing steel and apply two coats of FIBRE-PRIME or PATCH-PRIME rustproofing.

C. Treatment of Existing Cracks & All Non-Structural Joints:

1. Identify all the existing cracks, construction joints and apply a layer of CEM-KOTE FLEX ST, approximately 25 cm (10") wide and 1 mm (40 mils) thick, by trowel or squeegee.
2. Embed REINFORCING FABRIC HD over the entire area of CEM-KOTE FLEX ST and work into the CEM-KOTE FLEX ST, using trowel, to assure complete embedment of REINFORCING FABRIC HD.
3. Apply an additional coat of CEM-KOTE FLEX ST, to build up a min. total thickness of 2 mm (80 mils), over the entire area.

D. Corners & Protruding elements (pipes):

1. Form a cove min. 2" x 2" (5 x 5 cm), using FIBRE-PATCH OV or MEADOW-CRETE OV in the corner using CEM-KOTE BARRIER COTE 100 as a bonding agent.
2. The following day, clean the surface with steel brush and pressure wash, and apply two coats of CEM-KOTE FLEX ST.

### 3.03 Mixing

- A. Mix the content of the bag, 22.7 kg (50 lbs), with approximately 4.6-5.0 L (1.2-1.3 USG) of water.
- B. Use a drill (400-600 rpm) with a correct mixing paddle.
- C. Gradually add the dry material into the water and mix until a smooth and lump free mix is obtained. Do not over mix.

- D. Adjust the water for brushable consistency or a stiffer consistency for trowel application.

### 3.04 Application

- A. Application: Apply NANO-SHIELD OSP by brush, in two consecutive coats, to achieve the specified rate of application 3 mm (120 mils). No wetting is required between the coats. The recoating must be done within 1/2 hour. When layers over 3 mm (1/8") are required, apply a thin layer of CEM-KOTE CW PLUS first, as a bonding agent by brush or broom. Apply the second coat of CEM-KOTE CW PLUS into the wet slurry. Keep wet edge. Do not build up a layer thicker than 6 mm (1/4").
- B. Finishing: NANO-SHIELD OSP can be left with "brushed" surface. In application where a smooth surface is required, e.g., wastewater treatment facilities, swimming pools the surface must be "closed" using a steel trowel.
- C. Hot Weather Application: Protect the surface against rapid evaporation of water between the finishing and the final set time. Use water misting or apply a surface evaporation retarder.
- D. Cold Weather Application: Apply in temperatures above the freezing point and protect the material against freezing for a minimum of 48 hours. Use electrical, (NOT propane) heaters to avoid carbonation and carbonation cracking.
- E. Combustion engines must NOT be used in a confined space where NANO-SHIELD OSP is being applied. All gasoline/diesel/propane equipment should be shut off during placing of concrete or other cementitious materials.

### 3.05 Curing

- A. Moist cure NANO-SHIELD OSP for 3 days.
- B. Protect surfaces from rapid drying and rain and frost.

### 3.06 Preparation For Coating & Tiling:

- A. Surfaces, treated with NANO-SHIELD OSP, must be allowed to air-dry for 1 week after 3 day moist cure, before application of any coating, paint, or tiles.
  - 1. At the end of the curing period, saturate surfaces with water and neutralise with a 1:8 solution of muriatic acid.
  - 2. Rinse waterproofed areas thoroughly with water.

### 3.07 Cleaning

- A. All excess and waste materials are to be removed from the job site by the contractor in accordance with contract provisions. Surrounding areas where the material has been applied will be left free of debris.

END OF SECTION 09790

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 09000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide painting and protective coatings as shown on the drawings and specified herein.

- B. General:

1. Refer to the Paint/Protective Coating Schedule in this specification, the Room Finish Schedule and Drawings to determine items to receive painting and protective coatings.
2. Work covered in this section to comply to requirements of Credit 4 sub-categories contained in Canada Green Building Council's LEED Canada – NC Version 1.0, December 2004, and LEED Canada – NC Version 1.0 Addendum, issued September 2007
3. The work of this Section includes painting of exterior and interior structure and site element surfaces, materials, equipment, machinery, piping, and ducting including but not limited to:
  - a) Interior exposed to view Poured or Precast concrete surfaces, throughout the facility (all levels)
  - b) Concrete, Masonry block, ferrous metal.
  - c) Non-ferrous metal, galvanized metal including ducts and pipes.
  - d) Piping and duct work.
  - e) Machinery and equipment including appurtenances and items listed.
  - f) Shop and field application of primers and finish coats.
  - g) Touch-up work on pre-finished machinery, equipment and appurtenances.
  - h) Yard pipe, exposed ductile iron piping and fittings, and hydrants.
  - i) Conduits and fittings.
  - j) Metal flashings, buried, built into, fixed to and/or adjoining dissimilar materials.
  - k) Woodwork exposed to view, internal and external.
  - l) Painting of hollow metal doors and frames and louvres.

- m) Equipment and piping.

**1.03 Work Not Included:**

- A. Unless specification specified or otherwise noted, do not apply paint or protective coating to the following:
  - 1. Copper stainless steel, chrome plate, plastic, aluminum, bronze, or brass surfaces.
  - 2. Finishing hardware;
  - 3. Equipment nameplates and other such identification;
  - 4. Switch, receptacle and other electrical device faceplates except if constructed of prime coat painted or galvanized steel, in which case they are to be painted;
  - 5. Lighting fixtures;
  - 6. Surfaces factory coated including epoxy or enamel finishes, unless specified otherwise;
  - 7. Plastic laminate surfaces;
  - 8. Tile products, glazed or unglazed, including floor and wall tile;
  - 9. Covers or strainers associated with floor drains, cleanout terminations, and similar equipment;
  - 10. Recessed electrical boxes and similar equipment;
  - 11. Control panels/unless specified otherwise - see Coating Schedule this section.
  - 12. Circuit breakers, switches, receptacles, and similar electrical devices, unless specified otherwise;

**1.04 Related Work:**

- A. Masonry - Division 04
- B. Hollow Metal Doors and Frames - Section 08110

**1.05 Codes and Standards:**

- A. Surface preparation – Conform to Steel Structures Painting Manual Vo. 2 – Systems and Specifications published by S.S.P.C.
- B. Paint manufacturer's Product Data Sheets.
- C. Canada Green Building Council's LEED NC-1.0 Rating System, Credit 4 (sub-categories 4.1 to 4.4),

- D. Canada Green Building Council's LEED NC-1.0 Addendum, Credit 4 (sub categories 4.1 to 4.4) September 2007, December 2004
- E. Occupational Health and Safety Act, O.Reg. 691/80 and O.Reg. 692/80.
- F. The Interior Coating System of the potable water containment structures in this project is to be applied in accordance with the American National Sanitation Foundation Standard ANSI/NSF-61.
- G. Coating protection Systems (coatings) to be approved for interior use in potable water storage tanks by the MECP.

**1.06 Quality Assurance:**

- A. Qualification:
  - 1. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.
- B. Painting shall be performed by skilled painters using the materials and methods specified.

**1.07 Materials:**

- A. Contractor to submit complete list of materials showing name of manufacturer, grade and quality of materials proposed for use, prior to commencement of work.
- B. Only materials on approved list to be supplied.

**1.08 Safety:**

- A. Comply with precaution measures outlined in Ontario Regulation 691/80 – Occupational Health and Safety Act and Regulations for Construction Projects for the safety of workmen.

**1.09 Submittals:**

- A. Submit for Engineer/Architect's review complete list of materials listing proposed manufacturer, material designation and relevant identification data prior to ordering, along with cut sheets, Material Safety Data Sheets (MSDSs), signed attestations or other official literature from manufacturers clearly identifying VOC contents of each product used is within the VOC content limit per the reference CaGBC LEED Canada NC Version 1.0 and Addendum, Credit 4.
- B. Supply only reviewed material.
- C. Submit standard colour chips of all types of paint to be used. The Engineer/Architect will select all colours for use on this project.

**1.10 Manufacturer's Inspection and Approval:**

- A. Submit written certification to the Engineer/Architect stating that the manufacturer's representative has examined the various surfaces prior to application and that the surfaces and the environmental conditions are suitable to receive the specified finishes. Deliver this certification to this Engineer/Architect before starting work.
- B. Submit to the Engineer/Architect, on completion of painting, written certification, signed by the respective manufacturers of products, stating the manufacturer's representative has inspected (at intervals) the application of paint products and that paint products have been applied satisfactorily and to the required coverage.

**1.11 Product Delivery, Storage and Handling:**

- A. Deliver products to the site in original sealed containers, each labelled with the manufacturer's name, product name and catalogue number, colour and colour number, formula type, reducing instructions, and, where applicable, reference standard specifications number. Products delivered to the site must conform to products on the approved manufacturer's list of products.
- B. Store materials at the site only in safe, secure, ventilated areas specifically set aside for paint product storage, maintained at a temperature in excess of 40°F. (4°C), and protected from direct sunlight.
- C. Provide a fully charged, ULC 10:BC rated, 20 lb carbon dioxide fire extinguisher in the storage area for the entire time materials are stored in the area.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. All painting materials shall be pure and of the highest quality. Paint, stain and related materials: Paints and stains manufactured by Sherwin-Williams, and Sika Canada Inc. are used in the Paint and Protective Coating Schedule. Equivalent products by PPG Industrial Ltd. AkzoNobel (Gidden/ICI), Pratt and Lambert, Carboline or approved equal, may be acceptable. The Engineer/Architect shall be the final judge as to the equivalence of any proposed alternate product.
- B. All painting materials are specified in this Section or as referenced to other sections. The minimum number of coats or applications of each type of material is indicated in the paint schedules.
- C. The "Schedule(s) in this Section are not intended to be all inclusive and it shall be a requirement of these specifications that the painting contractor supply all necessary, substitute, or additional materials.
- D. Thinners and cleaners required for proper surface preparation shall be types recommended by the paint manufacturer for that particular finish paint.
- E. Non-standard colours may be selected by the Engineer. Non-standard colours shall be provided by the Contractor at no additional cost.



**PART 3 - EXECUTION****3.01 Examination:**

- A. Examine surfaces to be finished before commencing work and advise Engineer/Architect of any defective surfaces.
- B. Correct defective surfaces before commencing work. Commencement of work shall imply the acceptance of the existing conditions.

**3.02 Preparation:**

- A. Prior to beginning the coating work, clean all surfaces free of rust, corrosion, dirt, dust, grease, or any extraneous matter.
- B. Vacuum areas inside the building(s) clean immediately prior to commencing finishing work.
- C. Do not apply finishes on damp, wet or dirty surfaces or when the temperature falls below 10°C or on preceding coats which are not adequately dry.
- D. The Contractor is responsible for taking any and all precautions or protective measures that may be necessary to suit the prevailing (at the time the work is under way) environmental conditions (excessive heat, humidity, spray, etc.) as they may affect the work of this Section. Failure to comply with the foregoing will not be grounds for extra cost claims and will not void the specified maintenance guarantee.
- E. Deliver all paint materials to the site in unopened, clearly labelled original containers.
- F. Acid etch smooth, concrete surfaces to achieve better paint or protective coating adhesion.
- G. Prepare all surfaces in accordance with surface preparation specification by The Steel Structures Painting Council SSPC Manual - "Systems and Specifications" and as indicated the Schedule of Coating Systems provided in this Section.
  - 1. Surface Preparation:
    - a) SSPC-SP1 - Solvent Cleaning;
    - b) SSPC-SP2 - Hand Tool Cleaning;
    - c) SSPC-SP3 - Power Tool Cleaning;
    - d) SSPC-SP5 - White Metal Blast Cleaning;
    - e) SSPC-SP6 - Commercial Blast Cleaning;
    - f) SSPC-SP7 - Brush Blast Cleaning;
    - g) SSPC-SP10 - Near White Blast Cleaning.

- h) SSPC SP16 – Surface preparation of galvanized steel and non-ferrous metals
- H. Prepare galvanized metal surfaces in accordance with SSPC SP1, SSPC SP16
- I. Abrasive blast clean shop and field welds in accordance with SSPC-SP surface preparation indicated in the coating system provided at the end of this Section.
- J. Test all surfaces for moisture content with an electronic moisture meter, and test concrete, masonry, and gypsum surfaces for acid-alkali balance.
- K. Maintain at the site at all times until the work is completed, a moisture meter, hygrometer, and thermometer to verify surface and environmental conditions.
- L. Apply finishing materials at proper consistency, free from brush marks, sags, crawls, streaks, runs, laps, skips, voids, pinholes, missed areas, and other perceptible defects, and with even colour, sheen, and texture. Vary each coat slightly in tone to permit supervision identity.
- M. Apply finishing and coating materials to provide full coverage, and at a rate to provide the dry film thicknesses specified, but not to exceed that recommended by the manufacturer for the applicable surface.
- N. Make clean, true junctions with no overlap between adjoining applications of finish coatings.
- O. Leave all parts of mouldings and ornaments clean and true to details with no undue amount of coating in corners and depressions.
- P. Use materials of a single manufacturer in coating system.
- Q. Apply each coat only after the preceding coat is dry and hard, or as otherwise directed by the material manufacturer.
- R. Sand surfaces lightly with appropriate grit # sandpaper between coats on wood and metal.
- S. Prior to the application of special finishes, and coatings, arrange for a meeting at the site with the Engineer/Architect, the painting sub-contractor, and a representative of the special finish(es) manufacturer(s) to discuss the condition of surfaces to receive special finish, and application procedures.
- T. Scrub and treat mildewed surfaces with a solution of trisodium phosphate; bleach with a solution of one part sodium hydrochloride ('Javex') to three parts water, and rinse with clear water.
- U. Arrange for finishing hardware, electrical plates, accessories, and similar removable fittings on surfaces to be finished to be removed. Mask any other work that is not removable.

- V. Prepare surfaces to be painted or coated such that the surfaces are thoroughly dry and free of chemicals, mortar splatters, organic matter, oil, grease, rust, scale, loose paint, and any other material, and such that the surfaces are in a proper condition to receive paint, stain, or other specified coating.

### 3.03 Application:

- A. Apply all paint/stain material and protective coating finish in strict accordance with SSPC Manual – “Systems and Specifications”, manufacturer’s recommendations and as specified herein. In the event of any conflict in specifications, the more stringent specifications apply.
- B. Surface preparation shall be in accordance with SSPC Manual – “Systems and Specifications” and as specified herein.
- C. Field blending of colours shall not be permitted unless approved in writing by the Engineer/Architect.

### 3.04 Protection during Sandblasting:

- A. Comply with current Ontario Environmental Protection Act:
  - 1. Provide complete vacuum recovery system during any sandblasting operations.
- B. Contractor is to provide a shroud during any sandblasting operation. The shroud is to be designed so that contaminants do not leave the site during sandblasting. Alternative protection measures will be permitted provided that they meet the requirements of the MECP. It will be the responsibility of the Contractor to obtain MECP approval of the alternative measures.

### 3.05 Protection:

- A. Cover or mask surfaces adjacent to those receiving treatment and finishing to protect the work of others from damage and soil. Mask instruction and specification plates and controls attached to equipment being painted.
- B. Take particular care in storage and mixing areas to ensure that the floors are protected by tarpaulins and metal pans.
- C. Co-ordinate with the appropriate trades for the removal from finished surfaces, storage and reinstallation after finish work is completed of finish hardware, switch and receptacle plates, escutcheons, light fixture /luminaire frames, and similar items.
- D. Post "No Smoking" signs and ensure that spark-proof electrical equipment is used in areas where flammable painting materials are being applied or stored.
- E. Post "Wet Paint" signs throughout freshly finished areas and removed when finishes are dry.
- F. Provide portable ULC 10: BC rated, 8 kg carbon dioxide fire extinguisher at work areas and where paint is stored.

**3.06 Touch-up Surfaces:**

- A. Clean areas to receive touch-up paint as specified.
- B. Sand lightly to clean area for spot painting and apply two finish coats to match original coating specification.
- C. Provide touch-up paint of all types and colours used on this work, suitably identified, for future use by the facility operating personnel.
- D. Provide at least 1.5 litres of each type and colour of paint and stain.

**3.07 Pipe and Duct Identification Markers:**

- A. Identify exposed piping and ductwork in accordance with MECP., C.G.S.B. and W.H.M.I.S. standards and in locations as follows:
  - 1. Each end of piping or duct runs;
  - 2. Adjacent to each valve, strainer and similar accessory;
  - 3. At each piece of connecting equipment;
  - 4. On both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise noted;
  - 5. At 6 m intervals on pipe and duct runs exceeding 6 m in length
  - 6. On each side of special valves, special fittings and branch connections;
  - 7. At least once in each room, and at least once on pipe and duct runs less than 6 m in length.
  - 8. All labels must be applied prior to placing pipes in service, to ensure full adherence.
- B. Apply arrows and markers in a uniform manner truly parallel to piping and ducting.
  - 1. Apply arrows based on the above standards.
  - 2. Apply arrows at all locations as specified for the pipe identification labels.

**3.08 Clean-up:**

- A. Upon completion, remove all materials and debris from the buildings.
- B. Carefully clean all work and remove paint from all adjoining surfaces, glass, hardware, etc. the whole shall be left in a perfect condition.

**PAINT/PROTECTIVE COATING SCHEDULES**

DIV.	MATERIAL/ SERVICE AREA	SURFACE PREP. **	PRIME **	NO. OF COATS	FINISH **	NO. OF COATS *	COLOUR	REMARKS
3/4	Interior Poured Concrete/Masonry Block Walls	Clean & dry See Part 03300/04200	Sherwin Williams  Prep Rite Block Filler  B25W00025	1  (8.0 mils)	Sherwin Williams  Pro-industrial  Acrylic: Interior/Exterior Semi-Gloss/Gloss  B66W00611	2  (2.0 mils each)	TBL	Per Manufacturer's recommendations
3/4		Chemical resistant wall/floor coatings Section 09790						
3	Concrete Floors/Wall Epoxy Finishes	Clean & Dry See Part 03300/04200	Flooring – 09790 epoxy flooring				N/A	See Sections 03346 09790
3	Concrete Ceilings Exposed to View, including Pre-Cast Core Slab and T-Beam Units	Dry & Clean See Part 03300	Sherwin Williams  Loxon Concrete Masonry Primer  A24W08300	1  (2.5 to5.0 mils)	Sherwin Williams  Promar 200 Zero VOC Interior Latex Flat  B30W02651	2  (2.0 mils each)	White	
3	Exterior concrete walls	No coating						
5	Galvanized Steel: (Non-immersion)	SP-1	Sherwin Williams Pro-Cryl Universal PrimerPro-Cryl Universal Acrylic Primer  B66-310 SERIESB66 -310 series	1  (2.5 to 5.0 mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2  (2.0 mils each)	TBC	

## SECTION 09900 – PAINTING AND PROTECTIVE COATINGS

09900:10

DIV.	MATERIAL/ SERVICE AREA	SURFACE PREP. **	PRIME **	NO. OF COATS	FINISH **	NO. OF COATS *	COLOUR	REMARKS
5	Exposed structural, miscellaneous and cast iron steel, including factory primed equipment	SP-2	Sherwin Williams Pro-Cryl Universal Primer B66-310 SERIES	1 (2.5 to 5.0 mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss B66W00611	2 (2.5 to 4.0 mils each)	TBC	
5	Exposed unfinished misc. metal trim	SP-2	Sherwin Williams Pro-Cryl Universal Primer B66-310 SERIES	1 (2.5 to 5.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss B66W00611	2 (2.5 to 4.0mils each)	TBC	
5	Ductile Iron: Exposed	SP-3 (SP-6 Rust)	Sherwin Williams Pro-Cryl Universal Primer B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss B66W00611	2 (2.5 to 4.0mils each)	TBC	
5	Ductile Iron (Bitumen – Tar Coated)	SP-3	Sherwin Williams Multi Purpose Zero VOC Interior Exterior Latex Primer B51W00450	1 (2.0 mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss B66W00611	2 (2.5 to 4.0 mils each)	TBC	
5	Galvanized Steel: (Immersion) Non-Potable Water	SP-5 SP-1 4:1 Trisodium Phosphate	No Option	1 (3.0 mils)	No Option	2 (5.0 mils each)	TBC	
5 11	Steel/Cast Iron/Ductile Iron "In-ground"	SP10 steel or NAPF 500-03-05 level #2	Sherwin Williams Targuard coal tar epoxy B69B60	2 coats 8.0 to 16.0 mil per coat			TBC	
5		Heavy civil metal surface coatings Section 09915						
6	Wood/Plywood	See 09900 Part 3	Sherwin Williams Multi Purpose Zero VOC Interior Exterior Latex Primer B51W00450	1 (1.5 mils)	Sherwin Williams Solo 100% Acrylic Interior Exterior Semi-Gloss A76W00051	2 (2.0 mils each)		Other than stained or oiled
8	Hollow metal doors/steel frames	SP-2	Sherwin Williams Pro-Cryl Universal Primer B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss B66W00611	2 (2.5 to 4.0mils each)	TBC	

## SECTION 09900 – PAINTING AND PROTECTIVE COATINGS

09900:11

DIV.	MATERIAL/ SERVICE AREA	SURFACE PREP. **	PRIME **	NO. OF COATS	FINISH **	NO. OF COATS *	COLOUR	REMARKS
10	Alum Steel, Louvres (shop primed)	SP-1 SP-2	Sherwin Williams Pro-Cryl Universal Primer B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	Section 10210
11	Exposed gate stands, supports	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	
11	Steel operators, gear boxes, motors, and appurtenances	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	
11	Shop primed and/or factory finished equipment (including preselected items)	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	
11/ 15/ 16	Steel drains, vents, pipe duct supports, cable trays, conduits, process piping	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2  2.5 to 4.0 mils each)		
15	Exposed surfaces of fans and shutters	SP-2	Sherwin Williams Pro-Cryl Universal PrimerB66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss B66W00611	2 (2.5 to 4.0mils each)	Match colour of adjacent wall and/or ceiling	
15	Fabric jacketed (steel /cast iron galvanized) surfaces including appurtenances	Clean	Sherwin Williams ProMar 200 Zero VOC Primer  B28W02600	1 (2.0 mils)	Sherwin Williams ProMar 400 Interior Latex Semi-Gloss  B31W04451	2 (2-3 mils each)	TBC	

## SECTION 09900 – PAINTING AND PROTECTIVE COATINGS

09900:12

DIV.	MATERIAL/ SERVICE AREA	SURFACE PREP. **	PRIME **	NO. OF COATS	FINISH **	NO. OF COATS *	COLOUR	REMARKS
15	Fabric Jacket/ Insulation on Pipes and Ducts	Clean	Sherwin Williams Multi Purpose Zero VOC Interior Exterior Latex Primer  B51W00450	1 (1.5 mils)	Sherwin Williams Solo 100% Acrylic Interior Exterior Semi-Gloss  A76W00051	2 (2.0 mils each)	TBC	
15 16	Mech. Machinery & Equipm Convectors, Heating Unit Enclosure	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	
16	Steel electrical conduit	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	
16	PVC electrical conduit	SP-2	Sherwin Williams Multi Purpose Zero VOC Interior Exterior Latex Primer  B51W00450	1 (2.0 mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	
16	Non-shop finished Electrical switchgear and control panels	SP-2	Sherwin Williams Pro-Cryl Universal Primer  B66-310 SERIES	1 (2.0 to 4.0mils)	Sherwin Williams Pro Industrial Zero VOC Acrylic Gloss  B66W00611	2 (2.5 to 4.0mils each)	TBC	Unless shop finished



**3.09 Colour Schedule**

- A. To be chosen during construction by the Engineer/Architect.

**3.10 Clean-Up**

- A. Carefully clean all work and remove paint from all adjoining surfaces, glass, hardware, etc.

END OF SECTION 09900

**DIVISION 10**

**SPECIALTIES**

**INDEX**

SECTIONS

Section 10000 – Specialties

Section 10210 – Architectural Louvers

END OF INDEX DIVISION 10

**PART 1 - GENERAL****1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Work Included:**

- A. Provide specialty items as shown on the drawings and specified herein.

**PART 2 - PRODUCTS****2.01 General:**

- A. Comply with product requirements outlined in the Standard Sections, and/or as specified on the project Drawings. Subject to the approval of the project Engineer/Architect. Select all other materials, not specifically described but required for the proper completion of this Division,

**PART 3 - EXECUTION****3.01 General:**

- A. Comply with execution requirements outlined in the Standard Sections, and/or as specified on the project Drawings.

END OF SECTION 10000

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 10000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide architectural louvers including structural supports and frames as shown on the drawings and specified herein.

**1.03 Related Work:**

- A. Sealants - Section 07920
- B. Panting and Protective Coatings - Section 09900

**1.04 Quality Assurance:**

- A. Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.
- B. Comply with pertinent fire regulations.

**1.05 Submittals:**

- A. Submit shop drawings of all product specified.

**PART 2 - PRODUCTS****2.01 Materials:**

- A. Louvre dimensions will be dictated by structural openings.
- B. Louvre frames and blades shall be extruded aluminum alloy 6063- T52 sections, minimum 8-gauge material; louvre depth shall be 150 mm unless otherwise specified.
- C. Louvres up to 600 mm high shall have fixed horizontal storm proof blades and shall be the 35-degree, complete with water baffle.
- D. Louvres over 600 mm high shall have fixed horizontal drainable blades with gutters designed to catch and direct water to jamb and mullion drains.
- E. Frames shall be of all welded construction and shall be provided with a caulking recess all around.
- F. Provide 13 mm x 13 mm intercrimped aluminum heavy-duty bird screens (2.3 mm gauge) folded in extruded aluminum frames on all louvres, mounted on the interior.

- G. Storm proof louvers shall be Construction Specialties Model 6135, or approved equal, as distributed by Construction Specialties Inc., Mississauga, Ontario. Continuous blade louvers to be used with continuous blade mullions where required and indicated on the drawings. Finish shall be Kynar 500 resin.
- H. Drainable louvers shall be Construction Specialties Model 6097, or approved equal, as distributed by Construction Specialties Inc., Mississauga, Ontario. Continuous blade louvers to be used with continuous blade mullions where required and indicated on the drawings. Finish shall be Kynar 500 resin.
- I. Louvers for the Sodium Hydroxide chemical room shall be mild steel (not galvanized steel) with a C/S Duracolor thermosetting acrylic coating.
- J. Equivalent louvers by McGill will be considered equal. See Section 09900 for colour selection.
- K. Sills to be 6063-T52 alloy extruded aluminum sections, minimum 8 gauge thick with formed drip and turned up at underside of louver sill section.

### **PART 3 - EXECUTION**

#### **3.01 Examination:**

- A. Prior to ordering, carefully verify that building openings have the required dimensions.

#### **3.02 Installation:**

- A. Install louvers plumb and true, flush with the outside of building surfaces or as detailed on the drawing.
- B. The structural support or frame shall be designed by the louver manufacturer to support the louver against a basic wind load of not less than 1.0 kPa with the maximum deflection not exceeding 1/180 of the span.
- C. Upon completion of installation, all louvers shall be left clean and free from dirt. All debris shall be removed from the job site.
- D. The contractor shall replace or repair any scratches, dents or other damage to the louvers using manufacturer's recommended methods and to the satisfaction of the Engineer/Architect.
- E. Apply caulking at recesses in accordance with Section 07920.

END OF SECTION 10210

DIVISION 11

EQUIPMENT

INDEX

SECTIONS

- Section 11000 – Equipment
- Section 11005 – Electric Motors
- Section 11007 – Electric Actuators
- Section 11246 – Chemical Storage Tanks – FRP
- Section 11315 – Submersible Solids Handling Pumps
- Section 11332 – Spiral Conveyor Screen
- Section 11350 – Circular Clarifier Mechanisms
- Section 11370 – Positive Displacement Blower
- Section 11376 – Fine Bubble Aeration System
- Section 11995 – FRP Enclosure

END OF INDEX DIVISION 11



PART 1 - GENERAL

## 1.01 Governing Conditions:

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

## 1.02 Work Included:

- A. This Section covers the general requirements for the supply and installation of process equipment and other works as specified and/or indicated on the Drawings.

## 1.03 Submittals:

- A. Provide a copy of each specification section, addenda and referenced sections with each paragraph check-marked to indicate compliance. Check marks (✓) shall denote full compliance with a paragraph. Underline all deviations and provide a detailed justification for each deviation.
- B. Submit certified shop drawings for equipment in this Division indicating relevant equipment parameters, fit of equipment within structures and other relevant installation and fabrication details.
- C. Neatly assemble and submit operating and maintenance data, containing booklets, drawings, instruction sheets, etc., issued by the suppliers and relating to the equipment intended to be installed under this Division and necessary or desirable for the maintenance, repair or operation of the equipment.

## 1.04 Codes and Standards:

- A. The applicable standards established by the ASTM, CEC, CGSB and the CSA govern the materials and workmanship employed in the manufacture of all equipment. Canadian standards take precedence over American standards in the case of duplication or conflicting requirements.
- B. Ensure that electrical motors and equipment are built to EEMAC (Electrical and Electronic Manufacturers' Association of Canada) standards. Ensure that such motorized and electrical equipment are CSA approved or approved by the ESA (Electrical Safety Authority).

## 1.05 Payment for Equipment:

- A. For equipment identified separately on the form of tender the following payment schedule will apply. This payment breakdown is for equipment supply only.
  - 1. 10% of the item total upon approval of the shop drawings (marked RAN or REV).
  - 2. Up to 60% of the item total upon delivery to site and review by site inspector.

3. Up to 95% of the item total for successful testing and manufacturer certification that installation has been completed correctly – Form 11000-A & 11000-B have been completed and submitted for review.
  4. 100% of the item total for successful commissioning/performance testing and provision of all certified documents, performance guarantees, warranty and instructions to the operators (form 11000-C completed and submitted)
- B. Payment amount may be reduced at any stage as result of deficiencies. Contractual holdbacks will be applied to the above amounts.
- 1.06 Process Testing:
- A. Process Performance Testing shall be completed within sixty (60) days of start-up of the system.
- 1.07 Remedies:
- A. If failure to attain warranted performance is due to a defect in Manufacturer equipment, then the Manufacturer will, at its expense, provide operating assistance as required and/or modifications to equipment or its operation at Manufacturer's discretion until performance is attained or not to exceed fifty (50) maximum percent of the purchase price of the equipment is expended by Manufacturer. If any such additions or modifications are made, Owner and Manufacturer shall then mutually agree on a date to recommence testing to satisfy the Process Performance Guarantee. In the event the Manufacturer cannot satisfy the Process Performance Guarantee, the Manufacturer shall pay a credit, equal to 100 percent of equipment purchase price, less the amount of costs incurred by Manufacturer in implementing any modifications to the System pursuant to this section.

## PART 2 - PRODUCTS

- 2.01 General:
- A. Products required under this Division are included under the individual Sections in this Division.

## PART 3 - EXECUTION

- 3.01 Installation of Equipment:
- A. Obtain necessary installation instructions from the Equipment Supplier.
  - B. Provide and install lubricants and liquids, including water, necessary for initial operation of the equipment in accordance with the manufacturer's instructions, unless otherwise specified.
  - C. Provide other materials needed for the commissioning period.
  - D. Following installation clean equipment thoroughly.

### 3.02 Nameplates:

- A. Except where specified otherwise, provide corrosion-resistant metal nameplates for all equipment bearing at least the following information: manufacturer's name; year of manufacture; model number; capacity; dimensions.

### 3.03 Factory Testing:

- A. Where witnessed testing at the factory is specified, provide a written notice to the Engineer, at least four (4) weeks in advance, of the date when the equipment will be ready for testing. Provide a virtual platform for witnessing the testing.
- B. Where certified factory testing of the equipment is specified submit copies of required certified test reports showing that the equipment complies with the specification before the equipment is delivered to the site.

### 3.04 Anchors:

- A. All bolts for anchoring equipment to concrete shall be Hilti HAS stainless steel threaded rod complete with Hilti HIT-HY 200 adhesive anchoring.
- B. All bolts for anchoring equipment to masonry shall be Hilti HAS stainless steel threaded rod complete with Hilti HIT-HY 270 hybrid adhesive anchoring.

### 3.05 Seismic Restraints:

- A. Provide seismic restraints and anchors suitable for 'Post-Disaster Building', as per Ontario Building Code Table 4.1.8.5 and CSA S832, for Operational and Functional Components (OFCs).

### 3.06 Painting:

- A. As a minimum, shop prime the equipment in accordance with the manufacturer's standards.

### 3.07 Vibration:

- A. Furnish equipment designed to operate without excessive wear, noise and vibration.
- B. Unless the detailed equipment specifications have more stringent requirements, the vibration velocity limit required for rotating equipment is as follows:
  - 1. For vibrations above 13.3 cps (800 RPM):
    - a) Maximum velocity below 2 mm/sec, measured at up to 1.5 m from the mounting base and below 3 mm/sec, measured at between 1.5 to 2.5 m from the mounting base.
  - 2. For vibrations below 13.3 cps (800 RPM):
    - a) Maximum velocity below 1.5 mm/sec, measured at up to 1.5 m from the mounting base and below 2 mm/sec, measured at between 1.5 and 2.5 m from the mounting base.

- C. Measure the vibration velocity on the farthest bearing housing from the mounting base.

### 3.08 Inspection and Testing:

- A. Test equipment after installation in the presence of the Engineer to verify that it meets the stated specifications, local codes, and Ministry of Labour requirements.
- B. Have the testing procedure approved by the Engineer before commencement of the test, and in all cases where the equipment does not meet the specifications, it is to be revised, replaced or readjusted to the satisfaction of the Engineer and until it does meet the specifications.
- C. If witnessed testing is specified, provide to the Engineer, a minimum of 3 weeks notice in advance of the testing date.
- D. Where specified, make provision for the equipment manufacturer's representative to check the complete installation and prepare a written report to document their findings. Have the manufacturer's representative certify the installation by completing and submitting Form 11000-A. Manufacturer's Installation Certification Form included at the end of this Section.
- E. Where specified, include copies of test reports in the operations and maintenance manuals. Have each equipment test report accompanied by a properly completed Form 11000-B Equipment Test Report Form included at the end of this Section.

### 3.09 Operations and Maintenance Instructions:

- A. Where specified, have the manufacturer's or supplier's technical representative instruct the Owner's appointed operators on the proper operational and maintenance procedures of the equipment. For each item of equipment, document the instruction of the Owner's operating personnel by submission of a properly completed Form 11000-C Manufacturer's Instruction Certification Form included at the end of this Section.
- B. Be responsible for developing and coordinating a schedule of instruction by applicable equipment suppliers, and obtaining the Engineer's approval of the schedule, at least four (4) weeks in advance of the commencement of instruction.
- C. Instructional sessions may be recorded (for the future use of the Owner's staff only).

See the following forms on the succeeding pages which form part of Section 11000:

Form 11000-A Manufacturer's Installation Certification Form (2 pages).

Form 11000-B Equipment Test Report Form (8 pages).

Form 11000-C Manufacturer's Instruction Certification Form (2 pages).

END OF SECTION 11000

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

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11000 – A MANUFACTURER'S INSTALLATION CERTIFICATION FORM:

---

Contract No: \_\_\_\_\_

Specification section: \_\_\_\_\_

Equipment name: \_\_\_\_\_

Contractor: \_\_\_\_\_

Manufacturer of equipment item: \_\_\_\_\_

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: \_\_\_\_\_

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\_\_\_\_\_  
Date

\_\_\_\_\_  
Manufacturer

\_\_\_\_\_  
Signature of Authorized Representative

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

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Date

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Contractor

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Signature of Authorized Representative

NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

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MUNICIPALITY OF WEST ELGIN

RODNEY WATER POLLUTION CONTROL PLANT - UPGRADES

ABC Construction Company, Inc., General Contractor

XYZ Engineering, Inc., Construction Manager

EQUIPMENT TEST REPORT

Equipment Name: XXXX  
Equipment Number: XXXXXXXX  
Specification Ref: XXXXXXXX  
Location: XXXXXXXX

---

Contractor	_____	Construction Manager	_____
Verified Date	_____	Verified Date	_____

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

---

PREOPERATIONAL CHECKLIST

Mechanical

Lubrication	_____	_____	_____	_____
Alignment	_____	_____	_____	_____
Anchor bolts	_____	_____	_____	_____
Seal water system operational	_____	_____	_____	_____
Equipment rotates freely	_____	_____	_____	_____
Safety guards	_____	_____	_____	_____
Valves operational	_____	_____	_____	_____
Hopper purge systems operational	_____	_____	_____	_____
Sedimentation tank/hopper clean	_____	_____	_____	_____
O&M manual information complete	_____	_____	_____	_____
Manufacturer's installation certificate complete	_____	_____	_____	_____



SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

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11000 – B EQUIPMENT TEST REPORT FORM (continued):

Page 2 of 4

Contractor _____	Construction Manager _____
Verified Date _____	Verified Date _____

---

Electrical (circuit ring-out and high-pot tests)

Circuits:

Power to MCC No. ##	_____	_____	_____	_____
Control to HOA	_____	_____	_____	_____
Indicators at MCC:	_____	_____	_____	_____
Red (running)	_____	_____	_____	_____
Green (power)	_____	_____	_____	_____
Amber (auto)	_____	_____	_____	_____
Indicators at local control panel	_____	_____	_____	_____
Wiring labels complete	_____	_____	_____	_____
Nameplates:				
MCC				
Control station				
Control panel	_____	_____	_____	_____
Equipment bumped for rotation	_____	_____	_____	_____

Piping Systems

Cleaned and flushed:

Suction	_____	_____	_____	_____
Discharge	_____	_____	_____	_____
Pressure tests	_____	_____	_____	_____
Temporary piping screens in place	_____	_____	_____	_____

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

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Instrumentation and Controls

Flowmeter \_\_\_\_\_ (tag #) calibration \_\_\_\_\_

Calibration Report No. \_\_\_\_\_

Flow recorder \_\_\_\_\_ (tag #)  
calibrated against transmitter \_\_\_\_\_

VFD speed indicator calibrated against  
independent reference \_\_\_\_\_

Discharge overpressure shutdown switch  
calibration \_\_\_\_\_

Simulate discharge overpressure  
Shutdown \_\_\_\_\_

Contractor	_____	Construction Manager	_____
Verified Date	_____	Verified Date	_____

---

FUNCTIONAL TESTS

Mechanical

Motor operation temperature satisfactory	_____	_____	_____	_____
Pump operating temperature Satisfactory	_____	_____	_____	_____
Unusual noise, etc?	_____	_____	_____	_____
Pump operation: _____ (L/s or gpm/ _____ (m or psig)	_____	_____	_____	_____
Measurement:				
Flow _____				
Pressure _____ Test gage number _____				
Alignment hot	_____	_____	_____	_____
Dowelled in	_____	_____	_____	_____

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Electrical

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

---

Local switch function:

Runs in <i>HAND</i>	_____	_____	_____	_____
No control power in <i>OFF</i>	_____	_____	_____	_____
Timer control in <i>AUTO</i>	_____	_____	_____	_____
Overpressure protection switch _____ (tag #) functional in both <i>HAND</i> and <i>AUTO</i>	_____	_____	_____	_____
Overpressure protection switch _____ (tag #) set at _____ (m or psig)	_____	_____	_____	_____
PLC 2500 set at 24-hour cycle, 25 min ON	_____	_____	_____	_____

OPERATIONAL TEST

48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity overpressure protection remains functional, hour meter functional	_____	_____	_____	_____
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RECOMMENDED FOR BENEFICIAL OCCUPANCY

---

Contractor \_\_\_\_\_

Date \_\_\_\_\_

ACCEPTED FOR BENEFICIAL OCCUPANCY

---

Owner's Representative \_\_\_\_\_

Date \_\_\_\_\_

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

---

11000 – C MANUFACTURER'S INSTRUCTION CERTIFICATION FORM:

---

Contract No: \_\_\_\_\_

Specification section: \_\_\_\_\_

Equipment name: \_\_\_\_\_

Contractor: \_\_\_\_\_

Manufacturer of equipment item: \_\_\_\_\_

The undersigned manufacturer certifies that a service engineer has instructed the facility operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start-up procedure reviewed \_\_\_\_\_

Shutdown procedure reviewed \_\_\_\_\_

Normal operation procedure reviewed \_\_\_\_\_

Others: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency) \_\_\_\_\_

Described special tools required \_\_\_\_\_

Described normal items to be reviewed for wear \_\_\_\_\_

Described preventive maintenance instructions \_\_\_\_\_

Described greasing frequency \_\_\_\_\_

SECTION 11000 – EQUIPMENT - GENERAL REQUIREMENTS

---

Others: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Date

\_\_\_\_\_  
Manufacturer

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Owner's Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Contractor's Representative

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 11000 applies to and governs the work of this Section.

## 1.02 Work Included:

- A. Provide electric motors as shown on the drawings and specified herein.

## 1.03 Codes and Standards:

- A. CSA C390 - Test methods, marking requirements, and energy efficiency levels for three-phase induction motors

## 1.04 Submittals:

- A. Submit Shop Drawings of all components, including dimensional information and motor characteristics, including efficiency, power factor, insulation class, heat rise characteristics, details on winding protection and control diagrams.
- B. For each motor, submit a fully completed Form 11005-A Motor Data Form included at the end of this Section.

PART 2 - PRODUCTS

## 2.01 General:

- A. Service factor: 1.15.
- B. Frame and brackets and Conduit Box: Cast Iron (sized to suit the cables shown in the Electrical Single Line Diagram).
- C. Enclosure:
  - 1. Explosion Proof suitable for Class1 Zone 1 or 2 Group D in classified locations.
  - 2. Totally Enclosed Fan Cooled (TEFC) in all other locations.
- D. Heat rise characteristics at rated load not to exceed 80°C above 40°C ambient for Totally Enclosed Fan Cooled (TEFC) or Explosion Proof
- E. Insulation: Class "F" or better.
- F. Sizing of Motors: size motors for every duty condition, including run-out, without the use of the service factor.
- G. Special requirements: where motors are to be used with variable frequency drives, provide motors specifically designed for such application. Provide motors suitable for operation from 10 to 100% of rated synchronous speed without overheating. Motors must meet NEMA MG-1 part 30 and 31.



- H. Rotor: solid cast aluminum.
- I. Balancing: have motors statically and dynamically balanced and tested using standard industry tests.
- J. Winding protection: provide specially impregnated windings, equal to, or better than epoxy impregnated and dipped on motors 0.75 kW or larger to provide high dielectric strength and resistance to moisture.
- K. Bearings: anti-friction with B-10 life expectancy of 100,000 working hours as defined by the Anti-Friction Bearing Manufacturer's Association. Provide either oil type or grease bearing lubrication in accordance with the requirements specified for the connected equipment. Supply at least one insulated bearing per motor shaft to prevent shaft currents.
- L. Temperature sensors:
  - 1. Provide winding and bearing thermistors for motors less than 50 HP.
  - 2. Provide winding and bearing 100 ohm, platinum RTD type sensors for motors 50 HP and larger.
- M. Eyebolts: provide motors with eyebolts or lifting lugs.
- N. Provide TEFC motors with motor casing drain fittings.
- O. Motor Nameplates: in addition to the requirements of Section 11000, provide motors with corrosion-resistant metal nameplates giving the following information:
  - 1. Supply voltage (V)
  - 2. Full load current (A)
  - 3. Phase
  - 4. Frequency (Hz)
  - 5. Power (kW)
  - 6. Service factor
  - 7. Rated speed (RPM)
  - 8. Insulation class
  - 9. Bearing numbers
  - 10. Model number
  - 11. Serial number
  - 12. Anti-condensation heater rating (voltage, phase, watts) – if provided

13. Year of Production

P. Motor Efficiency: provide minimum motor efficiency in accordance with the CSA C390.

Q. Use of motors designed only for horizontal applications is not allowed for vertical mounting. Use P-flanged vertical motors for vertical installations.

2.02 Condition of Service:

A. Provide motor that comply with the conditions of service.

B. Condition of Service:

	WAS/RAS Motors
Number of Motors Required	2
Maximum Speed, RPM	900
Motor Size, kW	5.60 (7.5 HP)
Inverter Duty	Yes
Power Supply (V/ph/Hz)	600/3/60
Installation Category	Dry Pit
Area Classification	OESC Class 1 Zone II
Model # for First named Manufacturer	AEHHXU

2.03 Acceptable Manufacturers:

A. First Named: Teco-Westinghouse

B. Acceptable alternates: US Motors, WEG Motors, SIEMENS, Baldor

### PART 3 - EXECUTION

3.01 Installation:

A. Factory assemble electric motors to the equipment units (example pump and motor).

B. Unless otherwise specified or instructed by the Engineer, mount and install units in accordance with manufacturer's instructions and Drawings.

C. Provide lubricants and liquids necessary for operation in accordance with the manufacturer's instructions.

3.02 Inspection and Testing:

- A. Provide inspection of the complete unit by the electric motor manufacturer after factory assembly of the equipment units.
- B. Shop test the fully assembled units to verify the function of the complete mechanism.

3.03 Operations and Maintenance Instructions:

- A. Provide complete operations and maintenance manuals for the equipment covered by this Section.

See Form 11005-A Motor Data Form on the next page which forms part of Section 11005.

END OF SECTION 11005

11005 - A MOTOR DATA FORM:

Equipment Name \_\_\_\_\_ Equipment No.(s) \_\_\_\_\_

Site Location \_\_\_\_\_

Nameplate Markings

Mfr \_\_\_\_\_ Mfr Model \_\_\_\_\_ Frame \_\_\_\_\_ KW \_\_\_\_\_

Volts \_\_\_\_\_ Phase \_\_\_\_\_ RPM \_\_\_\_\_ Service factor \_\_\_\_\_

FLA \_\_\_\_\_ LRA \_\_\_\_\_ Freq \_\_\_\_\_ Amb temp rating \_\_\_\_\_ degrees C

Time rating \_\_\_\_\_ Design letter \_\_\_\_\_  
(NEMA MG1-10.35) (NEMA MG-1.16)

KVA code letter \_\_\_\_\_ Insulation class \_\_\_\_\_

The following information is required for explosion proof motors only:

- A. Approved by ULc/CSA for installation in Class \_\_\_\_\_, Div \_\_\_\_\_
- B. ULc frame temperature code \_\_\_\_\_; Group \_\_\_\_\_ Atmosphere \_\_\_\_\_

The following information is required for all motors 1/2 horsepower and larger:

- A. Guaranteed minimum efficiency \_\_\_\_\_  
(Part 2 of Section 11005)
- B. Nameplate or nominal efficiency \_\_\_\_\_

Data Not Necessarily Marked on Nameplate

Type of enclosure \_\_\_\_\_ Enclosure material \_\_\_\_\_

Temp rise \_\_\_\_\_ degrees C (NEMA MG1-12.41,42)

Space heater included? \_\_\_\_\_ Yes \_\_\_\_\_ No; if Yes, \_\_\_\_\_ watts \_\_\_\_\_ volts

Type of motor winding over-temperature protection, if specified: \_\_\_\_\_

Use the space below to provide additional information on other motor modifications, if specified:

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## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 11000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Provide electric actuators for valves and gates as shown on the drawings and specified herein.

### 1.03 Codes and Standards:

- A. Manufacture and install material described in this Section in accordance with ANSI/AWWA C540 Standard for Power-Actuating Devices.

### 1.04 Submittals:

- A. Submit drawings of components, wiring diagrams, and control diagrams.

## PART 2 - PRODUCTS

### 2.01 General Requirements:

- A. Actuator to contain motor, gearing, manual override, limit switches, torque switches, drive coupling, integral motor controls, position feedback transmitter (where required) and mechanical dial position indicator (where required).
- B. Actuators to be CSA certified and have a nameplate indicating the same.
- C. Actuators to have an operational temperature range of -25°C to +60°C.

### 2.02 Actuator Sizing:

- A. The actuator to be sized based on information provided by the valve supplier to guarantee valve closure at the specified flow velocity and differential pressure and include a 50% margin of safety.
- B. Design the actuator to provide rated torque with supply voltage variations of plus or minus 10% of the nominal supply value.
- C. Voltage to match drawings.

### 2.03 Enclosures:

- A. Enclosure ratings:
  - 1. EEMAC 3(X) for outdoor applications.
  - 2. EEMAC 4X for indoor applications.

3. EEMAC 6 for below grade installations.
  4. EEMAC 7 for explosion hazard areas.
  5. IP 68 (submersion protection for 6 metres of water for 96 hours) for all locations below grade.
- B. Actuator enclosure to be watertight with external fasteners on the actuator made of stainless steel.
- C. The actuator to have an integral, separately sealed wire termination compartment and utilize "O" ring seals at removable cover joints. The actuator to maintain its non-hazardous enclosure ratings even with the wiring compartment access cover removed.
- 2.04 Electrical Classification:
- A. Actuator to be rated for the classification of the area where it is located.
- 2.05 Actuator Operating Modes:
- A. Actuators in Open/Close service:
1. Furnish actuators with the following integral motor controls and features:
    - a) reversing starters,
    - b) control transformer,
    - c) phase discriminator,
    - d) monitor relay (to signal fault conditions),
    - e) "open-stop-close" pushbuttons,
    - f) "local-off-remote" selector switch c/w dry contact for remote indication,
    - g) local LED/LCD position display.
  2. Furnish following additional controls and features:
    - a) Hand held programmer, if available (1 per actuator).
    - b) Emergency shutdown (ESD) feature.
    - c) Programmable alarm relays (2).
- B. Actuators in Modulating service:
1. Select the actuator such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway torque. Power gearing in modulating actuators to have zero backlash between the motor and actuator output.

2. Furnish actuators with the following integral motor controls and features:
  - a) Reversing starters.
  - b) Control transformers.
  - c) Phase discriminator.
  - d) Monitor relay.
  - e) Positioner to be capable of accepting a 4-20 mA setpoint signal and positioning the valve. The positioner to be field adjustable.
  - f) Valve position feedback circuit with 4-20 mA output signal (isolated).
  - g) "open-stop-close" pushbuttons.
  - h) "local-off-remote" switch complete with dry contact for remote indication.
  - i) Local LED/LCD position display.
3. Furnish following additional controls and features:
  - a) Hand held programmer, if available (1 per actuator).
  - b) Minimum four (4) spare adjustable limit switches.
  - c) Emergency shutdown (ESD) feature.
  - d) Programmable alarm relays (2).
  - e) Actuator valve speed of travel adjustment.

#### 2.06 Additional Requirements:

- A. In addition to the requirements of the ANSI/AWWA C540, supply the following:
  1. Gearing:
    - a) The actuator gear train to be of all metal construction and totally enclosed in a grease or oil filled gearcase suitable for operation at any angle.
    - b) Gears to be able to operate from fully opened to fully closed or vice-versa as follows:
      - i. Slide valves (knife gates): 5 mm/s
      - ii. Gate valves: 2-4 mm/s
      - iii. Rotary valves: 5 mm/s tangential velocity, unless specified differently for individual valves

- iv. Quarter-turn valves: 60 sec closing time
  - v. Slide gates: 5mm/s
2. Manual override:
- a) Provide manual operation by a handwheel via power gearing to minimize required rim pull and facilitate easy changeover from motor to manual operation when actuator is under load. Return from manual to electric mode of operation to be automatic upon motor operation. A seized or inoperable motor not to interfere with manual operation.
3. Motors:
- a) Electrical and mechanical disconnection of the actuator motor to be possible without the need to drain the lubricant from the actuator gearcase.
  - b) The motor to be specifically designed for actuator service and be of totally enclosed, non-ventilated type.
  - c) Rating to match the service intended:
    - i. open/close and throttling - no more than 15 min. continuous run in one (1) hour, max. 60 starts/hour but no more than 10 starts/minute;
    - ii. modulating - 600 starts/hour.
4. Overload Protection:
- a) The motor to be de-energized in the event of a stall condition while attempting to unseat a jammed valve or if an obstruction is encountered during travel.
  - b) The motor to be de-energized in the event of overheating.
  - c) When supplied by a three-phase power supply system the motor to be de-energized upon the loss of any one of three phases.
5. Power Supply:
- a) 110 V/1ph/60HZ
6. Service:
- a) Open/close, throttling or modulating service to be in accordance with Drawings, valve lists or specifications.
7. Torque Control:
- a) The actuator to measure and control output torque electronically.



- b) Output torque to be field adjustable from 40% of rated torque to 100% of rated torque in 1% increments.
  - c) During valve unseating or starting of high inertia loads in mid-travel the torque control system to momentarily inhibit torque tripping.
8. Electrical Controls:
- a) Provide padlock lockable local controls.
  - b) The Open/Close remote control to be selectable to provide either maintained or push-to-run control (no seal in circuit).
9. Terminal Blocks:
- a) Terminate remote control, interlocking and remote indicating devices on terminal blocks.
10. Approval Identification:
- a) Provide plainly visible stamp or tag on equipment indicating CSA certification.
11. Communication System Integration and Connectivity:
- a) Provide a communication card/module integral to each actuator for connectivity to the communication system at the facility.
  - b) Card to allow full control and monitoring over the communication system.
  - c) Card to be compatible with one of the following fieldbus, networks, or serial communication protocols:
    - i. Hardwire I/O (discrete and analog)
- Refer to Drawings and Specifications for identifying which of the above systems is to be used.
- d) Provide all required hardware, software and programming so as to provide full integration and connectivity into the system.
- 2.07 Acceptable Manufacturers:
- A. For gates, valves above 50 mm, and PVC valves above 75mm:
    - 1. First named: AUMA (SQ, SQR, SA, SAR)
    - 2. Acceptable alternates: Rotork (IQ3)

- B. For valves 50 mm and less, and PVC valves 75mm and less:
  - 1. First named: Rotork ROMpak
  - 2. Acceptable alternate: AUMA SGC, Chemline: V-Series, CSA.

### PART 3 - EXECUTION

#### 3.01 Installation:

- A. Ensure that the supplied equipment is factory assembled.
- B. Mount the actuators as shown on the Drawings. Where not shown, mount as recommended by the manufacturer.
- C. Ensure that operating light and push buttons are readily visible and accessible.
- D. Coordinate wiring and sequencing of operation with process narrative and Division 13.

#### 3.02 Inspection and Testing:

- A. Shop test the fully assembled units to verify the function of the complete mechanism. The orientation of the actuator on a pedestal of a sluice gate or on a valve to be as directed by the Engineer, in the field.
- B. Technical representative of the actuator manufacturer to check the completed installation one week prior to initial operation.
- C. The technical representative will check the following:
  - 1. Proper installation of the equipment.
  - 2. Visual check of the completeness of installation.
  - 3. Measurement checks of clearances and fits.
  - 4. Running check of fits and clearances.
  - 5. Demonstration of overload features, alarm settings and safety device settings.
  - 6. Demonstration of actuator operation under design operating flows and pressures.
- D. Technical representative to provide certified inspection report.

#### 3.03 Operations and Maintenance Instructions:

- A. Provide complete operations and maintenance manuals for the equipment covered by this Section.

END OF SECTION 11007

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 11000 applies to and governs the work of this Section.

## 1.02 Work Included:

- A. Provide one (1) Fibreglass-Reinforced Plastic (FRP) tank and accessories as shown on the drawings and specified herein.
- B. Field-erect the tank onsite.

## 1.03 Codes and Standards:

- A. Comply with the requirements of AWWA Standard D-120-02a for the construction of FRP storage tanks.
- B. Comply with the requirements of AWWA Standard D-120-02a for the construction of FRP storage tanks.
- C. Contact molded tanks to be fabricated in accordance with ASTM D4097.
- D. Filament wound tanks to be fabricated in accordance with ASTM D3299.

## 1.04 Submittals:

- A. Submit certification from the manufacturer, for the tank being provided, that it is chemically compatible with materials to be stored.
- B. Submit detailed shop drawings including nozzle size and orientation.
- C. Submit the following information concerning the tank and fitting materials:
  - 1. Resin Manufacturer Data Sheets.
  - 2. Fitting material.
  - 3. Gasket style and material.
  - 4. Bolt material.
  - 5. Assembly instructions.
- D. Submit the following sealed by a Professional Engineer:
  - 1. Wall thickness calculation will use the maximum allowed hoop stress values. Calculation will assume that the tank contents have a specific gravity corresponding to the liquid stored.
- E. Submit manufacturer's unloading procedure.

- F. Submit manufacturer's installation instructions, including field erect work plan.
- G. Factory report to include:
  - 1. Results of surface cure test using Barcoal hardness and acetone sensitivity methods in accordance with the referenced ASTM specification.
  - 2. Visual inspection as per the ASTM specification.
  - 3. Hydrostatic test after the tank installation.
  - 4. Wall thickness verification.
  - 5. Fitting placement verification.

1.05 Environmental Conditions:

- A. Storage tank will be located indoors in a heated and ventilated area.

1.06 Warranty and Maintenance:

- A. The Warranty and Guarantee periods commence at Substantial Performance of the entire project, unless otherwise agreed to by the Owner in writing.
- B. Unless otherwise specified, provide a one (1) year warranty for all components of the work.
- C. Submit the required guarantee/warranty certificates and/or written documentation as specified.

## PART 2 - PRODUCTS

2.01 General:

- A. Supply FRP tank and accessories to service conditions indicated in Table 1 at the end of Part 2 and as shown on the Drawings.

2.02 Tank Design:

- A. The tank to be made of commercial grade glass fibre reinforced polyester or epoxy vinyl ester resin construction, complete with openings and connections per subsection 2.03 below.
- B. The tank shall be field erected on site. The tank pieces must fit through a 1600 mm wide x 2000 mm high doorway. The final tank will be a one-piece unit with resin rich interior surface without exposed fibres.
- C. Materials used for the tank construction will have sufficient strength and corrosion resistance to suit the specified chemicals, as well as have adequate resistance to impact in shipping, handling or use.
- D. The tank to be completely self-supporting without the need for ribs and stiffeners.

- E. The tank to be completely free from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes and pimples. No fibreglass reinforcing is to be left exposed. Any cuts are to be covered with resin.
- F. The tank to be given a high quality factory finish suitable to withstand spillage from the tank contents specified.
- G. Factory finish in a colour selected by the Engineer after award of contract and have suitable ultra-violet inhibitors and fire retardant.
- H. Attach a sign to the side of the tank alerting personnel to the presence of dangerous and hazardous chemicals. The size, wording, colour and location of the sign is subject to the Engineer's review.

#### 2.03 Additional Accessories:

- A. One (1) 75 mm FRP flanged inlet connection.
- B. One (1) 25 mm FRP flanged outlet connection.
- C. One (1) 50 mm FRP flanged drain connection.
- D. One (1) 600 mm FRP flanged translucent manway with cover, located as shown on the Drawings.
- E. One (1) 100 mm flanged vent.
- F. One (1) 100 mm flanged connection for differential pressure level sensor.
- G. One (1) 100 mm flanged connection for overflow.
- H. Provide hold down lugs suitable for mounting on a concrete slab. Fasteners to be 316 SS Hilti type. The design, number and attachment of such lugs are the responsibility of the fabricator based on the wind, seismic and other loads.
- I. Provide lifting lugs for tank.
- J. Provide manway with a minimum 600 mm diameter side access.
- K. Flanged nozzles will have the pipe stub molded integrally with the pipe flange. Compression molded or cemented-on flanges are not allowed.
- L. Threaded fittings to be used only where indicated herein or on the Drawings. Where specified, threaded fittings will be installed with laminates inside and outside as required for flanged nozzles. Threaded fittings to be made of glass-fiber reinforced resin with molded threads.
- M. Spacing at least 175 mm away from the tank face to give easy access through the manholes.
- N. One (1) 20 mm flanged connection for temperature sensor.

## 2.04 Level Indicators:

- A. Provide a level indicator in the form of a metric raised markings scale facing operators (min. at 50 L intervals). Unless otherwise specified, mark the graduations on the tank exterior. Make the level indicator completely visible. In the case of dark coloured tanks, a vertical strip of see-through tank surface to be made available for mounting of the level indicator.

## 2.01 Labels:

- A. Provide a WHMIS label that includes: the product name, hazard symbol(s), risk, precautionary measures and first aid measures. Primary chemical name font size 25mm high. Minimum font size is 22 point.

## 2.02 Equipment Tags:

- A. Tags to include the following information:
1. Project name and number.
  2. Product to be stored.
  3. Name of supplier.
  4. Name of manufacturer and date of manufacture.
  5. Model and serial number.
  6. Maximum allowable specific gravity and temperature.

## 2.03 Accepted Manufacturers:

- A. First named: Industrial Plastics Fabricators Ltd  
 B. Acceptable alternates: Precisioneering, Fabricated Plastics Ltd.

## 2.04 Data Forms:

## A. Table 1: Tank Design Requirements

Service Conditions	Alum Chemical Storage
Equipment No.	TK-1
Number of Tanks	1
Tank Volume (liters)	6,500
Contents and Concentration (% weight)	Liquid Alum
Specific Gravity (kg/m <sup>3</sup> )	1.335
Solution pH	2.0-2.4
Design Temperature (deg C)	5-40

Service Conditions	Alum Chemical Storage
Working Temperature (deg C)	10-25
Tank Internal Pressure (kPa)	atmospheric
Location	indoors
Tank Colour	natural
Tank Configuration	Vertical
Tank Base Size (m)	1.8 m Ø
Tank Height (m)	2.4 m
Tank Top	flat
Tank Bottom	flat
Bottom Drain	full
Lugs	lift
Manway 600 mm (24 ")	side
Manway Secure	flanged
Agitator Weight (kg)	Not applicable
Level Gauge	Reverse float
Ladder	no
Insulation	no
Heat Tracing	no

B. Table 2: Tank Nozzle Schedule

Nozzles	Quantity	CL Elevation (mm) from tank base	Diameter	CL Radius (mm)	Orientation Angle (90 degree at plant North, CW)
Inlet	1	Top, 215.800	75	500	45
Outlet	1	Side, 213.000	25	N/A	135
Drain	1	Side, 213.000	50	N/A	180
Manway	1	Side, 213.800	600	N/A	45
Vent	1	Top, 215.800	100	500	0
Overflow	1	Side, 213.950	100	N/A	225
Differential Level Sensor	1	Side, 213.000	100	N/A	315
Level Gauge	1	Top	50	800	67.5

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**PART 3 - EXECUTION****3.01 Installation:**

- A. Install the equipment in strict accordance with the manufacturer's instructions and as shown on the Drawings.
- B. Install legible signs, on each tank, identifying the liquid being stored.

**3.02 Inspection and Testing:**

- A. Once the tank is in place, provide the services of a technical representative to inspect and supervise the testing and commissioning procedures.
- B. As part of the site inspection, have the technical representative certify the following:
  - 1. Proper installation procedures are being followed (at the start of installation).
  - 2. Visual check of the completeness of installation, including installation of anchor bolts to slab.
  - 3. Measurement checks of clearances and fits.
- C. Water-tightness Test:
  - 1. Test the storage tank on site, following on-site assembly for water-tightness by completely filling the tank with clean water and allowing it to stand for 24 hours. Loss of any water during the test or visual evidence of leakage constitutes test failure.
  - 2. Notify the Engineer at least five (5) working days in advance of the planned water-tightness test to allow witnessing of the test, at the discretion of the Engineer. Perform additional testing as deemed necessary to assess the ability of each tank to meet the conditions specified.
  - 3. The design will make due recognition of the higher specific gravity of the chemicals to be stored, as compared with the water test conditions.
- D. Upon completion of the above, obtain from the equipment supplier and submit to the Engineer certified report detailing the findings of the above testing and inspection.

**3.03 Operations and Maintenance Instructions:**

- A. Provide complete operations and maintenance manuals for the equipment covered by this Section.

END OF SECTION 11246



PART 1 - GENERAL

## 1.01 Reference:

- A. Section 11000 applies to and governs the work of this Section.

## 1.02 Work Included:

- A. Provide submersible sewage pump(s) as shown on the Drawings and specified herein.

## 1.03 Submittals:

Provide complete working and assembly drawings showing the design and method of construction of the pumps and appurtenances. Provide detailed installation instructions, pump and motor performance curves within the operating range, and CSA certification.

PART 2 - PRODUCTS

## 2.01 General:

- A. Each pump shall consist of a submersible, vertical, single stage, bottom suction, non-clog, centrifugal type pump, close coupled to the motor via stainless steel shaft.
- B. Pumps shall be of cast iron construction with smooth finished cast iron, single piece non-clog impeller, capable of passing fibrous materials and solids as indicated in the Conditions of Service.
- C. Provide pumps that:
  - 1. are self-cooled or include a closed-cooling system such that submergence by the medium is not required.
  - 2. are designed to operate continuously or intermittently up to 15 starts per hour.
  - 3. operate in air indefinitely without any adverse effect on the pump or motor.
- D. All pumps shall be supplied with replaceable stainless-steel wear rings of different hardness on both the impeller and volute casings.
- E. The pump seal design shall include Nitrile (Buna-N) rubber O-rings.
- F. Bearings to provide minimum service life of 100,000 hours.

## 2.02 Conditions of Service:

- A. Provide pumps that comply with the conditions of service.
- B. The material to be pumped is comprised of abrasive and aggressive municipal waste water. The water-based suspension will include biological solids, fats, grease, oils, rags, fibrous materials (hair), sand and gravel, and natural materials such as leaves/sticks or vegetable matter.

- C. Typical solids content ranges from 0.2% to 0.8% for return activated sludge.
- D. Typical solids content ranges from 0.2% to 0.5% for wastewater.
- E. Conditions of Service:

	Return Sludge Pumps
Number of Pumps Required	1
Rated Capacity, L/s @ m TDH	7.95 @ 2.0
Maximum Static Head, m	1.2
Solids Passage Size, mm	63.5
Maximum Speed, RPM	1710
Motor Size, kW	2.24 (3.0 HP)
Inverter Duty	Yes
Minimum Pump Efficiency, %	41
Power Supply (V/ph/Hz)	600/3/60
Installation Category	Wet Pit
Area Classification	OESC Class 1 Zone 1
Model # for First named Manufacturer	NP3085SH~456

#### 2.03 Motor:

- A. The complete pump assembly including the motor shall be rated for the area classification.
- B. Motors shall be housed in a watertight air filled, cast iron casing with IP68 protection rating. The motors shall be insulated to offer high resistance to moisture, heat and aging. The casing shall be coated with two-part epoxy.
- C. The motors shall be capable of operating the pump at any point on the pump curve without exceeding the motor nominal rating.

#### 2.04 Float Level Switches:

- A. Provide one (1) level switch to be wired directly to the pump and positioned so that the pump will shut off at the minimum water level indicated in the manufacturer's drawing.

- B. Level switches to be intrinsically safe if in a classified area.
- C. Level switches to be clamp type.
- D. Sway control ring – Provide one sway control ring to reduce movement of the float switches in the sump pit.

#### 2.05 Float Switch Bracket:

- A. Provide a stainless steel level control bracket from the same manufacturer as the pumps and attach floats to the bracket with stainless steel cord grips.

#### 2.06 Seals:

- A. The shaft seals shall be a tandem mechanical seal consisting of two independent seal assemblies. The pump shall be supplied with tungsten-carbide to silicon-carbide seals for both sets of seals. All seals shall have stainless steel metal parts, with an exclusion lip seal in front of the mechanical seal. The seals shall require neither maintenance nor adjustment. The seals shall be of non-proprietary design. Seals requiring set screws, pins or other mechanical locking devices to hold in place will not be accepted

#### 2.07 Protection:

- A. Provide thermistor type temperature protection for motors below 50hp.

#### 2.08 Vibration:

- A. The rotating components of the assembled units shall be statically and dynamically balanced and shall be designed to restrict vibration to that specified in Section 11000 and in accordance with the standards of the Hydraulic Institute.

#### 2.09 Accessories:

##### A. Wet Pit Installation:

1. Pumps shall be furnished with a quick disconnect discharge flange, cast iron anchor frames, upper guide bar holders, and all attachment and anchor bolts required for installation.
2. Pump shall be installed with upper and lower guide holders, one or two guide bars or a tee rail of suitable length and the pump discharge casing shall be designed to permit lowering or raising of the units without the need for entry into the wet well. Provide intermediate guide bar holders as necessary to adequately support the guide bar.
3. Pump shall be fitted with a chain of adequate strength to permit raising the pump for inspection or removal. The top end of the chain shall be stored on a hook attached to the concrete inside the access cover. Provide chain length 2m greater than the wet well depth.

4. Pumps shall be supplied complete with power and control cable long enough to connect to the junction box without undue stress on the cable. Supply hooks to support the cables at the top of the wet well.
5. All anchors, brackets, supports, guide rods, chains, lifting rings, lifting loops, hangers and other appurtenances to be 316 stainless-steel.

#### 2.10 Control Panel:

- A. Provide NEMA 4X duplex intrinsically safe control panel
- B. Instrumentation and Controls to be in accordance with general requirements and qualities specified in Division 13 Control and Instrumentation, and the component qualities below. Provide panels and controls as follows:

Name	NEMA 250 rating	Material
Sump Pump Control Panel	NEMA 4x	Stainless steel

- C. A single 600 VAC 3 phase 60-Hz feed shall be supplied to the panel to power the motor and panel.
- D. Panel to contain all local control devices and circuit breakers.
- E. Provide a single main disconnect switch with the door lockable handle for the power supply.
- F. Provide terminals in the control panel. All equipment shall be wired to the control panel.
- G. Pre-wired control components.
- H. Ship control panel loose for installation near the sump.
- I. A motor protection breaker type combination starter for each pump, with handles.
- J. Complete motor thermal overload protection.
- K. Alarm must trigger when the low float level switch is activated.
- L. Pump must not be able to turn on if low level switch is activated.
- M. Provide the following on the control panel door:
  1. Manual Start-Stop switch for the pump
  2. Pump Run (red) and Alarm light (amber) for each pump.
- N. Provide the following hardwired connection to the ROD2 control panel (PLC) to provide control and monitoring possibility from the plant PLC/SCADA:

1. Sump Level Switch, Low level Alarm
  2. Sump Pump Running Status
- O. Provide a hardwired interlock between the Low-level float switch and the pump starter to stop the pump when the level is low.
- 2.11 Acceptable Manufacturers:
- A. First named: Flygt N-Series (Xylem)
  - B. Alternate Alternates: KSB, ABS XFP (Sulzer)

### PART 3 - EXECUTION

- 3.01 Factory Testing and Inspection:
- A. Each pump shall be accurately aligned in accordance with the manufacturer's stated, acceptable tolerances. The pump shall be tested in accordance with the Standards of the Hydraulic Institute to demonstrate compliance with the operating requirements as specified. Certified performance test curves of each pump shall be submitted before shipment to the site.
  - B. All pump casings shall be hydrostatically tested to 1035 kPa. Certified hydrostatic test results of each pump shall be submitted before shipment to the site.
- 3.02 Installation:
- A. Make any adjustments necessary, including concrete modifications to ensure the pump and discharge base elbow are installed correctly.
  - B. All ferrous non-galvanized surfaces shall be painted with 2-part epoxy.
- 3.03 Operations and Maintenance Training:
- A. Provide the services of an experienced manufacturer service representative to instruct the Owners staff on operations and maintenance. Training sessions to consist of two person-days and two site trips. Provide an electronic copy of the training session. Training days are in addition to any other commissioning time required. Training to be complete prior to commissioning.
- 3.01 Commissioning:
- A. Provide the services of an experienced manufacturer service representative for testing, commissioning and start-up as follows:
    1. One person-day, one trip for installation assistance and inspection.
    2. One person-day, one trip for functional and performance testing.

3. Two person-days, two trips for commissioning and completion of a certified installation report.
  4. Two person-days, two trips for facility start-up.
- B. Provide a report from the service representative certifying the following:
1. Proper installation procedures have been followed.
  2. Installation is complete.
  3. Mechanical check of alignment and clearances. The alignment check shall be repeated after the pump has been operated at maximum load for a minimum of one hour. Measurement checks of all clearances and fits. This will be repeated after operating the equipment at full and varying loads.
  4. Overload features and alarms are functioning.

END OF SECTION 11315

## PART 1 - GENERAL

### 1.01 Reference:

- A. Sections 11000 applies to and govern the work under this Section.

### 1.02 Work Included:

- A. Provide one (1) perforated conveyor screen system to collect, transport, wash and dewater municipal wastewater screenings from an existing channel. Screen system to include an FRP enclosure as specified in Section 11995, control panel and instrumentation as shown on the Drawings and specified herein.

### 1.03 Related Work:

- A. Painting and Protective Coatings - Section 09900
- B. Electric Motors - Section 11005
- C. FRP Enclosure - Section 11995
- D. Process Control Narrative - Section 13310

### 1.04 Standards:

- A. The equipment included in this specification shall comply with the latest edition of the applicable codes and regulations including the following:
  - 1. ASME - American Society of Mechanical Engineers
  - 2. CSA - Canadian Standards Association
  - 3. AGMA - American Gear Manufacturers Association
  - 4. ASTM - American Society for Testing and Materials
  - 5. ANSI - American National Standard Institute
  - 6. OESC - Ontario Electrical Safety Code

### 1.05 Submittals:

- A. Submit shop drawings indicating conveyor screen system parameters, as specified herein, fit of equipment within existing concrete channel and other relevant installation and fabrication details. The shop drawings shall clearly indicate the following:
  - 1. General equipment layout drawing showing equipment within and above the existing concrete channel. Include cross sections and details drawings of the screen equipment in the channel and inside the FRP enclosure with equipment dimensions and maintenance clearances requirements.

2. Bill of material for all equipment components.
3. Descriptive information including catalogue cuts and manufacturer's specifications for all equipment components. Include all motor performance data and curves.
4. Electrical and control panel schematics and layout.
5. Control panel enclosure details, part list and layout, control panel wiring diagrams.
6. P&IDs showing all I/O and process control narrative.
7. Tag list, showing all components of screening system, tagging standard, and project tagging standard shown on the contract P&ID drawings.

#### 1.06 Environmental Conditions:

- A. The screen shall be located inside an FRP enclosure classified as hazardous area rated for Class 1 Zone 1, as per OESC. Control panel shall be located outdoors in an unclassified area.

## PART 2 - PRODUCTS

### 2.01 Service Conditions

- A. The screw/conveyor screen shall be designed to capture and lift out municipal screenings typically found in domestic wastewater influent channels for disposal into a screenings bin (supplied by others) located as shown on the Drawings. The screen shall be installed in an existing 405 mm wide channel (dimension to be field-verified and confirmed by Contractor).

### 2.02 General Design Data:

- A. Screen system shall be designed to operate and meet the following plant conditions and design criteria:

Hydraulic Peak Flow Rate	27 L/s (2,333 m <sup>3</sup> /d)
Screen Perforations Size	6 mm
Screen inclination	45 degrees, pivots out of channel
Max. Capacity at Peak Flow	27 L/s @ 30% screen blockage
Channel Dimensions	405 mm wide x 810 mm deep
Discharge Chute Height above Concrete Floor	1880 mm above aeration tank catwalk

### 2.03 Conveyor Assembly

- A. Provide shaftless conveyor constructed of stainless steel 304L.
- B. The conveyor within the screen basket shall be fitted with a water-resistant brush which



will clean the screen basket openings and be fastened to the trailing side of the spiral edge in the screen basket. Each brush section will be molded into a plastic core and cover a 180-degree section of the spiral. Brush sections will be mounted to form a continuous brush and clean the entire basket area during operation. The brush sections will have stainless steel nuts pressed into the core and can be attached to the spiral with stainless steel fastener that enables easy change of brush when required.

- C. The shaft will include a flange with a bolted connection to the drive shaft stub flange for ease of disassembly for maintenance.

#### 2.04 Screen Basket:

- A. The screen basket shall be constructed of 11 gauge perforated 304 stainless steel. The screen basket shall be fitted with neoprene to provide a seal between the channel walls and the screen basket.

#### 2.05 Transport Tube:

- A. The transport tube shall be constructed of 11-gauge type 304 stainless steel. The transport tube shall be fitted with wear bars to prevent the spiral from wearing on the surface of the tube. The wear bars will be constructed of equal or greater than 0.38" thick stainless steel. The wear bars shall be fixed by cap screws inserted through the tube and threaded into tapped holes in the wear bars. This construction will allow for ease of replacement and monitoring of wear rate on the bars by periodic removal and length measurement of the cap screws.

#### 2.06 Press Zone Assembly:

- A. Enclosure: The press zone enclosure shall be mounted to the end flange of the transport tube and constructed of minimum 11 gauge type 304 stainless steel. The enclosure shall include provision to mount the gear reducer, compaction tube and discharge chute. The enclosure shall have a top mounted hinged lid for full access to the press zone and discharge sections. The lid shall be secured with latches for easy access and have an interlock switch to stop the screen when the lid is open.
- B. Compaction Tube: The compaction tube shall be flange mounted to the inside of the press zone enclosure. The bottom half of the tube shall have 1/8" perforations to drain the screenings pressate.
- C. Discharge Chute: The discharge chute shall be bolted to the bottom of the press zone enclosure. It shall include a drain under the compaction tube, and have a discharge opening under the discharge section. The pressate and flush water will be directed into a discharge hose to be returned to the downstream side of the screen. The discharge opening shall maintain the clearance above the concrete floor as specified above, and shall direct screenings to a screenings bin.

#### 2.07 Spray Wash System:

- A. Basket Spray Wash: The spray wash system will have nine (9) stainless steel nozzles to aid in the conveyance of screened material from the screen basket. A 3/4" NPT solenoid valve shall be provided to operate the water spray system automatically, along with a

3/4" isolation ball valve upstream of the solenoid.

- B. Press Zone Spray Wash: The spray flush system shall have a spray flush header mounted to the enclosure which will flush the pressate into a discharge hose to be returned to the downstream side of the screen. A solenoid valve shall be provided to operate the water spray system automatically, along with an isolation ball valve upstream of the solenoid.
- C. The spray pipe and fittings to be Schedule 40 stainless steel.
- D. Both spray wash systems shall have a common connection to the plant effluent water.
- E. Solenoid valves to be ASCO Model 8210.

#### 2.08 Drive System:

- A. The spiral drive system will consist of a SEW motor flange coupled to a SEW type helical gear reducer with NEMA adapter.
- B. Motor: conform to Section 11005 and rated for Class 1 Zone 1 hazardous area. The motor shall be explosion proof rated, suitable for 3p/600V/60Hz power supply and mounted to the gear reducer.
- C. Gear Reducer: Design in accordance with AGMA Class II service based on the horsepower required to operate the screen.

#### 2.09 Pivot Stand:

- A. The conveyor screen unit shall have a support stand with an integral pivot to allow the rotation of the unit out of the channel and lateral pivoting above the channel for ease of maintenance. The stand's structural members shall be constructed of stainless steel with a minimum thickness of 3.3 mm (0.13 inch).

#### 2.10 Surface Treatment:

- A. All stainless steel subassemblies will be acid passivated after welding for corrosion resistance and to provide a superior surface finish. This will be done by full dipping of weldments; or by using an acid passivation paste in the weld and heat affected areas and spray-on acid solutions elsewhere. After passivation, the weldments will be thoroughly rinsed with clean water and allowed to air dry. Sandblasting, bead blasting or grit blasting of stainless steel surfaces will not be allowed in lieu of acid passivation.

#### 2.11 Control System:

- A. The screening system shall be supplied with a control panel in a NEMA 4X type 304 stainless steel enclosure equipped with all components that enable a fully functional system. The control panel will be installed outdoor as shown on the contract drawings. Control panel to be CSA certified.
- B. The control panel shall include a main circuit breaker, reversing starters for all motors, and 600/120-volt control circuit transformer with control circuit protection.

- C. The control panel shall require a single 600V/3Ph/60 Hz feed. All other auxiliary power supplies shall be internally generated in the control panel by stepping down 600V supply.
- D. Provide the control panel with two doors, one door being dedicated to 600+V and the other door for PLC components/terminals with a separation barrier inside the panel, so that the operator can open the PLC side door independently of the 600V side door or without shutting down the equipment.
- E. Control Panel Devices:
1. Allen-Bradley MicroLogix 1100 PLC.
  2. 4" Siemens HMI color graphic touch screen HMI
  3. Programmable relay to monitor equipment mounted electrical devices to perform necessary logic functions.
  4. Emergency Stop push button.
  5. Hand-Off-Auto selector switches for the drive and spray wash.
  6. Hand-Off-Local Auto-Remote Manual selector switch for the spiral drive.
  7. Forward-Off-Reverse selector switch for the spiral drive.
  8. Control power and spiral run incandescent indicating lights.
  9. Spiral motor current monitor and hour meter.
  10. Fault incandescent light and fault reset push button.
  11. Forward and Reverse Run and Fault auxiliary output contacts for connection to plant SCADA system.
  12. All pushbuttons are to be oil tight 30mm diameter, 120V, 720VAC, manufactured by Allen Bradley 800E, Cutler Hammer, Square D or approved alternate.
- F. Provide surge protector for the PLC and a loss-of-phase protector.
- G. Provide the below-listed dry contact inside the control panel to control and monitor the equipment remotely from the plant PLC/SCADA:
- .1 Screen General Alarm (Digital Output to plant PLC)
  - .2 Screen Remote Status (Digital Output to plant PLC)
  - .3 Screen Reverse Run Status (Digital Output to plant PLC)
  - .4 Screen Forward Status (Digital Output to plant PLC)
  - .5 Screen Overcurrent Alarm (Digital Output to plant PLC)
  - .6 Screen Enable Status (Digital Output to plant PLC)
  - .7 Screen Motor Fault Status (Digital Output to plant PLC)
  - .8 Screen E-Stop (Digital Output to plant PLC)

- .9 Screen Forward Run Command (Digital Input from the plant PLC)
- .10 Screen Reverse Run Command (Digital Input from the plant PLC)
- .11 Screen Motor Current (Analog Output to plant PLC)
- .12 Screen Ultrasonic Level transmitter, Level (Analog Output to plant PLC)
- .13 Screen Ultrasonic Level transmitter fault (Digital Output to plant PLC)
- .14 Screen Float Level Switch, Low (Digital Output to plant PLC)

H. Accessories and Instrumentation:

1. Provide One (1) Endress + Hauser Prosonic S ultrasonic level detector upstream of screen (1 total); detector c/w 15 m of sealed Class I, Zone 1 cable. Din-rail-mounted transmitter installed inside control panel.
2. Float Switch: The mercury free float switch will be of polypropylene construction, and will have a type 316 stainless steel pipe mounting bracket, and a float mounting clamp. The pipe mounting bracket and float mounting clamp require a suitable length of 1 inch pipe to suspend the float in the channel, by others. The float will have a 20-foot-long integral cable. An intrinsically safe barrier relay will be mounted in the main control panel.
3. Emergency Stop Local Push Button Station: A NEMA 7 emergency stop push button station shall be mounted to the support stand.
4. Two (2) solenoids as specified above for the basket and press zone spray wash, 120/1/60 supply, with a NEMA 7 enclosure rating.
5. Davit Crane System: A galvanized steel davit crane mast and rotatable boom arm complete with side anchored support management, anchored to side of wall. Maximum lifting capacity of 3600 lbs. Boom arm length and height to be field determined and submitted as part of the shop drawing review.
6. Dumpster Bin: Provide (1) rolling dumpster bin for waste screenings. Bin opening to be large enough to collect screens from screen bagger and fit through a 900 mm wide opening. Minimum 2-wheels required for easy transport.

I. Sequence of Operation:

1. HAND OPERATION. The spiral motor and spray wash will run continuously.
2. AUTOMATIC OPERATION. The level switch shall start the unit in the forward direction. After the upstream level has been lowered, the unit will continue to run for the length of time set per the off delay timer, typically set at 30 seconds. After forward operation is complete, the unit will stop and then operate in reverse for a short duration.  
The press zone spray wash will provide a periodic flush based on the settings of an independent repeat cycle timer.  
The basket spray solenoid will operate whenever the screen runs forward.

3. EMERGENCY STOP. The unit can be deactivated at any time by pressing the unit-mounted Emergency Stop push button.
  4. FAULT CONDITIONS. Motor overload or high current will stop the drive motor and illuminate the fault light.
- J. Class 1 Zone 1 power lock-out disconnect switch for the motor shall be supplied for installation in the screen room (by Division 16) as shown on the contract drawings.

#### 2.12 Approved Manufacturers:

- A. First Listed: Spiral Conveyor Screen by Claro Environmental
- B. Alternate Manufacturers: Hycor Helisieve by Parkson Corp.  
CleanFlo Spiral by Westech Engineering Inc.  
Conveyor Screen by WTP Equipment Corp.  
Model ALE Auger Monster by JWC Environmental

### PART 3 - EXECUTION

#### 3.01 Painting:

- A. Shop and field painting and protective coatings to all components other than stainless steel or plastic as per Section 09900.

#### 3.02 Installation:

- A. The manufacturer shall provide all required installation instructions to the General Contractor to ensure the correctness of the equipment installation.
- B. The General Contractor shall install all equipment per the manufacturer's installation instructions.
- C. The manufacturer/supplier shall provide the services of experienced, factory-trained representatives to supervise the installation of the equipment to ensure that it is in compliance with specifications and is free of foreign materials.

#### 3.03 Testing and Inspection:

- A. The manufacturer/supplier shall provide the services of a technical representative to monitor the installation, testing and commissioning of equipment designated herein. The representative shall check the following, after the installation is complete:
  1. Visual check of the completeness of the installation and verify that the installation of the equipment is in accordance with the drawings and provided installation instructions.
  2. Check equipment for soundness and for correctness of setting, alignment and relative arrangement of various parts of the systems.
  3. Running check performance to demonstrate the equipment's ability to operate

and to prove its general fitness for service.

4. The manufacturer's representative is to adjust and set all system parameters during commissioning.
- B. Control Panel Site Acceptance Testing (SAT) – This SAT includes all hardware and software supplied. A successful completion of the SAT test will be one of the criteria required for the substantial performance of the General Contractor. This includes:
1. Demonstrate and confirm that all the field instruments, control panels and communication links have been supplied, installed and connected as per approved shop drawings, and are operating as designed.
  2. Demonstrate that an approved set of shop drawings was made available to the Engineer at least one month before SAT.
- C. Upon completion of commissioning the manufacturer/supplier shall submit to the Engineer the complete signed report of the results of his inspection, operation, adjustments, tests and performance validation. The report shall include:
1. Equipment Test Reports and Manufacturer's Installation Certifications for all individual pieces of equipment and motors. Test reports are to be signed by the General Contractor and the equipment manufacturer/supplier.
  2. Confirmation that the tests performed adhered to the testing and commissioning plans submitted. Any deviations from the planned procedure shall be documented.
  3. Test flow rates, pressures, levels, concentrations and all other data and results as required to demonstrate that all items tested meet specified requirements.
  4. A summary of all adjustable parameters and their set values.
  5. Certificate that the equipment conforms to the requirements of the contract and is ready for permanent operation that nothing in the installation will render the manufacturer's warranty null and void
- D. The manufacturer /supplier shall furnish the services of a factory trained representative for a minimum of:
1. Two (2) trips and four (4) work days to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide assistance.
- 3.04 Instruction of Plant Personnel:
- A. Manufacturer/supplier is to conduct a detailed training session to provide instructions to the Owner's operating staff in the proper care, operation and maintenance of the equipment and instrumentation. A copy of the operation and maintenance manual for the equipment shall be present at the training session.

- B. The manufacturer/supplier shall furnish the services of a factory trained representative to complete this training session. This visit may be completed in conjunction with the site visits for testing/commissioning.

END OF SECTION 11332.

PART 1 - GENERAL

## 1.01 Reference:

- A. Sections 11000 applies to and govern the work under this Section.

## 1.02 Work Included:

- A. Design, manufacture, deliver, site supervision, test, and commission one (1) clarifier mechanism at the Rodney Water Pollution Control Plant. Clarifier mechanism shall include, but not limited to the following:
  - a. Centre drive unit and torque control;
  - b. Center influent column with RAS adaptor, energy dissipating inlet, and centre feed-well;
  - c. Rotating drive cage and rake arms with spiral blades;
  - d. Sludge withdrawal ring with RAS adaptor;
  - e. Scum skimmer, scum box, scum baffle, and effluent weir plates;
  - f. A half-span bridge walkway, from the centre influent column to the clarifier tank wall, complete with platform, kickplates and handrails.
  - g. Anchor bolts, supports and all necessary appurtenances as specified to suit the existing clarifier tank as shown in the contract drawings.

## 1.03 Submittals:

- A. Submit shop drawings in accordance with Section 11000 Equipment and requirements listed below.
- B. Submit shop drawings to indicate relevant parameters, fit of equipment within existing clarifier tank and other relevant installation and fabrication details. The shop drawings shall clearly indicate the following:
  - 1. General equipment layout showing clarifier mechanism within and above the existing clarifier tank. Include cross sections and details showing the clarifier mechanism installation in the tank with the half-span bridge walkway on top of the tank. Include all field verified dimensions of existing clarifier tank along with equipment layout.
  - 2. Bill of material and weight for all equipment components.



- C. Provide the following design and description information:
1. Certified general equipment layout arrangement drawings, including sections and details showing the clarifier mechanism within the existing clarifier tank and the half-span bridge walkway with dimensions.
  2. Certificate of design stamped by an Ontario Registered Professional Engineer stating that the equipment to be provided for this project meets or exceeds all design requirements of these specifications. The certificate shall state the respective loads and design criteria.
  3. Drive mechanism rating calculations, stamped by an Ontario Registered Professional Engineer, verifying the compliance of the drive gears and bearing with the specified continuous torque rating and bearing life rating.
  4. Calculations to demonstrate that the scraper design has adequate capacity to transport the maximum day sludge loadings.
  5. Motor data and catalog information. Electrical drawings as applicable to the supply of the clarifier equipment manufacturer.
  6. Catalog cut sheets for purchased subcomponents.
- D. Each operation and maintenance manual shall contain as a minimum, the following items:
1. Certified as-built drawings (general arrangement and general arrangement detail drawings).
  2. Erection drawings.
  3. A complete bill of materials for the equipment including the weights of all structural steel components.
  4. Installation and maintenance instructions for the specific equipment including the erection sequence, maintenance and trouble-shooting check points, and complete lubrication procedures with recommended grades of lubricants.
  5. Cut sheets for all equipment items purchased from sub-vendors.
  6. A list of the clarifier manufacture's recommended spare parts specifically denoting wear items, long delivery items, and all items convenient for stocking as optional replacement items.
  7. Equipment Data Sheets.
  8. Complete parts list including manufacturer part numbers and universal part numbers.

9. Details of preventative maintenance measures and intervals.

E. Provide three (3) copies of USB drives containing all information identified in section

Process Requirements	
Design Peak Hourly Flow (m <sup>3</sup> /day)	1,640
Peak Daily Solids Loading Rate (kg/m <sup>2</sup> day)	100
Mechanism Rotation	Clockwise
Mechanism Type	Spiral Blade
Design Requirements	
Diameter (m)	Approx. 9.75
Side water Depth (m)	Approx. 3.7
Freeboard (m)	Approx. 0.65
Floor Slope	1:12
Feed Inlet	Center Feed
Maximum Tip Velocity of Scraper	2.0-3.0 m/min

1.03 C.

F. Provide three sets (3) of installation instructions specifically applying to the order.

G. The Equipment Supplier shall agree that submission of the foregoing data constitutes a guarantee that the units proposed conform thereto and in accordance with these specifications.

H. Follow submittal procedures in specification section 01300.

1.04 Conditions for Service:

A. The mechanism shall be designed for the following:

The Supplier is advised all measurements are approximate. Supplier shall field verify all dimensions prior to commencing any work.

B. The machine design torque for the complete mechanism including drive and structural members shall be based on the following:

Loading of Rake Arms	Minimum of 12 kg/m
Load due to Scum Skimming	Add 10-15%

PART 2 – PRODUCTS

## 2.01 General – Clarifier Components:

- A. One (1) clarifier mechanism, as per “Clarifier Data Sheet”, shall comprise of a complete assembly listed in Part 1.
- B. The equipment shall be designed to effectively settle suspended solids and scrape the settled solids from the basin floor to the sludge withdrawal as shown on the drawings. The clarified effluent shall be collected uniformly by the peripheral launder. Surface scum shall be collected by the scum skimming equipment and discharged through the scum withdrawal pipe.
- C. The Supplier shall be responsible that the clarifier assembly will be:
  - 1. Designed, fabricated and assembled to provide reliable and efficient clarifying operation with good engineering practice;
  - 2. CSA approved and comply with the codes and standards referred to in this specification;
  - 3. Of new material which is of current manufacture and proven in the field of the duty required;
  - 4. In accordance with the requirements of Table 1 Data Form and that the data given or associated with Table 2 is correct.
- D. Provide a clarification mechanism of proven design. The Supplier shall have a minimum of five (5) years of successful experience in the manufacture of such equipment.
- E. It is not the intent to give every detail in the drawing and specifications. Nevertheless, the Supplier shall supply the clarifier mechanism and components complete in every detail.
- F. The mechanism shall be of a design such that sludge material shall be directed to the sludge hopper by raking blades equipped with adjustable squeegees. The blades shall be such that the bottom of the clarifier is raked twice per rotation.
- G. The equipment shall be designed for continuous operation under climatic conditions prevailing in Southern Ontario. Particular attention shall be given to winter operation with provision for handling ice, snow, and low temperatures, which would otherwise interfere with the required operation.
- H. These Specifications direct attention to certain features, but do not purport to cover all details entering into the design of the equipment. All parts shall be designed and proportioned so as to have liberal strength, stability and stiffness, and to be especially adapted for the service intended. Plenty of room shall be provided for inspection, maintenance, repairs and adjustments.

## 2.02 Drive Mechanism:

Operating Condition	Notes
Continuous	At (1.0) Service Factor
Alarm	100% of Continuous
Motor Cut-Off	120% of Continuous
Backup Motor Cut-off	160% of Continuous
Momentary Peak	200% of Continuous

- A. The drive unit shall be designed for the torque values listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L10 life of 100 years or 876,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.
- B. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard.

## 2.03 Physical Characteristics:

- A. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardening steel. The pinion shall be heat treated alloy steel. Support base for the drive shall be welded steel to assure rigidity. Lubricant and dust shields shall be provided. The drive shall include a forged steel precision gear/bearing set and protected by a neoprene seal. Strip liners designed for a periodic maintenance and replacement shall not be accepted. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. Lubrication fittings shall be readily accessible. Continuous condensation drains shall be provided.

## 2.04 Overload Device:

- A. The overload protection device shall:
- Include an actuator that is totally enclosed in a stainless steel weatherproof enclosure;
  - Display a visual load indicator that plainly shows the overload points;
  - Be equipped with a view port window that allows the dial position to be seen.

- B. The device shall be actuated by torque generated from the main drive, which shall operate three independently adjustable switches (alarm switch, motor cutout switch, and backup motor cutout switch). These three switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position.

#### 2.05 Turntable:

- A. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of the elasticity shall be a minimum of  $29 \times 10^6$  psi. The center cage shall be fastened to and supported from the gear casing. Ball bearing shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set.

#### 2.06 Speed Reducing Unit:

- A. The speed reducing unit shall consist of a cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.
- B. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
- C. Speed reducer helical or planetary gear shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.
- D. The reducers shall be fitted with radial and thrust bearing of proper size for all mechanism loads. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

#### 2.07 Motor:

- A. The motor shall be suitable for Zone 2 and conform to section 11005.

#### 2.08 Center Column:

- A. A stationary center column shall be provided with RAS adaptor for retro-fitting an existing tank with the RAS pipe located in the influent pipe. Center column shall serve as the influent pipe and the support for the clarifier mechanism and one half of the access walkway bridge.

- B. Influent openings shall be provided in the inner portion of the column to allow unrestricted passage of the flow into the energy dissipating feedwell. Influent velocity shall be reduced by providing a total inlet port area a minimum of 135 percent of the center column cross sectional area.
- C. Two access bolted access covers with neoprene seals shall be provided to access the existing RAS pipe. A RAS connection with flexible coupling shall be provided to adapt the existing RAS line through the wall of the column to the sludge ring.

#### 2.09 Energy Dissipating Inlet:

- A. The clarifier shall be equipped with an energy dissipating inlet. The dispersion inlet shall be designed to dissipate the energy of the incoming flow by way of multiple baffled inlet ports equally spaced around the dispersion well.
- B. The center dispersion well shall include a bottom plate to fit within 25.4mm (1") of the center column. EDI outlet ports equally spaced around the periphery shall be provided for energy dissipation.
- C. The bottom plate of the EDI shall be provided with properly sized drain holes.
- D. Inlet shall be fabricated with a minimum thickness of 4.76 mm (3/16") and shall be constructed to provide an efficient velocity dissipation of the influent as it enters the tank.
- E. Scum relief ports shall be provided.

#### 2.10 Feed Well:

- A. The flocculating feed-well shall be located outside the EDI to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
- B. Vertical supporting steel rods shall have sufficient length to allow adjustment of the feed-well elevation up or down by 100mm.
- C. The depth of the feed-well shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge.
- D. The feed-wells shall be made of not less than 4.76mm (3/16") thick steel plate with necessary stiffing angles.

#### 2.11 Center Cage and Sludge Removal Arms:

- A. The center cage shall be constructed with connections for the (2) sludge removal arms, and EDI supports. The top of the cage shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell.

- B. The rake arms shall be equipped with spiral blades and adjustable squeegees. Adjustable squeegees shall project 30mm below the bottom of the blades. Fasteners for the squeegees shall be hexagonal head bolts, washers and nuts.
- C. The rake arms shall be of truss construction conforming to the slope of the tank floor and shall be rigidly supported from the center cage.
- D. Spiral blades shall be constructed to logarithmic spiral curve with a constant 30° angle of attack.
- E. The rake blades shall ensure complete raking of the bottom of the clarifier twice per revolution at the peripheral speed specified. The arms shall be designed to withstand the mechanism design strength so that there is no deflection under maximum load conditions, which might allow any part of the arm to rub against the tank floor.
- F. The blades shall be positioned to direct the sludge to the tank sump.
- G. Where spiral curve blades are used, the structural calculations shall include an analysis of the torsional loads from the spiral curved blade.

#### 2.12 Walkway Bridge:

- A. The clarifier shall be provided with a 1.2m clear open width walkway extending across approximately one-half the tank diameter. The walkway shall be supported at the center by the centre column and supported by the opposite end by the tank wall.
- B. It shall be designed to support its own weight and all attached parts and to withstand the maximum torque developed and all eccentric loads imposed by the revolving mechanism plus a live load of 2.5kN/m on the walkway.
- C. A center drive operations platform shall be provided. It shall be a minimum of 2.5mX2.5m and provide a minimum clearance around the center assembly and drive control of 1.0m for the maintenance and service. The drive platform shall be decked with non-slip aluminum open grating and have sufficient structural steel support to meet the specific design load conditions.
- D. The bridge design shall ensure that the lateral sway of the bridge and movement between panels is kept to a minimum and suitable means for expansion and contraction are provided.
- E. The bridge shall be fitted with an electrical conduit raceway, to carry all required electrical supply and control wiring from the tank periphery to the tank centre.
- F. The walkway shall span from the periphery of the tank to the centre mechanism, have 1.2m width, non-slip aluminum open grating laying perpendicular to the bridge, and be designed to adequately support the loads to be carried. Handrails and kick plate shall be provided to both sides of the walkways and around the center drive platform.

- G. The deflection of the walkway grating shall not exceed 1/240 of its span and the overall bridge design shall be such that the deflection of the bridge does not exceed 1/360 of its span when, in addition to the dead load, it is subjected to a live load of 2.5kN/m.
- H. The handrail shall be 1050mm high with an intermediate rail 450mm from the bottom and be made of anodized aluminum pipe with posts surrounding the platform. The rails shall be 48mm in diameter I.P.S. anodized aluminum pipe with posts of 48mm diameter anodized aluminum pipe, minimum wall thickness 3.7mm. Vertical handrail support posts should be isolated from the steel by using a neoprene gasket between the aluminum mounting plate and steel. All handrails shall be of welded construction and adhere to CSA W59.2, ensuring welds are ground to a smooth, even finish.
- I. Toe plates to be 6.4mm thick x 125 mm wide aluminum.
- J. A 6mm aluminum kick plate, 100mm high shall be fitted to the bottom of the handrails.
- K. Expansion Joints: Provide tight fitting, semi-concealed internal aluminum pipe sleeve at expansion joint locations. Provide expansion joints at 8m max spacing.
- L. Post spacing shall not exceed 1.2m.
- M. Prepare galvanized metal surfaces in accordance with CAN/CGSB-85.10-99.

#### 2.13 Scum Skimmer and Trough:

- A. Two (2) scum skimming devices shall be provided for continuous operation.
- B. The surface skimmers shall consist of adjustable wiper blades of oil-resistant neoprene securely clamped in position with a backing plate. The wiper assembly shall be suspended from a double-pivoted arm arrangement with the arms positioned in pivot sleeves mounted on a Type 304 stainless steel boom supported from the collector arm.
- C. The skimmer arm shall be made in two sections so that the blade may be removed to clear any ice formation on the surface of the clarifier.
- D. A separate hinged blade, the width of the scum trough, shall be provided. The hinged blade shall be equipped with neoprene strips on the bottom and side wiping blades to properly seal the entrapped scum and water when discharging into the trough. The blade shall be designed to travel in a vertical plane so that the bottom edge of the hinged blade is always in contact with the scum trough inclined beach plate. The blade shall be made of 9.5mm, 65 durometer neoprene and shall be fastened to the arm. The hinged blade shall be forced against the scum baffle of the tank by a coil spring or weighted arm arrangement to effectively keep the scum baffle clean.
- E. The scum trough shall consist of a steel box with a minimum length of 1000mm, vertically adjustable approach lip, rider straps and a back plate to allow the skimmer arm a smooth transition from the trough to the water surface. A 150mm ANSI Class 125 flange connection shall be made from the scum line to the scum chamber. The trough and connection to the support structure shall be designed to ensure a minimum of deflection.



- F. The supplier shall provide all materials necessary to maintain the balance of the collector arms.

2.14 Scum Baffle:

- A. The scum baffle shall be of curved, forming a true circle around the clarifier, 300mm high, providing two (2) angles for adjustment and supported at 1.2m intervals.
- B. The baffle supports shall be assembled as per the manufacturer's approved shop drawings, with a maximum vertical deflection of 5mm.

2.15 Effluent Weir:

- A. Weir plates shall produce a smooth, resin-rich surface, without voids, porosity, exposed glass or cracks.
- B. Weir plates shall be "saw-tooth" adjustable type with a nominal thickness of 6mm (1/4"). The top edge shall contain 90° V-notches in the plate. Each notch shall have a nominal width of 100mm (4") and have a depth of 50mm (2"). There shall be a distance of 200mm (8") separating the bottom of adjacent notches.
- C. Stainless steel 'Hilti Hit hy 150' adhesive type units shall be used to attach the weir to the tank, minimum 150mm embedment. They shall be 16x150mm in dimension with washers spaced at 450mm centres and butt plates at joints.

2.16 Materials:

- A. Material of construction shall be as follows:

Component	Material
Bolts and nuts	Type 304 L Stainless Steel for S.S. components, Hot-dipped galvanized steel for galvanized components
Centre Cage	Hot-dipped galvanized steel
Centre Column	Hot-dipped galvanized steel
Feed-well, EDI, and Supports	Hot-dipped galvanized steel
Drive Torque overload Housing	Type 304 L Stainless Steel
Scum baffle and supports	FRP
Scum skimmer and supports	Hot-dipped galvanized steel
Scum box/beach plate	304 Stainless Steel
Scum skimmer blades	Oil resistant Neoprene
Scraper arms	Hot-dipped galvanized steel
Scraper Blades	Hot-dipped galvanized steel
Squeegees	Oil resistant Neoprene
Effluent weir	FRP
Truss arms and other misc. structural components	Hot-dipped galvanized steel
Walkway bridge	Hot-dipped galvanized steel

## 2.17 Spare Parts:

- A. The manufacturer shall provide a recommended spare parts list complete with prices for a period of two (2) years. This list shall be appended to the Shop Drawings when submitted for review and included in the O&M manuals.
- B. The following spare parts shall be provided.
  - 1. One (1) sight glass or dip stick for each main drive housing containing oil.
  - 2. One (1) set of neoprene skimmer wipers for each mechanism.

## 2.18 Acceptable Manufacturers/Suppliers:

- A. First named: WesTech inc.
- B. Acceptable alternate: Envirodyne Systems Inc., or approved equal

**PART 3 – EXECUTION**

## 3.01 Delivery:

- A. Provide packing to protect the shipment against breakage or injury, or loss of components during transit to its destination and which is acceptable to the transportation companies.
- B. Provide grease protection on unpainted machine parts.
- C. The equipment will be received, unloaded and stored under the supervision of the Contractor, who shall approve the methods used for unloading, handling and storage.
- D. The Supplier shall give the Engineer four (4) weeks advanced notice of delivery, and shall provide four (4) copies of complete and itemized shipping lists. Each item shall be clearly marked, identified and referenced to the shipping lists. Such lists will be checked on delivery by a representative of the Owner.
- E. Do not ship the equipment from the plant except by prior agreement with the Engineer.

## 3.02 Installation:

- A. The Contractor shall install the clarifier components in accordance with the Suppliers written instructions.
- B. The Supplier shall provide all required instructions to ensure the correctness of the equipment installation.

## 3.03 Commissioning and Testing:

- A. The Supplier shall provide the services of experienced, factory-trained representatives to supervise the commissioning of the equipment as well as any testing required at the number of days specified in the "Site Supervision" section.

- B. As part of the commissioning, the representative shall instruct plant staff in the proper care and operation of the equipment.
- C. A technical representative from the clarifier manufacturer shall attend the site to check for the following after installation is complete:
  - (a) Visual check of the completeness of the installation;
  - (b) Measurement check of all clearances and fits. This shall be repeated after operating the equipment under load;
  - (c) Running check of fits in a dry tank to check clearances and performance to demonstrate the equipment's ability to operate without vibration or overheating and to prove its general fitness for service.
- D. The clarifier mechanism shall operate problem free continuously for a period of 14 days. Following this period, the tank shall be drained for inspection.
- E. During the inspection, observations shall be made to detect any defect in the equipment. In the event that any defect is noted in any test, it shall be corrected, and the test shall be repeated until satisfactory results are obtained.
- F. All adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests. Upon completion of the tests, the Supplier's representative shall submit in triplicate, to the City, a complete signed report of the results of his inspection, operation, adjustments and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the contract and is ready for permanent operation and that nothing in the installation will render the Supplier's warranty null and void.
- G. The mechanism and all associated parts shall operate smoothly and shall effectively perform the service intended.

#### 3.04 Site Supervision

- A. The clarifier manufacturer shall provide an experienced, factory-trained representative to supervise the installation, commissioning, and testing of the clarifier mechanism and components.
- B. A minimum of two (2) man days must be provided by the clarifier manufacturer for testing and training of plant staff for proper care and operation of the equipment after commissioning. A minimum of one (1) day shall be provided by the clarifier manufacturer for commissioning of the unit. Additional man-days shall be provided at the request of the Engineer, and shall be paid as per the provisional items in the Form of Tender.

END OF SECTION 11350

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 11000 applies to and governs the work of this Section.
- B. Section 11005 Motors
- C. Section 16816 Variable Frequency Drives

## 1.02 Work Included:

- A. Provide three (3) positive displacement blowers, each complete with motor, control panel, variable frequency drive (VFD), acoustic enclosure, base and accessories, as shown on the drawings and as specified herein.

## 1.03 Codes and Standards:

- A. ASME PTC 13 Wire to Air Performance Test Code for Blower Systems.
- B. American Bearing Manufacturers Association (ABMA) B10.

## 1.04 Submittals:

- A. Submit the following shop drawings:
  - 1. Layout of blower base, blower, electric motor, inlet filter/silencer, discharge silencer, vibration isolator, valves and anchor bolts.
  - 2. Cross-sectional details of the blower with complete cross-reference list of materials.
  - 3. Details of the motor and drive components.
  - 4. Details of inlet and outlet flexible connectors including list of materials.
  - 5. Sectional details of check valves, silencers and blowers, including list of materials.
  - 6. Sound attenuation curves of the inlet filter/silencer and discharge silencer.
  - 7. Performance curve for the blower.
  - 8. Certified unwitnessed performance test to ASME PTC 13.
  - 9. Details of storage and off-loading and field assembly requirements.

## 1.05 Environmental Conditions:

- A. Blowers will be located indoors in a heated and ventilated area.

- B. Blower Room operating temperature: 10 C to 40 C
- C. Blower inlet temperature: -40 C to 40 C.

#### 1.06 Quality Assurance:

- A. The blowers and appurtenances to be supplied by a single manufacturer that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished.
- B. The equipment manufacturer has been regularly engaged in the design and manufacture of the specified equipment for a minimum of 5 years.

#### 1.07 Warranty and Maintenance:

- A. The Warranty and Guarantee periods commence at Substantial Performance of the entire project, unless otherwise agreed to by the Owner in writing.
- B. Unless otherwise specified, provide a one (1) year warranty for all components of the work.
- C. Submit the required guarantee/warranty certificates and/or written documentation as specified.

## PART 2 - PRODUCTS

#### 2.01 General:

- A. Each blower unit to include blower, electric motor complete with starters, variable frequency drive, mounting and accessories, as hereinafter specified.
- B. Base the design and selection on a minimum useful life of 15 years and a minimum mean time between overhauls of 5 years of operation. The components of the package to be of proven design.
- C. Supply identical blower units by one supplier with parts that are interchangeable between units.
- D. Blower package to be CSA and ULc approved. Manufacturers with UL certifications will be responsible for providing appropriate documentation and materials to obtain CSA approval.
- E. Provide blower with CSA/ULc certified acoustic enclosure covering the blower package. Design acoustic enclosure for easy inspection and maintenance to all blower's components. Provide quick release panels for routine maintenance of the blower and accessories.
- F. Provide certification label on the nameplate at the point of manufacturing. Provide certification at submittal phase, prior to approval. Field evaluation for certification approval is not permitted.

## 2.02 Blower Design Requirements:

- A. Refer to Table 1 in Part 2.
- B. Blowers shall not exceed the nameplate motor rating at any of the listed operating conditions in Table 1.

## 2.03 Equipment:

- A. Supply the blower as a complete unit comprising:
  1. Rotary positive displacement air blower, V-belt driven by an electric motor, mounted on a fabricated steel base.
  2. Inverter duty rated and NEMA premium efficiency motor suitable for VFD.
  3. V-belt drive system with fabricated steel guard to comply with OSHA requirements. The guard to be complete with quick release knobs.
  4. Inlet vacuum and discharge pressure gauges.
  5. Pressure relief valve.
  6. Inlet air filter/silencer mounted on the blower, suitable for direct connection to an outdoor air intake duct or piping and complete with removable internals and cleanable fibre filter. Provide a clogged filter visual indicator and a thermowell for a temperature sensor.
  7. Base frame with integrated discharge silencer, adjustable motor base and flexible machine mountings.
  8. Flexible, corrosion-proof and temperature resistant connectors for piping connection to inlet and discharge silencers.
  9. Acoustic enclosure with cooling fan.
  10. Instrumentation as described in subsection 2.04 I below.
  11. Temperature and pressure switches, pressure gauges and other accessories, spare parts, etc.

## 2.04 Blower Unit:

- A. Casings:
  1. The blower casings to be cast iron (GG20 – ASTM A 48, CL 25), foot mounted, heavily ribbed to ensure effective connection, cooling and to prevent distortion under the specified operating conditions.
  2. Mount the blower and motor assembly in the horizontal position.

3. Intake and discharge flanges: ASME B16.1, Class 125, C.I. flat faced. Provide taps for gauge connections in suction and discharge flanges.
4. Provide necessary eye bolts in the casings for lifting.

B. Rotary Lobes:

1. Provide three lobe rotors and shafts or two lobe rotors and shafts to be a single piece of forged steel (C45N-SAE1045) having a high carbon content (minimum 0.45% C), or of high strength ductile iron, allowing for the largest possible shaft diameter, to maximize deflection and torsion resistance.

C. Timing Gears:

1. The timing gears to have a helical tooth design in order to guarantee vibration free, quiet and durable operation. The gears to be mounted onto the shaft by means of a taper interference fit. Locate the gears to allow their inspection without having to remove drive components.

D. Bearings:

1. Timing gear end to have double row, deep groove ball bearings (maintaining a precise position of the rotors with respect to the housing). Drive shaft end to have roller bearings and single row ball bearings allowing free shaft expansion under the effect of heat. Design the bearings to guarantee a service life of at least 100,000 hrs. (per ABMA B10) at maximum speed, pressure, and temperature conditions.
2. The bearings and timing gears to be splash oil lubricated on both sides. The splash lubrication to be ensured by oil thrower discs. Grease lubrication is not acceptable. The oil casings to be heavily ribbed permitting a high degree of heat transfer. Install an oil sight glass on each side of the oil casing to facilitate level checks from each side of the machine.

E. Sealing:

1. Provide each blower with sealing systems designed to guarantee oil free conveying and to avoid contamination of the lubricating oil. Located the system between the conveying chamber and the oil casing. Each seal to have a labyrinth comprising four cast iron piston rings, and o-ring, an oil slinger, and a neutral (vent/condensate) channel.
2. The drive shaft seal to include a lip seal and a replaceable shaft sleeve.

F. Performance Test:

1. Performance test every blower for at least 1.5 hours under load, carried out in accordance with DIN 1945-1 or ASME PTC13 standards.
2. The tolerance between flow-pressure-temperature and flow-pressure-power shown on the curves and actual data must not exceed  $\pm 5\%$ .

## G. Blower Spare Parts:

1. Submit a list of recommended spare parts for the Engineer's review. Submit a list of special tools that may be required for the proper maintenance of the blower. Supply a set of the following spare parts with the blower:
  - a) 2 sets of V-belts,
  - b) replacement air filter.

## H. Blower Efficiency:

1. Refer to Table 1 for the minimum acceptable blower efficiency.

## I. Instrumentation:

1. Pressure switch on the discharge line to be a stainless steel bourdon tube type with 2 form C contacts in EEMAC 4 enclosure. Equal to Mercoild, as distributed by Davis Controls Limited, Toronto or Ashcroft. The switch shall have the following specification:
  - a) Pressure switch shall be capable of withstanding 200% over pressure
  - b) Accuracy: 1% of the span.
  - c) Contacts: It shall be equipped with a SPDT contact for each setpoint.
  - d) Contact Rating: minimum rating of 1A @ 120 VAC, 0.2A @ 24VDC.
  - e) Use S.S. tag and S.S. wire, and tag with "Tag No." and "Location - Service"
2. Temperature switch on the discharge line including thermowell capillary tube type, with 2 form C contacts in EEMAC 4 enclosure, equal to Mercoild or Ashcroft. The switch shall have the following specification:
  - a) Accuracy: 1% of the span.
  - b) Contacts: It shall be equipped with a SPDT contact for each setpoint.
  - c) Contact Rating: minimum rating of 1A @ 120 VAC, 0.2A @ 24VDC.
  - d) Use S.S. tag and S.S. wire, and tag with "Tag No." and "Location - Service"
3. The switches to be directly interlocked to the blower starter/VFD for shut off in case of excessive pressure or temperature as recommended by the blower manufacturer.



4. Vendor to provide all interlock wiring between Harmonic Filter, VFD and Blower control panel in coordination with the contractor.
5. Supply vacuum restriction gauge on the inlet with a 100mm (4") dial indicator.
6. Supply pressure gauge on the blower discharge with a 100mm (4") dial indicator and a scale range of 0 to 150 kPa. Refer to Division 13 for general requirements for pressure gauges.
7. Supply discharge temperature gauge with bulb and capillary with a 100 mm diameter (4") dial. The dial to have a scale range of 0 to 160 °C.
8. Install gauges on the acoustic enclosure that are visible without opening the acoustic hood.

#### 2.05 Power Supply

- A. The Blower skid mounted controller to receive a single source, 600V, 3 Phase power supply. All auxiliary loads, ventilation fans etc. to be powered via integral control power transformers to be supplied by the vendor.

#### 2.06 Electric Motor:

##### A. Motor Construction:

1. Supply inverter duty rated and NEMA premium efficiency motor in accordance with Section 11005 for power supply at 600V/3ph/60Hz.
2. Provide motor with 1.15 service factor above maximum design condition with minimum number of starts/hour of 15.
3. Provide motor with capability to operate at the rated voltage with a variance of +/- 5 percent of the nameplate frequency.
4. Provide motor with capability for continuous operation at full load and rated frequency at voltage variance of +/- 5 percent of the nameplate voltage.

##### B. Motor Terminals:

1. Provide the motor with an approved, diagonally split cable terminal box with cable fittings having adequate space for proper termination of three single conductor 600 volt rubber insulated neoprene jacketed box interlocked armoured or type RA-90 cable.

##### C. Motor Winding Protection:

1. Provide the motor with six (6) embedded 100 ohm platinum resistance type temperature detectors, for winding temperature alarm, two (2) in each phase of the stator windings.

2. Supply of a winding temperature relay to be installed in the unit control panel. Terminate each detector at clearly marked terminals in a suitable junction box on the motor frame.

D. Motor Vibration:

1. Rotating components of the drive to be statically and dynamically balanced as an assembled unit and produce a minimum vibration under service conditions.

E. Skid Mounted Local Control Panel:

1. Provide control panel integrally mounted on the blower package. The control panel shall consist of main disconnect, control power transformer, fuses and breakers, blower VFD including input harmonic filter and output filter, and support electrical components required for a complete, operable system. Remotely located components shall be identified. The unit shall require a single 600V power supply. All auxiliary power supplies should be internally generated in the control panel by providing transformers and breakers.
2. Each blower to be complete with a surge shutdown control system including start delay timer and single set point meter relay in EEMAC 12 enclosure. Surge protection to be accomplished by means of an adjustable set point with two normally open contacts which open at surge conditions (under set point) or when the panel is not powered. Panel to be complete with motor running lights, surge indication local controls and alarm indication. Panel to include the tripping relay. All components in the control panel to be CSA or ULc approved or labeled.
3. Supply motor starter as part of the control panel.
4. Provide below listed selector switches, push buttons, knobs on the local control panel for each blower:
  - a) Remote-Local Selector Switch (no off position – bump less transfer from remote to local and vice versa)
  - b) Start Push Button
  - c) Stop Push Button
  - d) Emergency Stop Push Button
  - e) Speed Setpoint Knob
5. Provide the below listed contacts (5A 120VAC rated contacts) from the motor starter for connection to the plant PLC for remote monitoring and control purposes:
  - a) Remote/Local selected status – Digital Input to the plant PLC
  - b) Motor Running Status – Digital Input to the plant PLC

- c) Motor General Alarm (VFD Fault, Motor High Temperature, any other alarms) Status – Digital Input to the plant PLC
- d) Motor Start Command – Digital Output from the plant PLC
- e) Motor Stop Command – Digital Output from the plant PLC
- f) Motor Speed Feedback – Analog Input to the plant PLC (isolated 4-20 mA)
- g) Motor Speed Setpoint – Analog Output from the plant PLC (isolated 4-20 mA).

#### F. Variable Frequency Drive (VFD)

1. VFD manufacturer must have demonstrated full factory support for the Canadian market and established in the market for a minimum of 10 years with appropriate Canadian Certifications
2. Select and size VFD for proper operation with blower motor.
3. All adjustments and settings to be performed by the manufacturer.
4. Size the VFDs to match with 110% of the motor's rated full load current. The VFDs must be supplied by the vendor complete with input harmonic filter and output dv/dt filter.

#### 2.07 Motor and VFD Cooling Unit

- A. Provide blower cooling by forced air convection and internal closed loop water glycol system. No external cooling provisions shall be permitted.
- B. The blower shall not require separate exhaust connections for ventilation of cooling air. Blower shall not allow heat caused by motor or electrical cooling to be exhausted into the blower room. Blower shall not require any external cooling devices such as cooling fans, ducting, or external glycol cooling.

#### 2.08 Drive:

##### A. Pulleys:

1. Pulleys for motor and blower to be grooved V-belt type, keyed to shafts, easily removable. Supply the blower with three pulleys to match the duty point, as well as the extremes of the operating range as per Table 1. Match the V-belt rating in accordance with the manufacturer's continuous service rating multiplied by a service factor of 1.5, to suit the arrangements of pulleys.

##### B. Belt Guards:

1. Belt guards to be removable and made of #12 gauge minimum perforated steel plate with stiffeners and mounting brackets. Vertical parts of guards to be of

perforated steel for ventilation. Guards to be rigid enough to prevent vibration during blower operation. Include quick release knobs for easy removal.

#### 2.09 Accessories:

A. Supply accessories with the blower unit.

B. Air Relief Valve:

1. Air relief valve to be of the adjustable spring type or of the weighted type with spare weights for field adjustments to the design head, with Class 125 bottom flanges. Springs to be rust proof.
2. Size the valve adequately to relieve the total flow generated by the blower. The valve could be installed either inside or outside the acoustic hoods. If inside, connect the valve to the discharge silencers. If outside, install the valve upstream of the discharge shut off valve. Provide and install the required piping.

C. Check Valve

1. Check valve to be integrated within the blower acoustic enclosure but externally accessible.

D. Filter Silencer:

1. A labyrinth – absorption inlet filter-silencer manufactured of cast aluminum to be flange mounted to the blower inlet. The filter silencer cover to be made of cast aluminum, and be capable of connecting to inlet ducting and to allow easy access to filter.
2. The filter to be made of a dry, cleanable, and synthetic material rated as retaining 99% of particles having a minimum size of 10 microns. It must be sized to handle the maximum flow capacity of the blower while minimizing pressure losses across its surface. The absorption material elements to be removable for inspection and replacement purposes.
3. Provide each filter with a filter contamination visual indicator mounted on the inlet silencer housing. When the filter becomes clogged (resulting in an inlet pressure drop of 50 mbar), the indicator will be actuated and reveal a “red” zone.

E. Flexible Pipe Connectors:

1. Provide flexible pipe connectors, spool type, for piping connections to the inlet ductwork and discharge silencer. Rubber sleeve, suitable for the temperature to be encountered, with steel split retaining rings. Face to face flange dimension is 350 mm minimum. Flanges to be ANSI B16.1, Class 125.

#### 2.10 Base Frame with Integrated Discharge Silencer:

A. The base frame supports the entire package and incorporates an absorption type silencer effectively dampening high frequency noise.

- B. Design the base frame/silencer to support the blower by its mounting flange and comprise a module motor base including double belt tensioning rails making it possible to substitute the motor without modifying the base frame.
- C. The base frame to be manufactured of stress relieved steel of high carbon content (ASTM 234 WPA) having a minimum thickness of 5 mm.
- D. The silencer internals to be galvanized or coated to prevent corrosion.
- E. The base frame to be supported on four flexible machine mountings absorbing at least 90% of the vibrations, making installation on a standard foundation (i.e., without special measures to handle dynamic loads) possible. The flexible mountings to be fastened to the foundation by means of anchor bolts. The position of the mounting feet to be adjustable, allowing their accurate positioning under the center of gravity of the blower and motor.

#### 2.11 Acoustic Enclosures:

- A. Provide acoustic hood for the blower to meet the required noise level. Provide the hood with adequate ventilation system to prevent any temperature difference greater than 10°C between inside and outside of the hood. Provide a hardwired interlock to automatically turn blower off in case of ventilation system failure. Make the hood of galvanized steel panels or fiberglass reinforced plastic (FRP) covered with non-flammable absorption material. Each panel to include handles for easy removal.
- B. The hood design to allow for inlet and outlet piping openings.

#### 2.12 Acceptable Manufacturers/Suppliers:

- A. First named: Aerzen
- B. Acceptable alternate: Lamson, Hibon.

#### 2.13 Data Forms:

- A. Table 1: Blower Selection Requirements

Selection Parameters	Blower Group 1
Application	Aeration Tanks
Site Location	Rodney Water Pollution Control Plant, Ontario
Base Model & Equipment Manufacturer	Aerzen model GM 7L
Equipment Designation	BL - 401, 402, 403
Number of Units	(3) three
Site Elevation *ASL (m)	211
Installation	Indoor
Air Inlet Temperature Range	-30° C to 40° C

Selection Parameters	Blower Group 1
Inlet Design Conditions: Temperature Relative Humidity	35°C 75%
Duty Point at Outlet: *Normal Flow @ *Discharge Pressure Note: Discharge pressure is measured after outlet silencer.	332 Nm <sup>3</sup> /hr @ 48 kPa(g)
Minimum Acceptable Blower Efficiency	80%
Discharge Piping/Duct Size (mm)	150 diameter
Outlet Flow Range	1080 to 2520 Nm <sup>3</sup> /hr
Maximum Blower Speed	Not to exceed the manufacturers recommended maximum speed at highest flow rate, as indicated on the performance curves and other published data.
Max/Min. Motor Speeds	1800 / 1080 RPM
Power Supply (V/ph/Hz)	600/3/60
Variable Speed Drive	Heavy Duty, industrial type.
Maximum Motor Load	Not to exceed 90% of rated motor capacity at duty point or 100% rated capacity at max. load.
Motor Temperature Protection	Provide 6 x 100 Ohms Platinum RTDs in motor windings (2 per phase). Provide motor protection relay in the skid mounted controller.
Operating Arrangement	3 Blower Units (2 duty/1 standby)
Duty	Continuous or intermittent at max. or min. speed
Special Provision	Blower not to exceed, at any time, maximum allowable temperature rise recommended by manufacturer
Certified Test Curve Required	Yes
Noise Level of Complete Package (dBA)	80
Blower Controller	Provide skid mounted controller complete with starters and motor protection relays.

## Notes:

N - refers to air volume at standard condition, i.e. at atmospheric pressure of 101.3 kPa absolute and at temperature of 20°C.

(g) - refers to pressure that is above the value of local atmospheric pressure.

ASL – Above Sea Level

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PART 3 - EXECUTION

## 3.01 Installation:

- A. Ensure that the supplied equipment is factory assembled.
- B. Noise Level:
  - 1. The noise level not to exceed 80 dBA under the following conditions:
    - a) One blower operating at maximum output.
    - b) In "free field" location, 1 m from nearest major machine surface.
    - c) Measured on the "A" weighing network using methods conforming to ANSI S1.13.

## 3.01 Operations and Maintenance Training:

- A. Provide the services of an experienced manufacturer service representative to instruct the Owners staff on operations and maintenance. Training sessions to consist of two person-days and two site trips. Provide an electronic copy of the training session. Training days are in addition to any other commissioning time required. Training to be complete prior to commissioning.

## 3.01 Commissioning:

- A. Provide the services of an experienced manufacturer service representative for testing, commissioning and start-up as follows:
  - 1. Two person-days, two trips for installation assistance and inspection.
  - 2. Two person-days, two trips for functional and performance testing.
  - 3. Two person-days, two trips for commissioning and completion of a certified installation report.
  - 4. Two person-days, two trips for facility start-up.
- B. Provide a report from the service representative certifying the following:
  - 1. Proper installation procedures are being followed.
  - 2. Completeness of installation.
  - 3. Measurement checks of all clearances and fits. This will be repeated after operating the equipment at full and varying loads.
  - 4. Running check of fits and clearances.

5. Demonstration of any overload features, alarm settings and safety device settings.
6. Running check of blower performance at the specified flows and heads.
7. Certify installed noise levels meet specification.

END OF SECTION 11370



**PART 1 - GENERAL****1.01** Reference:

- A. Sections 11000 applies to and govern the work under this Section.

**1.02** Work Included:

- A. Provide two (2) fine bubble aeration systems to be installed in two (2) existing aeration tanks, including all in-tank piping, diffusers, anchors, supports, fittings, connections, expansion pieces, moisture blowouts, pressure monitoring and all other appurtenances to complete the aeration systems.

**1.03** Related Work:

- A. Concrete - Division 3
- B. Mechanical - Division 15

**1.04** Submittals:

- A. Refer to Section 01300 - Submittals.
- B. Shop drawing submission shall include complete working and assembly drawings showing the design and method of construction of the apparatus and general arrangement thereof.
- C. Shop drawings shall indicate relevant aeration system parameters, fit of equipment within structure and other relevant installation and fabrication details. The shop drawings will clearly indicate:
1. General aeration system and grid layout within the tanks; proposed number of diffusers; grids and diffuser density in each grid, and air flow distribution. Include supporting design calculations;
  2. Material listings;
  3. Appropriate cross sections and details of the aeration equipment, including:
    - a) Diffusers including holders, retainers and orifice.
    - b) Piping including fittings and joints.
    - c) Pipe supports.
    - d) Moisture blow off assemblies.
    - e) Diffuser pressure monitoring system.

- D. Provide a certified test curve showing the performance characteristics for:
1. Oxygen transfer efficiency. State the guaranteed efficiency over the airflow range given hereunder.
  2. Engineering reports confirming clean water oxygen transfer efficiency, including description of test facility, methods of sampling and calculations.
  3. Head loss vs air flow for the membrane diffuser offered.
- E. Provide installation instruction manuals before shipment of any parts.
- F. Provide operation and maintenance manuals as per Section 01300 - Submittals. In addition, operation and maintenance manuals shall contain as a minimum the following items:
1. Equipment Data Sheets
  2. Spare Parts List
- G. The equipment supplier shall agree that submission of the foregoing data constitutes a guarantee that the units proposed conform thereto and in accordance with these specifications.

## PART 2 - PRODUCTS

### **2.01** General – Aeration Tanks:

- A. The fine bubble aeration system shall be installed in two (2) existing aeration tanks. Each tank to comprise an aeration section measuring 20.7 m x 6.6 m x 3.0 m deep with a total volume of 410 m<sup>3</sup>. Each tank shall be equipped with full floor coverage of diffusers, with separate drop legs and manifolds to allow each tank (2) to be isolated. The coverage to each tank shall be via air distributors connected to the manifolds.
- B. The aeration system shall be designed to satisfy the oxygen demand for CBOD and NOD requirements.
- C. Under clean water and standard conditions (20°C and 101.3 kPa barometric pressure), the system shall meet the following requirements:

alpha	=	0.50
beta	=	0.90
theta	=	1.035

Clean water oxygen transfer efficiency	=	32.1% (minimum)
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Operating dissolved oxygen concentration	=	2.0 mg/L
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Wastewater temperature	=	6° – 22°C
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The following are the physical conditions and loadings after the aeration tanks:

Parameter	Rodney WPCP
Number of aeration tanks	2
Size of each tank (m)	6.6 x 20.7 x 3.0
Side water depth (m)	3.0
Plant elevation (ASL) (m)	214.9
AOR (kg/d) – average/peak	360
Air flow rate (m <sup>3</sup> /hr) – average/peak	250/600

- D. Provide fine bubble aeration systems of proven design. The supplier shall have a minimum of five (5) years of experience in the manufacture of disk type fine bubble membrane aeration diffusers.
- E. The aeration system shall consist of two (2) grids of 225mm diameter disk type diffusers.
- F. Materials used shall be of the best quality and suitable in every respect for the service required. Materials shall conform to the current Standard Specifications of the American Society for Testing and Materials, where such specifications exist. The use of other materials, not covered by such specifications, will only be approved on evidence of continuous and successful use under similar conditions.
- G. It is not the intent to give every detail in the drawing and specifications. Nevertheless, the supplier shall supply the aeration systems complete in every detail.
- H. Supply the aeration systems such that the diffuser density is approximately evenly distributed in each tank to provide full floor coverage.
- I. Design the system such that the air system pressure required at the top of any drop pipe is a maximum of 48. kPa. under any condition.

## 2.02 Air Distribution Piping:

- A. Drop pipe to be fabricated of stainless steel type 304L, schedule 10, conforming to ASTM A240 and ASTM A778. Supply drop pipe from the isolation butterfly valve to the connection to the header. Connections to be pressed collars with galvanized backing flanges with drilling to ANSI B.16.5 Class 150. Connect manifolds and air distributors of PVC to the header. PVC distributors up to 100 mm dia. to be SDR 26.5 conforming to ASTM D2241 and D3915. PVC manifolds 150 mm dia and larger shall be schedule 40 conforming to CSA B137.3 and ASTM D1785.

- B. Provide a restraint coupling at the connection of the manifold to the drop pipe and flanges or union joints at connections of the manifold to the distributors. Coupling pressure rating should be sufficient for the application.
- C. Air piping sections shall have adjustable angle PVC positive locking flanges with stainless steel flange bolts.
- D. Drop pipe and manifold to be 100 mm diameter minimum.
- E. Diffuser headers to be 75 mm diameter minimum
- F. A maximum of 1200 mm shall be provided between adjacent rows of diffusers.
- G. PVC piping and fittings shall contain a minimum of 2% by weight of titanium dioxide for ultraviolet protection.
- H. Mounting of the diffusers on the distributors shall include a rigid saddle of factory solvent welded connection. Pipe nipple connections of stainless steel or PVC will not be accepted.
- I. Moisture blowout assemblies to be fabricated from nominal 19 mm diameter schedule 80 PVC conforming to CSA B137.3. Moisture blowout assemblies to be located to allow complete dewatering of the air piping system within 15 minutes of start-up. A minimum of one (1) assembly per grid to be supplied.
- J. Provide expansion joints in diffuser piping at all expansion joints in the concrete slab and as necessary to provide movement in piping due to thermal expansion and contraction. The expansion joints shall be true to alignment and have same test pressure rating.
- K. Provide a stainless steel anchorage system for mounting the diffuser piping system and anchoring it to the concrete floor. The supports shall be adjustable to compensate for variation in the concrete slab.
- L. All field assembled joints on manifolds to be at flanges or flexible couplings. Nuts, bolts and gaskets to be provided. No field solvent weld joints to be allowed.
- M. Supports, anchors, guides, hardware, etc., to be fabricated of stainless steel type 316. Anchor bolts to secure diffuser grids to the tank floors to be Hilti Hy150 Bolts or approved equal.

**2.03** Diffuser Assemblies:

- A. Provide diffuser assemblies consisting of 225mm diameter disk type diffusers.
- B. Diffusers membranes to be fabricated of EPDM rubber and shall have characteristics as per ASTM D-573.
- C. When submerged in water, diffuser assemblies shall have uniform distribution of air bubble release across the diffuser membrane.
- D. The diffuser membrane shall be perforated with uniform slits of a shape and size to prevent tearing or excessive opening of the slits during normal operation.

- E. Each diffuser assembly shall have an air flow control orifice.
- F. One blank diffuser site on each distributor grid shall be provided.

**2.04** Manifold and Distributor Lateral Supports:

- A. Supports shall consist of a two piece pipe clamp, threaded rods, nuts, washers, and drop in anchors. All components shall be fabricated of Type 316 stainless steel.
- B. The pipe clamp shall be a minimum 25 mm wide and shall have a bearing surface contoured to fit the full 360 degrees of manifold contact, whether the manifold is subject to buoyancy or gravity. The pipe clamp shall be 18 gauge minimum.
- C. The support assembly shall be designed to allow for vertical adjustment up to 50 mm beyond the total aeration tank floor variation.
- D. Provide Type 316 stainless steel drop pipe supports.
- E. The support system shall provide adequate resistance to any thrust generated by water hammer at the end of each distribution lateral.

**2.05** Anchor Bolt Connectors:

- A. Supports, anchors, guides, hardware, etc. are to be fabricated of stainless steel type 316. Anchor bolts to secure diffuser grids to the tank floors to be Hilti adhesive anchors (HIT HY 150 MAX) or approved equal.

**2.06** Quality Control Testing:

- A. Along with the submittals the supplier shall submit to the Engineer for approval, the manufacturer's standard testing plan designed to ensure good quality and uniformity of the diffusers.

**2.07** Diffuser Pressure Monitoring System:

- A. Furnish monitoring equipment to measure dynamic wet pressure and diffuser air flow of two typical diffusers in each aeration grid, the diffuser manifold pressure and the pressure within the tank at the same elevation as the diffusers.
- B. Furnish one portable Fiberglass EEMAC 3S monitoring panel. Provide monitoring panel with:
  - 1. Orifice and differential pressure gauges.
  - 2. Bubble pipe blow-down valve.
  - 3. Bubble pipe air flow rotometer.
  - 4. Quick coupling connectors.
  - 5. Polypropylene fittings.
  - 6. Polyethylene tubing.

7. One set of monitoring instructions complete with calibration curves.  
The portable panel dimensions shall be a minimum of 350 mm high X 250 mm wide.

C. Furnish one pressure monitoring connecting box assembly for each aeration system grid. The connecting box assembly shall be used to connect the pressure monitoring panels to the in-tank aeration grids. This assembly shall contain the following equipment components for each diffuser monitored.

1. One fiberglass connecting box housing, three sets of isolation valves and male quick disconnects.
2. One each 15 mm diameter, 10 mm diameter and 8 mm diameter polyethylene tubes and fittings running from the connecting box isolation valves to the in-tank aeration grid.
3. One each 15 mm diameter, 10 mm diameter and 8 mm diameter tapped holder, header and bubble pipe connections on one air distributor on the in-tank aeration grid.
4. All pressure monitoring tubes shall be housed in a schedule 40 carrier column extending from the top of the tank near the connecting box to the bottom of the tank.
5. The carrier column shall be anchored to the tank floor and wall using stainless steel supports and fastening hardware.
6. The connecting box shall be mounted to the handrail using stainless steel supports and fastening hardware.
7. The connecting box shall be located outside in a weatherproof enclosure.
8. Furnish one set of 3.0 m long pressure monitoring leads to connect the connecting boxes to the pressure monitoring panels. Each set to contain one 15 mm, 10 mm and 8 mm diameter polyethylene tube with female end quick disconnects. The tube bundle shall be encased in a 38 mm diameter polyethylene tube.
9. The pressure monitoring connecting box dimensions shall be as a minimum 300 mm high X 275 mm wide.

**2.08** Approved Suppliers:

A. Environmental Dynamics International by H2Flow Equipment Inc. or approved equal.

**PART 3 -EXECUTION**

**3.01** Delivery:

A. The Supplier shall carefully pack all equipment for shipment to protect it from any damage from movement, moisture or temperature. The Supplier shall provide shipping list and erection drawings.

**3.02** Installation and Commissioning:

- A. The Supplier shall provide all required installation instructions to the Contractor. The Supplier shall provide the services of an experienced, factory trained representative to provide direction for installation, testing and commissioning for a total of three (3) days over two (2) trips to the site to cover all membrane diffuser equipment.
- B. As part of commissioning the supplier shall be required to instruct plant operations in the proper care, operation and maintenance of the equipment.

**3.03** Testing and Inspection:

- A. Provide the services of a technical representative to check the following:
  - 1. Visual check of the completeness of the installation.
  - 2. Measurement check of all clearances, alignments, and fits. This shall be repeated after operating the equipment at load.
  - 3. Running check of fits, alignments, clearances, and performance where possible.
- B. The supplier's representative shall arrange for any adjustments prior to commencement of operation. A complete report of this inspection shall be submitted (in duplicate) directly to the Engineer.

**3.04** Training:

- A. Provide the services of a factory engineer thoroughly knowledgeable with installation and operation of the process to train and instruct the Owner's personnel in the use of the equipment.
- B. The training and instructional periods shall be broken down into two sessions which are as follows:
  - 1. Conduct classroom training session(s) to instruct Owner's personnel in:
    - a) Obtaining diffuser pressure measurements.
    - b) Equipment operation and repair
    - c) Data recording procedures
  - 2. Conduct a field operational demonstration to instruct the owner's personnel in:
    - a) Pressure monitoring system connection.
    - b) Data collection and recording procedures.

END OF SECTION 11376

## PART 1 - GENERAL

### 1.01 Reference:

- A. Sections 11000 applies to and govern the work under this Section.

### 1.02 Work Included:

- A. Provide one (1) pre-assembled fibreglass enclosure.

### 1.03 Submittals:

- A. Shop drawing submission shall include complete assembly drawings showing the design and method of construction, apparatus, and general arrangement. Include design calculations of the enclosure.

### 1.04 Warranty:

- A. Provide a one (1) year warranty for all components of the work, commencing upon Substantial Performance of the project.

## PART 2 - PRODUCTS

### 2.01 FRP Enclosure:

- A. The building design is pre-engineered, defined by using a schematic of a Finite Element Analysis (FEA) model to determine the acceptable wind and snow loads of this enclosure. The FEA report is to be supplied with the shop drawing submittal.
- B. FEA must be completed by a recognized third party structural engineering consultant, and signed and sealed by a structural Professional Engineer licensed in the Province of Ontario.
- C. Certified Panel Testing: ASTM C393 determining the flexural properties of the sandwich construction and ASTM D7250 was done to determine flexural stiffness and other core shear modulus. These tests are required so there are no assumptions made when doing the modeling.
- D. Sealed Engineering Drawings by a Professional Engineer licensed in the province of Ontario are required at time of shop drawing submittals.
- E. Design of the enclosure shall be in accordance with the latest version of the Ontario Building Code for Rodney, Ontario.
  - 1. Wind Load: As a minimum, the design shall meet wind speeds noted on drawing S01.
  - 2. Snow Load: The minimum allowable design value for snow load noted on drawing S01.



- F. Wall, roof, and end sections: All component sections shall consist of a minimum of one inch of high density foam that is totally encapsulated by the fiberglass laminate. Laminate to have a minimum glass content of 25%.
  - G. Enclosure size shall be as shown on the Contract Drawings.
  - H. Building roof pitch shall be low profile with a 1:6 pitch slope.
  - I. Insulation: Insulation shall consist of a minimum 1" foam closed cell polyiso foam core with a density PCF (-30 kg/m<sup>3</sup>) core, Type 1 Class 1. Foam core shall meet ASTM E 84-98 Fire Test flame Spread – 25 or less and smoke density – 450 or less. Minimum R value shall be R-12.
  - J. Laminate: All properties shall meet or exceed requirements that are laid out in the corresponding FEA report that defines load achievements:
    - 1. Tensile Strength – ASTM D 638 – 13,390 psi
    - 2. Flexure Strength – ASTM D790 – 22,501 psi
    - 3. Compressive Strength – ASTM D695 – 20,747 psi
    - 4. Density – 2.995 g/cc
  - K. Exterior Finish: All exterior surfaces are orthophthalic polyester with high quality ultra violet inhibitors and fully pigmented.
  - L. Concrete Mounting: Provide a 4" wide fiberglass internal mounting flange bolted to a stainless steel channel around the building perimeter. An expandable neoprene sponge rubber gasket shall be provided as a weather tight seal. The base shall be anchored with  $\frac{3}{4}$ " adhesive anchors providing a safety factor of 2:1. Anchors and fasteners shall be stainless steel.
- 2.02 Doors, Frames and Louvers:
- A. Provide one (1) 915 mm man-door with stainless steel hardware, lock set and threshold 4" wide x  $\frac{1}{2}$ " high and thermal break located on each short side of the closure as shown on the drawings.
  - B. Provide one (1) roll-up overhead door with a minimum width of 2.5 m, as shown on the drawings.
  - C. The frames shall be a minimum of  $\frac{3}{8}$ " thick solid fiberglass designated specifically for the provided doors.
  - D. Door gasket shall extrude closed cell neoprene sponge rubber providing a tight weather seal.
  - E. Hinges: Three hinges 4.5" x 4" ball bearing NRP hinges, stainless steel finish.
  - F. Locksets: each door shall be equipped with a stainless steel lock set.

- G. Louvre dimensions and performance requirements as indicated on Mechanical drawings.
  - H. Louvres up to 600 mm high shall have fixed horizontal storm proof blades and shall be the 35-degree, complete with water baffle.
  - I. Louvres over 600 mm high shall have fixed horizontal drainable blades with gutters designed to catch and direct water to jamb and mullion drains.
  - J. Frames shall be of all welded construction and shall be provided with a caulking recess all around.
  - K. Provide 13 mm x 13 mm intercrimped heavy-duty bird screens folded in frames on all louvres, mounted on the interior.
  - L. Louver sills with formed drip and turned up at underside of louvre sill section.
- 2.03 Approved Manufacturers:
- A. RM Products Limited – Fibreglass Structures or approved equal.

### PART 3 - EXECUTION

#### 3.01 General Arrangement:

- A. Provide the general arrangements based on attached drawings, as well as all necessary design details including anchorage and sealing details to ensure the long-term success of the installation.

#### 3.02 Delivery:

- A. Carefully package all parts for shipment to protect every item from damage which may result from handling, movement, moisture, freezing, dust or heat.

#### 3.03 Installation and Commissioning:

- A. Provide all necessary installation instructions to the Contractor and provide full-time services of an experienced, factory-trained representative to supervise installation, calibration and commissioning.
- B. Install all equipment in strict accordance with the manufacturers written instructions.

#### 3.04 Testing and Inspection:

- A. Review the commissioning procedure on site with the equipment supplier, the Owner and the Engineer, prior to implementation. Any damage to building enclosure during installation, testing and commissioning is Contractor's responsibility.
- B. The manufacturer shall provide the service of a qualified representative for one (1) trip and two (2) days to inspect and assist in the installation.

3.05 Operation and Maintenance Instructions:

- A. Provide an assembly manual and manufacturer's contact information.

3.06 Warranty:

- A. A written manufacturer's warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum of one (1) year from Substantial Performance. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service.

END OF SECTION 11995

# **DIVISION 13**

## **CONTROL AND INSTRUMENTATION**

**INDEX**

SECTIONS

- Section 13000 – Control and Instrumentation
- Section 13322 – Control Panels
- Section 13323 – Control Panel Devices
- Section 13324 – Data Processing System
- Section 13327 – Application Software
- Section 13329 – Field Instruments and Devices
- Section 13341 – Pressure Instrument-Indicators
- Section 13343 – Pressure Instrument-Transmitter
- Section 13362 – Level Switches-Float
- Section 13381 – Analyzer -Dissolved Oxygen

END OF INDEX DIVISION 13

**PART 1 - GENERAL**

**1.01 Governing Conditions:**

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

**1.02 Reference:**

- A. Comply with the latest edition of the Codes and Standards referred to in these documents and or as required by local, provincial, and federal authorities. Be responsible for the procurement of relevant Codes and Standards.
- B. Ensure that the materials, design, and workmanship employed in the manufacture and installation of equipment conforms to the applicable standards established by ASTM, CEC, CGSB, CSA, ULc, ISA and the provincial Electrical Safety Code. Canadian standards take precedence over foreign standards in the case of duplication or conflict.
- C. Have the material, equipment, installation, and workmanship meet the latest edition of standards of the following organizations:
  - 1. Canadian Standards Association (CSA)
  - 2. Canadian Electrical Safety Code (CESC) – C22.2, Canadian Electrical Code
  - 3. Ontario Electrical Safety Code (OESC) – Ontario Supplement to the Canadian Electrical Code.
  - 4. CSA Workplace Electrical Safety Standard Z462-18
  - 5. Underwriters Laboratories of Canada (ULc)
  - 6. Canadian Electrical Manufacturers Association (CEMA)
  - 7. National Electrical Manufacturers Association (NEMA)
  - 8. Electrical and Electronic Manufacturers Association of Canada (EEMAC)
  - 9. Electronic Industries Association / Telecommunications Industries Association (ANSI/EIA/TIA 606)
  - 10. National Fire Code (NFPA) NFPA-820, Fire Protection in Wastewater/Water Treatment Plants
  - 11. National Sanitation Foundation (NSF) - NSF/ANSI Standard 61, Drinking Water System Components
  - 12. Underwriters Laboratory Inc. – UL508 Standards for Safety, Industrial Control Equipment. To include Canadian, CUL standards and codes.

13. International Society of Automation (ISA) standards including, S5.1 - Instrument symbols and identification, and S50.1 - Compatibility of analog signals for electronic industrial process instruments.
14. Institute of Electrical and Electronic Engineers Inc. (IEEE): C62.41 - Recommended Practice on Surge Voltages in low-voltage AC power circuits.
15. National Fire Code (NFPA) - NFPA – 49, Hazardous Chemicals

**1.03 Definitions and Abbreviations:**

A. Abbreviations:

C&I	Control & Instrumentation
DCS	Distributed Control System
FAT	Factory Acceptance Test
ESA	Electrical Safety Authority
FM	Fiber Media
F/O	Fiber Optic
HVAC	Heating, Ventilating and Air Conditioning
ICP	Instrument Control Panel
I/O	Input/Output
ISR	Intrinsically Safe Relay
HMI	Human Machine Interface, also can be referred to as Operator Interface Terminal (OIT)
LCP	Local Control Panel
MCC	Motor Control Center
O&M	Operation and Maintenance (Manual)
OIT	Operator Interface Terminal
SAT	Site Acceptance Test
PC	Personal Computer
PCS	Process Control System (comprised of all parts of system hardware and software, such as PLCs, OITs, communication System)
PLC	Programmable Logic Controller (also called RTU, RPU or DPU)
RTU	Remote Terminal Unit (also called PLC, RPU, DPU)
RPU	Remote Processing Unit (also called PLC, RTU, DPU)
UPS	Uninterruptible Power System

B. Definitions:

1. Device: equipment, instrument

2. Item: system, device, service, document, action
3. Contractor's scope for each item, as related to work specified herein: new, remove, replace, re-wire, modify, upgrade, integrate, package as required.
4. New: provide new item
5. Existing: not in scope, information only item.
6. Remove: make safe the running process, structural, power and signal connections, disconnect the item from these systems and hand it over to the Owner. Remove the pertaining connecting appurtenances and make safe the systems affected by this operation. e.g.: removal of a control panel will also include the removal of the housekeeping curb, the covering of the exposed cable trench with a permanent structure, removal of all cables/wires and cable trays/conduit, impulse lines connected to this panel and securing all these at their other end (insulation, structural supports, pipe capping) and finishing the affected floor/walls to the make them blend with the surrounding areas.
7. Replace: remove existing item, provide new item.
8. Relocate: remove existing item, install new item in new location.
9. Re-wire: remove existing wiring, connect power and/or signals to new destinations, as shown on the Contract Documents.
10. Modify: implement changes which provide different functions to the item, as shown on the Contract Documents.
11. Upgrade: implement changes which improve the performance of the item, as shown on the Contract Documents.
12. Integrate: include the item in the new control system, as shown on the Contract Documents.
13. Package: provide field work as shown herein and as required by the documents pertaining to the referred package.
14. Provide: Supply and install, calibrate, setup, program, test, commission, and supply documentation.

**C. Software Description:**

1. Software encompasses and refers to programming and software packages provided as part of the Contract required for:
  - a) Programming of digital devices using various/all types of programming languages.
  - b) Configuration of digital devices using all types of configuration processes.



- c) Programs and configuration data stored in read-only memory, programmable read-only memory, read/write memory, disk, tape, CD, etc.

**D. Types of Software:**

1. Software packages independent of project specific software. These represent normally off-the-shelf products, such as:
  - a) System Software such as software required for: operating systems, programming language <s>, utilities, assembles, text editors, communication software, and graphics generator.
  - b) Process Software: data acquisition, alarming, monitoring, human machine, interface software, data collection, historical data, trending, report generation, control, and diagnostics.
2. Application Software:
  - a) Software provided for project specific functions and processes.
  - b) Database data configuration software, including real and virtual I/O data and parameters.
  - c) Tables and displays include pump tables, setpoint tables, equipment tables, pop ups, etc.
  - d) Reports, trends, historical data.
  - e) PLC programming.
  - f) Graphic station programming.

**1.04 Intent:**

- A. It is the intent of this Section to provide a control and instrumentation system that:
  1. Monitors and controls process parameters and equipment to be provided under this Contract, as shown on the Drawings, and/or as specified.
  2. Is integrated into Rodney Water Pollution Control Plant SCADA HMI system.

**1.05 General Requirements:**

- A. Implement the full functionality specified in the Contract Documents.
- B. Demonstrate an operational system and put all equipment into operational service to the satisfaction of the Engineer.
- C. Satisfactory performance of the system to be assessed based on the entire control system being fully operational and in use under peak load conditions during the process run.

- D. Performance requirements to be based upon worst case scenarios.
- E. Provide documentation in a timely manner and as specified.

**1.06 Work Included:**

- A. The Work of this Section consists of the provision of a complete, integrated, operational instrumentation and control system for the “Rodney Water Pollution Control Plant upgrade project” in accordance with the Contract.
- B. As a minimum, the work to be completed consists of, the design, manufacture, assembly, supply, shop testing, calibrating, delivery, installation, commissioning, training, and the provision of guarantees, for the complete control and instrumentation system as specified, and as shown on the Drawings.
- C. The instrumentation and control system work includes but is not necessarily limited to:
  - 1. Modify the existing PLC control system by adding required I/O cards to the PLC Rod2, connecting the IO signals of this project to the PLC Rod2 as specified on the drawings/documents, and reprogramming the PLC.
  - 2. Provide, test and commission all field instrumentation, and control system hardware including all peripheral/accessory devices necessary.
  - 3. Test, and commission the programmable logic controllers (PLC) and associated equipment. Programming of the PLC’s and Graphics is by the System Programmer.
  - 4. Test and commission the modification to the existing SCADA HMI system and associated equipment, at the local control room.
  - 5. Implement a full SCADA system at the plant, where major equipment is controlled and monitored through field adjustable Programmable Logic Controller and allows for adjustments and recording historical data/events.
  - 6. Provide all interconnecting cabling for PLC equipment and tie-ins.
  - 7. The Drawings are intended to be a functional description of the system required, and as such shall serve as a guide in designing the system. Submit designed, complete control and wiring shop and loop drawings, in addition to shop drawings for equipment and panels. Provide all hardware, wiring etc. to connect the instrumentation added, moved, or modified under this and other divisions for a complete and operating system. Verify the actual site conditions and modify the proposals to provide the desired results without additional charges to the Contract.
  - 8. Reference to the Drawings and Divisions 11, 13, 15 and 16 to ensure completeness of installation for control items covered there and that these items are compatible with the control and operation intent of the design.
  - 9. Shop drawings, to be submitted before any equipment is ordered, are required for all items in this Section.

10. Prepare all documentation, descriptive data, schematic and interconnecting wiring diagrams for submission and review in accordance with the requirements of Division 1.
  11. Provide testing and commissioning services including those associated with installing and testing software prepared by others. Allow for a minimum of fourteen (14) working days, based on an 8-hour working day, for software testing during which time, the Contractor's staff are to be available. Not all days will be necessarily full days or concurrent. It is expected that the project will be commissioned in a staged approach. Allow in the Contract Price, for any additional time deemed necessary to meet the testing and commission requirements.
  12. Provide the services of qualified manufacturer's service representatives for installation, setup, calibration, testing, commissioning and guarantee and warranty period and training activities.
  13. Provide supervision, calibration, and loop check-out for instrumentation systems in the field, to the Engineer's satisfaction. Complete loop check-out and submit to the Engineer, a typed report on verification and results of the loop check-out, including details of calibration and settings of equipment. Loop checks must exercise the entire loop, stroking motorized or actuated field equipment, monitored, and operated through SCADA and PLC I/O as well as locally. Each loop check must be witnessed by, and successfully demonstrated to, the Engineer for sign-off approval. Before requesting witnessed loop checks, carry out Contractor's own field and loop check tests to verify that the equipment operates as intended. Correct and problems or deficiencies prior to requesting witnessed checks.
  14. Thoroughly vacuum and clean all Instrument Control Panels prior to site acceptance testing.
  15. Provide Site Acceptance Testing (SAT) to demonstrate the correct operation of control system with both hardware and software in place. This site acceptance testing forms part of commissioning and must be completed satisfactorily prior to application software being loaded. Notify the Engineer ten (10) days in advance of SAT such that this test may be witnessed by the appropriate parties.
  16. Provide and maintain 'As Constructed' equipment drawings, detailed wiring diagrams, equipment and programming tools manuals, documentation, and materials, on satisfactory completion and certification of operation as intended.
  17. Provide training as specified.
- D. Provide sample screens for the OIT for review and approval by the Owner and Engineer before completing/finalizing programming work. Coordinate with Rodney Water Pollution Control Plant to obtain copies of OIT sample screens.
- E. Provide equipment, documentation and programming tools needed to enable the programmer to produce the application software.

**1.07 Submittals:**

- A. Milestone Schedule: Prepare and submit a proposed schedule of instrumentation and control work. Indicate the following major milestones as a minimum:
  - 1. Hardware shop drawing submission including issue of product data sheets and deviations.
  - 2. Purpose-made drawing submission.
  - 3. Preliminary issue of operating and maintenance manual.
  - 4. PLC program and Graphics Station installation and testing.
  - 5. Site acceptance testing (SAT) including documentation.
  - 6. Operation and maintenance training sessions.
  - 7. System commissioning.
- B. Prepare and submit a clear, typed Index listing the number and title of all purpose-made drawings proposed.
- C. Provide a complete set of purpose-made drawings, shop drawings, and product data sheets bound into one volume and submitted to the Engineer before the commencement of work.

**1.08 Shop Drawings:**

- A. Submit shop drawings in accordance with Section 01300. Submissions to include but not be limited to:
  - 1. Engineering Product Data Sheets
  - 2. List of Deviations from the Specifications and reasons for the deviations.
  - 3. Equipment identification name tags as specified.
  - 4. Materials of construction and equipment configuration.
  - 5. Equipment type/model, dimensions, and weight.
  - 6. Performance and operating characteristics.
  - 7. Complete bill of materials for equipment to be purchased.
  - 8. Wiring and interconnection schematic.
  - 9. Preliminary configuration sheets for instruments requiring configuration.
  - 10. SAT check off sheets.

- B. Submit purpose-made drawings for all items as follows:
1. Prepare purpose-made drawings neatly and accurately by means of the latest version of AutoCAD or as directed by the Engineer. Do not use external references or customized file extensions. Provide fully portable electronic file copies of drawings.
  2. Prepare purpose-made drawings that are neat and legible in 11 x 17-inch format.
  3. Make submissions on reproducible material such as mylar, vellum or 11 x 17 sized paper, complete with a title block containing the Engineer's project number, your project number and company logo, a drawing and project title as stated on the Drawings, and a referenced drawing number (related to a file name if applicable). Provide tabular columns to record the original submission date, a revision number, date and reason for subsequent revisions, and signature of authorized issuing staff member.
  4. Submit, as a minimum, the following purpose-made drawings:
    - a) Scaled, referenced, front of panel layouts, and general arrangement drawings.
    - b) Scaled, referenced, internal panel layouts (may be combined with the above)
    - c) Detailed panel power wiring schematic
    - d) System Wiring/Block Diagram approved by the PLC Manufacturer c/w PLC module model numbers, cable model numbers, etc.
    - e) Network drawings.
    - f) I/O wiring arm drawings
    - g) Lamacoid schedule
- C. Provide on-site engineering and supervision of equipment installations. Ensure that a qualified Supervisor is present at all times while equipment is being installed.
- D. Use all necessary test equipment to check out field wiring, equipment connections and other parts of the system to determine whether the system is installed correctly.
- E. Take responsibility for the correctness of the installation.

**1.09 Instrument and Equipment Manufacturers:**

- A. When a product is specified with a manufacturer's name and specific identification or model number, and the words "or approved alternate" are not included, and acceptable alternative manufacturers are not specified, then the specified product must be supplied. Alternative or substitute products will not be acceptable.

- B. When a product is specified with two or more manufacturers' names and respective specific product identification, and the words "or approved equal" are not included, then the product supplied must be one of those specified.
- C. When a product is specified with a generic description and performance data, or by manufacturer's name and product data with the words "or approved equal", the Engineer will decide at the time of shop drawing review whether the product proposed is acceptable, and the Engineer's decision will be final.
- D. Design is based on the first named manufacturer. If use of a product other than the first named is proposed, and the submission is accepted; be responsible for completing required redesign work is proposed at no additional cost to the Contract.
- E. Pre-Tender approval of equivalents and alternatives will not be given.

**1.10 System Integrator**

- A. The System Integrator is responsible for providing the control and instrumentation system as specified and/or as shown on the Drawings. This includes, but is not limited to all instrumentation, panels, wiring, system equipment, documentation, and training.
- B. Unless otherwise specified, ensure that instruments and control system hardware, including testing, calibration, commissioning is provided as a complete package by an experienced, reputable instrumentation and control subcontractor. Include, service technicians qualified by the manufacturer to be on-site if requested by the Engineer, or if correct methods for installation, setup and calibration are uncertain. Unless otherwise stipulated, only the manufacturer's technicians are acceptable where control system hardware, analyzers or flow meters are concerned. This includes subcontracting main suppliers and their services as necessary, and as specified. Bear the costs of required supplier engineering, including the necessary wiring configuration, preparation of shop drawings and site visits.
- C. Submit to the Contract Administrator documentation verifying that the company proposed as the System Integrator is experienced in instrumentation and control work and is capable of properly carrying out that work. Provide a list of at least five projects successfully completed for this type of work as well as the name of the Consulting Engineer and the name of his field representative for each project. Acceptance of the proposed System Integrator is at the sole discretion of the Contract Administrator.
- D. Perform on-site control and instrumentation work under the direct supervision of a qualified and experienced supervisor employed by the System Integrator.
- E. Approved System Integrator is:
  - 1. TBD by the Owner.

**1.11 System Programmer:**

- A. The Detailed Process Control Narrative, RPU Programming and OIT/SCADA HMI Development is by the System Programmer, who shall be carried by the System Integrator.

- B. The System Integrator shall provide field support for the System Programmer during installation and testing. Allow ten (10) working days.
- C. Once the PLC and SCADA software has been installed and successfully tested by the Programmer, be responsible for demonstrating the proper operation of the hardware and software during a SAT.
- D. Approved System programmer is:
  - 1. TBD by the Owner.

**1.12 Operating and Maintenance Manuals:**

- A. In addition to requirements for operating and maintenance manuals specified in Section 01700, include the following:
  - 1. Manufacturer's hardware and software manuals.
  - 2. Special instructions or procedures, including System, Software, and Instrument Trouble-shooting techniques.
  - 3. Systematic procedures for operations personnel to start up, shut-down, manually override and locally operate all related equipment in accordingly titled manual sections.
  - 4. Recommendations on equipment maintenance and suggested spare parts.
  - 5. Final Shop Drawings and signed-off product data sheets as defined in this Specification.
  - 6. Copies of "As Built" drawings of all purpose-made drawings.
  - 7. Calibration certificates from the manufacturers for each calibrated instrument.
  - 8. Copy of the final Process Control Narrative.
  - 9. Complete PLC Program and the screens and configuration for the Graphics Station
  - 10. Name(s), address(s) and telephone number(s) for local qualified system and/or product service representatives.

**1.13 Warranty and Guarantee:**

- A. In addition to the requirements of Section 01700, provide the following:
  - 1. Necessary hardware warranties and guarantees as required to guarantee that the entire control and instrumentation system will perform as specified.
  - 2. A one (1) year warranty period commencing on the established Date of Substantial Performance.

3. Engineering support services during the warranty period, at no extra cost to the Owner.

## **PART 2 - PRODUCTS**

### **2.01 General:**

- A. Equipment specified under this Section comprises instrumentation (including appropriate mounting hardware) and control equipment (including cards/terminal block/wiring) as specified herein and shown on the drawings. Include primary devices, transmitters, receivers, signal protection, conditioning equipment, indicators, switches (pressure, flow, temp.) etc.
- B. The entire control system shown is to operate automatically on an electric/electronic basis, principally through the use of programmable microprocessor-based equipment which can be revised, reprogrammed and reset digitally without the need for hardware changes, additions, rewiring, or mechanical adjustments.
- C. Provide equipment designed for use in industrial applications.
- D. Provide all necessary equipment, tools, labour and materials, for installing and testing equipment supplied by this Division.
- E. Devices shall have CSA or ULc approval.
- F. Modify, at no additional cost to the Owner, the location of materials and/or equipment as directed by the Engineer, provided that the changes are made before installation and do not necessitate the purchasing of additional material.
- G. As a minimum standard, unless specified otherwise provide each instrument with corrosion-resistant mechanism and enclosed in NEMA 250 Type 4x casing, suitable for mounting at the locations and by the method shown on the Drawings or as indicated by the shop drawings. Where applicable, upgrade all items to equal the EEMAC rating of the related area.
- H. Areas of a hazardous nature are classified as noted in the Drawings and in NFPA Standard No. 820, latest edition. Comply with Section 18 of the Canadian Electrical Code - Part 1 for all electrical work and equipment enclosures in hazardous areas and to Section 22 of the Canadian Electrical Code for all electrical work and equipment enclosures in corrosive areas.
- I. Provide EEMAC 4x enclosures for all equipment mounted outdoors as a minimum standard, unless specified otherwise, suitable for operating in temperatures from -30 to +50oC. To prevent condensation, use panel heaters and polyisocyanurate insulation for equipment located outdoors to maintain a temperature 5°C above ambient.
- J. Design the control system to operate satisfactorily on normal and standby electrical power, including transient periods under changeover conditions. Provide instrument components that have ample margin to withstand transient and other surge voltages which may occur.



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- K. Provide required current isolators, signal conditioners and any other instruments which may or may not be shown, but which are required for the entire control and instrumentation system to operate as intended by these Specifications and as designed.
- L. For control circuit wiring, follow the color code for panel wiring found in Section 13322 – Control Panels.
- M. All communication and network lines/cables to be provided with surge and lightning protection.
- N. All buried analog cabling to be provided with suitable surge and lightning protection.
- O. Provide electrical raceways, conduits, and ducts as specified and or as per Code. Refer to Division 16 and electrical drawings for additional details.
- P. Unless specifically stated otherwise, provide all readouts, indicators, recorders, etc., with linear, metric and imperial engineering unit scales. If the display is not available in dual units, select metric units. All final units, ranges, set points, colors, etc., will be finalized on the shop drawings.
- Q. Meet the accuracies specified for all instruments. If a supplier cannot meet any of the specified accuracies, clearly state so in the shop drawing submission, and state the highest accuracy which the instrument can consistently meet. The Engineer will decide at the time of shop drawing review whether the product proposed is acceptable, and the Engineer's decision will be final.
- R. Note compliance and variance with specifications on shop drawings.
- S. Purchase equipment via official Ontario distribution channels that are authorized to sell, service, and support the equipment and have the responsibility to warranty its performance. Equipment that bypasses the manufacturer's authorized distribution channels is not acceptable. Be responsible for costs associated with return, repair and/or replacement of equipment later discovered to be obtained in such a way.
- T. Provide instruments of current design. Obsolete equipment, or equipment which has been identified for withdrawal from the market by the manufacturer before date of Substantial Performance is not acceptable.
- U. Provide new equipment of the best quality. Used or reconditioned equipment is not acceptable.
- V. In addition to the insurance coverage required in the General Conditions, provide insurance coverage against theft or damage for any equipment turned over to the Owner during transit to and from the place of delivery and for the period when the equipment remains on the Owner's premises. Maintain coverage until the equipment is installed or removed from the site.
- W. Replacement electronics, sensors, and transmitters to be stocked locally.
- X. Ensure that nonstock hardware is available in not longer than three days.
- Y. Ensure that on-site technical support is available within 24 hours.

**PART 3 - EXECUTION**

**3.01 General:**

- A. Be responsible for verifying all measurements and details of the existing equipment and structures necessary for the proper fitting and connecting of the new equipment, before proceeding with the work. Report discrepancies between the Drawings and existing work to the Engineer. Be responsible for the proper fitting of the work and make such changes as necessary and directed by the Engineer without additional cost to the Owner.
- B. Comply with applicable Federal, Provincial and Municipal laws, regulations, Codes, and by-laws.
- C. Comply with the requirements of the latest edition of the applicable CSA Standards, the applicable standards of the Underwriters' Association and all other authorities having jurisdiction. These Codes, Standards and Regulations constitute an integral part of these Specifications.
- D. In case of conflict between the standard specified by the Drawings and Specifications and Codes referred to herein, the most stringent provision takes precedence.
- E. Obtain and pay for necessary permits, licenses, certificates, and approvals.

**3.02 Equipment Protection:**

- A. Take delivery, offload, and store equipment on site in accordance with the equipment manufacturer's recommendations. Be responsible for storage charges and obtain from each manufacturer, instructions on the correct storage procedures.
- B. After installation and before operation, protect equipment against weather, dust, dirt, dampness, and other damaging factors in a manner satisfactory to the Engineer and in accordance with the manufacturer's instructions.
- C. Pay costs associated with repairing equipment damage occurring before project completion.
- D. Provide insurance for equipment free issued to programmers for program development and testing.
- E. In addition to the insurance coverage required in the General Conditions, provide insurance coverage against theft or damage for any equipment turned over to the Engineer Owner during transit to and from the place of delivery and for the period when the equipment remains on the Owner's premises. Maintain coverage until the equipment is installed or removed from the site.

**3.03 Equipment Installation:**

- A. Provide onsite engineering and supervision of equipment during its installation. Supervisor's presence is required at all times while equipment is being installed.

- B. Use necessary test equipment to check out field wiring, equipment connections and other parts of the system to determine whether the system is being installed correctly.
- C. Provide necessary labor, equipment, tools, and materials for the complete installation of equipment supplied under this Section.
- D. Install and calibrate instrumentation and control system hardware in a workmanlike manner and in accordance with the manufacturer's drawings, instructions and/or under the direction of their qualified technical representative except as otherwise specified or instructed in writing by the Engineer.
- E. If any requirements of this Specification, or a drawing detail, contradicts the equipment manufacturer's instructions or recommendations in a manner which could be detrimental to its operation, including the possibility of inducing adverse side effects elsewhere to the system, immediately notify the Engineer in writing and do not continue with installation until the contradiction is resolved.
- F. Once an instrument has been inspected by the Engineer and initially calibrated, it is to remain powered up at all times unless the instrument is being serviced.
- G. Confirm with the Engineer instrument calibration, set points and other programmable parameters during on-site inspection as soon as site conditions are sufficiently ready. Final calibration values may vary from the nominal values specified in the Product Data Sheets. Recalibrate the instruments at no extra cost to the Owner.
- H. Confirm the correct locations for equipment with the Engineer prior to installation and/or roughing-in.
- I. Provide and install lubricants necessary for initial operation of the equipment in accordance with the manufacturer's instructions.
- J. Provide isolation valves for all instruments.
- K. Supply equipment with factory applied finishes. Repaint or refinish surfaces damaged during shipment, erection, or construction work to an "as new" condition. Make provisions to mask before, and clean equipment after, final site painting. Paint devices to color codes established by the Owner in accordance with Section 09900.
- L. Expedite the ordering and delivery of required materials and equipment. No claims will be allowed for delays or additional expenses resulting from failure to place orders in ample time.
- M. Arrange for regular inspections and a final inspection by the local Hydro Authority.
- N. Take responsibility for the correctness of the installation.

**3.04 Modifications to Existing Equipment:**

- A. Do not remove existing equipment from service without written approval.
- B. Removal of equipment and/or wiring means the disconnection and complete removal of related cables, conduit, and wiring from the equipment, shut off related power sources and

capping resulting holes openings, blanking off any panel openings, etc. Provide tags at the power sources indicating "Not Used".

- C. Leave in place existing wiring and equipment not required to be modified, whether it meets current codes unless there is a definite safety hazard. Draw to the attention of the Engineer any such condition.
- D. Have equipment taken out of service, removed, and delivered to the Owner or left in place as directed by the Engineer.

**3.05 System Testing:**

- A. Arrange for and co-ordinate Site Acceptance Tests.
- B. Make arrangements to ensure that, during the testing period, required test equipment such as meters, scopes, calibrators, communication equipment, and other instruments and equipment, are on-site and that competent technicians are available on site to assist.
- C. Thoroughly test the instrumentation system equipment in the shop for both individual unit operation, and in simulation tests as a control system. Perform such tests before shipment to site.
- D. Two (2) weeks in advance of the SAT, submit to the Engineer, a detailed test procedure outlining methods and items to be included in the test. The Engineer reserves the right to modify the procedure to ensure that all items are included. Demonstrate in each test to the Engineer's satisfaction, the proper operation, calibration and installation of all systems (loops, control circuits, monitoring, etc.).
- E. Any failure during individual testing will result in a complete re-test after the failure is corrected.

**3.06 Software Site Acceptance Testing**

- A. Provide Software SAT plan per Rodney Water Pollution Control Plant requirements.
- B. Prior to the start of any software SAT, the system integrator is to conduct initial software testing and validation.
- C. Provide Pre-SAT documentation and Pre-SAT software submittal per Rodney Water Pollution Control Plant requirements.
- D. Software SAT testing is to be led by the system integrator. Provide all necessary computers, network equipment and PLC hardware required to conduct the SAT. The system integrator is to be responsible for:
  - 1. Setup of the SAT environment
  - 2. Providing all software licenses (PLC, OIT, SCADA, I/O drivers, I/O servers, etc.) for testing
  - 3. Scheduling of the SAT

4. Execution of the SAT plan
  5. Signing off the test records
  6. Producing the SAT report, following the SAT, including a listing of all issues or deficiencies and appropriate corrective action plan
- E. The consultant and PLC/SCADA group from the Rodney Water Pollution Control Plant to witness the SAT.
- F. Within one week following completion of the SAT, the System Integrator shall submit the SAT records to the Consultant for review.
- G. Software SAT shall be performed by:
1. TBD by the Owner.

**3.07 Site Acceptance and Commissioning:**

- A. Perform the Site Acceptance Test (SAT) on site, at the facility per Rodney Water Pollution Control Plant requirements. The scope of the SAT includes hardware and software provided under this Contract. Successful completion of the SAT test will be one of the criteria required for Substantial Performance.
- B. Confirm that all supplied software and firmware is the latest released version at the time of the SAT, with update support for the two-year warranty period.
- C. Confirm the version of the PLC firmware with the Owner.
- D. Demonstrate and confirm that all the field instruments, control panels and communication links have been provided as per approved shop drawings and are operating as designed.
- E. Demonstrate that an approved set of shop drawings was made available to the Engineer at least one month before the SAT.
- F. Coordinate with the Programmer, the schedule for their application software testing.
- G. Provide site acceptance testing and commissioning to thoroughly check the final installation and performance of each individual piece of equipment, to certify that the equipment is correctly installed, to check each loop control, to start up the equipment and verify the installed equipment accuracy and to test application software performance, and to instruct the Owner's staff on the operation, programming, and maintenance of the system. Provide site supervision of the installations, repairs and/or adjustments to the equipment, and coordination of the field supervision by other suppliers within their areas of responsibility as specified.
- H. The start-up procedures require the cooperation and presence of the Engineer or their designated representative. Coordinate the work and completely commission the entire control and instrumentation system so that it is operating as designed to the satisfaction of the Engineer.

- I. Be responsible to provide a complete and working system, in full conformance with the Contract Documents.
- J. Ensure that equipment checkout, calibration and operator training is performed and certified by an authorized service representative of the respective instrument suppliers.
- K. Commissioning of the system involves complete operation of the facility under fully automatic control.
- L. Compliance with proper operation will be judged over a trial operation period. The duration of this period is 14 consecutive plant operating days. If the system fails for any reason during the trial operation period, re-initiate the SAT test after deficiencies are corrected.
- M. Responsibilities:
  - 1. Be available within 4 hours of site for the trial operation period.
  - 2. Follow the agreed test procedure in testing the system.
  - 3. Keep a test log, based on approved test procedures in which indicate all tests, significant events and failures with times, durations and actions taken.
  - 4. Be responsible for costs associated with time lost and/or extra time spent on remedial works due to failures.
- N. Site Acceptance and Commissioning for software shall be performed by:
  - 1. TBD by the Owner.

**3.08 Documentation:**

- A. Provide complete typed and certified documentation for each instrument programming, calibration, and verification, including changes which may have been made during start-up and commissioning.
- B. Provide documentation and instructions for reprogramming instruments.
- C. Provide maintenance and calibration manuals for the control and instrumentation system equipment in accordance with Section 01700.
- D. Provide 'As Constructed' equipment Drawings, detailed equipment and field wiring diagrams and equipment manuals, on satisfactory completion and certification of the trial operation.
- E. Documentation related to software shall be provided by the programmer.

**3.09 Training and Support:**

- A. Provide operator training as specified. Provide the following minimal on-site training:

1. One session of two (2) days in the use of the control system including hardware and software systems, to be performed before commissioning, including hardware and software systems.
  2. Provide one (1) day for training refresher to be performed prior to end of the warranty period.
  3. Provide training by manufacturers' representatives for major field equipment. See equipment specifications for requirements.
- B. Training and support on software shall be provided by the programmer.

**3.10 Co-ordination of the Work:**

- A. Co-operate with other trades in such a manner as not to interfere with work of other Divisions or Contracts.
- B. Relocate, without extra cost to the Owner, and as directed by the Engineer, all equipment, conduit, and other hardware installed but not coordinated with the work of other trades.
- C. Be responsible for work, which may be required, to change over, reconnect existing services including power, signals, branch circuit wiring, that cannot be completed during regular working hours. No additional charges will be accepted for work done on premium time to maintain the necessary continuity of services within the plant property.
- D. Install equipment requiring maintenance adjustment or eventual replacement with due allowance for space and access.
- E. Include in the work, the equipment manufacturers' requirements shown on shop drawings.
- F. In work already finished as part of this Contract, all cutting, and patching will be carried out at no extra cost to the Owner. Obtain the approval of the Engineer before doing cutting. Do not cut supporting members of any floor, wall or building structure except as approved by the Engineer and in such a manner as approved by the Engineer. Arrange to have all patching done by the respective trades whose work is affected. Perform this work in accordance with the Contract Documents.

END OF SECTION 13000.

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 13000 - Control and Instrumentation applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Modification, testing and commissioning of the control panel where shown on the Drawings, and in this specification.
- B. Enclosures shall be complete with all instruments, meters, control switches, indicating lights, programmable control I/O modules, power supplies, wiring terminals and other devices as required.

**PART 2 - PRODUCTS****2.01 General:**

- A. Modify (1) floor mounted control panel and tag as follows:
  - **Control Panel, Rodney WPCP Sludge Building ROD2**See project documents for details.
- B. Instrument control panels are not to be used as a wire way or for cable routing for unrelated devices and equipment.
- C. Provide all control panel electrical terminations as "Finger Safe" / "Safe to Touch".
- D. All components and instruments shall be complete with factory applied finishes. Repaint all damaged factory applied finishes.

**2.02 Terminal Blocks:**

- A. Provide DIN style high density, rail mount type terminal blocks.
  - a) Control relays c/w L.E.D. Provide control relays, as required. Relays shall be 10 A, 120 VAC, Single Pole Double Throw (SPDT) or Double Pole Double Throw (DPDT), pin-base, plug-in style with neon indicator.
- B. Fused Terminal Blocks with Fuse Blown Indicator:
  - b) Manufacturer: Refer to the Bill of Materials on the panel drawings.
- C. Non-Fused Terminal Blocks:
  - c) Manufacturer: Refer to the Bill of Materials on the panel drawings.
- D. All terminals should be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument loop (4-20 mA, etc.) from 120VAC terminals as necessary. Arrange terminal strips so that power, control wiring,



instrument wiring and ground points are partitioned by terminal block barriers. In panels with large numbers of terminals provide separate rails for 120VAC blocks.

- E. Provide mounting rails as required with one end stop at each end of rail.
- F. Space terminal block strips no closer than 150mm center to center.
- G. Minimum spacing between two (2) rows of terminal blocks shall be 80mm (3" inches).
- H. Minimum space from edge of terminal strip to edge of wire duct: 50mm
- I. Provide a continuous marking strip with the terminals.
- J. Provide terminal block barriers to separate 24 VDC instrument loops, 120 VAC power, 120 VAC control wiring, 24 VDC control wiring and grounding.
- K. Reserve one side of each terminal strip for field incoming conductors. Do not make common connections and jumpers required for internal wiring on the field side of the terminal. Terminate no more than one wire at any one terminal except where jumper wires are needed for internal wiring in which case two wires may be connected.
- L. Provide a minimum of 25% spare terminals on each rail, minimum four (4) spares per rail.
- M. Provide insulated center jumper bars for 120 VAC terminal blocks. Refer to Bill of Materials.
- N. Provide centre jumper bars to connect common wires and terminals. All common terminals to have the same number.
- O. For each instrument or piece of equipment, group all field wiring together at the terminal strip. Provide a common group marker for each set.
- P. Provide individual terminal block type circuit breakers to isolate 120 VAC power feed to field instruments.
- Q. Manufacturer: Refer to the Bill of Materials on the panel drawings.
- R. Supply twenty (20) spare fuses of each fuse type rating in a DIN rail mountable storage box with each Control Panel

### **2.03 Panel Wire and Cable:**

- A. Size and install all wire and cable in accordance with the requirements of the provincial electrical safety code and/or CSA standards.
- B. Segregate signal wiring from control power wiring according to the following categories: 120 VAC, 24 VDC analogue, 24 VDC digital, communication wiring, I.S. wiring. See the Contract Drawings for details.
- C. Wherever AC digital signals are transmitted between two controllers, interposing relays shall be used to provide a dry contact interface. The topology of solid-state output to solid state input and/or the use of pull up or pull down resistors is to be avoided.
- D. The 120VAC digital I/O field cabling is to be a minimum #14 AWG stranded copper.

- E. AC digital signal wiring shall be of the following characteristics, or otherwise approved by the Town:
1. Cable Type: T90
  2. Description: Multi-stranded bare copper, flame retardant PVC compound, overall nylon covering
  3. Application: exposed or concealed wiring in raceways (except cable troughs) in dry or damp locations
  4. Gauge: #14AWG
  5. Spec: CSA Spec. 22.2, No. 75; UL Spec. No. 83
  6. Temperature: -10 deg C to 90 deg C dry, +75 deg C wet, +60 deg C exposed to oil
- F. For analog and low voltage signal wiring use stranded copper, color coded, No. 16 AWG (minimum) shielded twisted pairs or triads with PVC insulation and jacket, complete with tinned copper drain wire.
- G. For analog wire:
1. Description: Twisted shielded pair
  2. Gauge: #16 AWG
  3. Rating: 600V, 80 deg C
  4. Conductors: 16-stranded copper
  5. Shield: Beldfoil aluminium-polyster shield
  6. Drain wire: Bare #18AWG copper drain wire
- H. Isolate, bend back, and heat shrink all communication and analogue signal conductor shields at one end and terminate the shields at a single ground point at the other end. Heat shrink the bare conductor on the grounded end. Terminate and ground all signal shields to the "Signal Gnd" instrument ground bar at the panel ends only.
- I. For power circuit wiring use stranded copper, 600 volt TEW type, color coded black (line) and white (neutral), No. 12 AWG (minimum) or larger, except where indicated otherwise.
- J. For internal circuit wiring use stranded copper, 300 volt TEW type, color coded, No. 16 AWG (minimum) or larger, except where indicated otherwise.
- K. All panel wiring to be neatly dressed and run in plastic duct. Physically separate power supply cables from analogue signals and communication cables using plastic duct, minimum 6" wide x 3" deep for incoming field wiring, and minimum 4" wide x 3" deep for internal wiring.
- L. Run all feeders in continuous length between power supply point and the local terminal block with no splices.

- M. Provide adequate slack (6 inches minimum) on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules, terminal blocks, and instruments for service or repair.
- N. Provide Velcro tie wraps (Hubbell or Panduit) for bundling and securing all wiring not enclosed in duct, and for all fiber cables.
- O. Submit wire labels to the Engineer for approval prior to installation.
- P. Provide Belden type 3107A, 2 pair, 18 AWG stranded copper, each pair separately twisted for RS 485 communication cables. Provide D-shell connectors with metal or metalized plastic (shielded type) hoods. ("Phoenix" SUBCON or equal).
- Q. Identify all wiring circuits and cables with heat shrinkable slip-on markers as manufactured by Brady or similar. Size heat shrinkable slip-on markers to suit wire size and type. Where handwritten markers are necessary, use an indelible marker pen recommended by the manufacturers. Printing shall be neat, and in capital letters only.
- R. Terminate field wiring at terminal blocks with no more than two wires on each side of the block.
- S. Terminate all PLC I/O points at terminal blocks within the cabinet.
- T. Color code for panel wiring shall be as follows:

1. Line and load circuits AC:
  - Hot: Black
  - Neutral: White
2. 24VDC Distribution:
  - Blue (+)
  - Blue/White Stripe (COM)
3. Analog signal grounding conductors:
  - Green/Yellow Stripes
4. Equipment grounding conductors:
  - Green
5. Analog Signals
  - Black (-)
  - White (+)
6. AC Control Circuits
  - Red
7. DC Control Circuits
  - Blue
8. Interlock control circuits on the panel energized from external source:
  - Yellow
9. Current carrying grounded conductor (neutral):
  - White
10. Foreign source interlock control circuit:
  - Yellow
11. Intrinsically safe circuits:
  - Light Blue

U. Color code for field wiring shall be as follows:

- |    |                                       |                                     |
|----|---------------------------------------|-------------------------------------|
| 1. | DC Digital Signals                    | Blue                                |
| 2. | AC Digital Inputs                     | Red (control from external: Yellow) |
| 3. | Ground                                | Green                               |
| 4. | Analog Signals                        | Black (-) White (+)                 |
| 5. | Multi-conductor cable control cabling |                                     |
|    | 1-conductor power                     | - Black                             |
|    | 1-conductor control                   | - Red                               |
|    | 2-conductor cable                     | - Black, White                      |
|    | 3-conductor cable                     | - Red, Black, White (Neutral)       |
|    |                                       | - Red, Black, Blue                  |
|    | 4-conductor cable                     | - Red, Black, Blue, White           |
|    | Multi-conductor cables                | - Manufacturer's standard           |

#### 2.04 Power Distribution:

- A. The maximum voltage in the panel shall be 120 VAC or less.
- B. Refer to drawing for receptacles.
- C. Provide two (2) 120 Vac/24 Vdc (3 Amp Min.) power supplies c/w diode protection. Size so that one power supply can handle all the 24 VDC loads. ("Phoenix" QUINT series).
- D. Provide power fail timer relay ("Omron"H3CR-A8 c/w Base). Set for 5 second delay off.
- E. Provide DIN rail mounted secondary circuit breakers to isolate the power to each panel mounted device. Provide 20% spare (3 minimum) secondary circuit breakers.
- F. Power field mounted process instrumentation from the Instrument Control Panel. Provide DIN rail mounting secondary circuit breakers to isolate each field device. Provide 20% spare (3 minimum) secondary circuit breakers.
- G. Provide a Cutler Hammer AGPH12020 surge suppression unit for the instruments being powered from the ICP, but not on the UPS.
- H. Provide and wire UPS (See Wiring Drawings and Spec.). Provide Load/Time Calculations for Shop Drawing Review.

#### 2.05 Grounding:

- A. Ground the power system and PLC chassis in accordance with the PLC manufacturer's recommendations.
- B. Provide two separate grounding bus bars c/w ground screws, one for instrument grounding (Signal Gnd) and one for case grounding (AC Gnd). Separate and isolate the two grounds. Electrically isolate the signal ground from the panel using insulated stand – offs.

- C. For the case ground use light green color, and for instrument ground use dark green.
- D. Provide vinyl insulated ring type crimp connectors for all ground connections.

**2.06 Panel Devices**

- A. Provide an interior LED light complete with door switch. (Hoffman LED 24V15) c/w terminal covers.
- B. Provide all signal isolators / signal conditioners as required. Provide two minimum and two spares ("Pribusin" ITC model or equal).
- C. Provide signal isolators on all analogue signals between the control panel and any variable speed drives.
- D. Provide separate signal line transient protection units on each control signal line that runs outside ("Phoenix" or equal).
- E. Provide all one-to-one isolating relays as required. Provide two minimum and two spares. (Allen Bradley 700 Series).
- F. Provide 200 watt thermostatically controlled, fan-driven heater for condensation control unless otherwise specified. Mount heater near the bottom center of the enclosure. Do not mount electronic components closer than 15 cm to the heater. ("Hoffman" Model DAH2001A).
- G. Provide 30.5 mm IP66 NEMA 250 Type 4/13 push buttons, pilot lights (LED, full voltage, push to test), and selector switches as required ("AB" 800T Series).
- H. Provide self-regenerating desiccant with vapor corrosion inhibitors for moisture and corrosion protection suitable for two (2) years operation. Provide the size and number of packets needed to protect the size of panel. Mark the date installed on the package.
- I. Provide one (1) DIN rail mounted utility boxes (Phoenix m/n 5516162 or equal) c/w 5 GMA fuses of each size used.

**2.07 Equipment Tags and Nameplates:**

- A. Each device will be tagged with at least one nameplate, visible from the connection side of the instrument after all connections are done, indicating its project tag and description.
- B. Provide lamicaid nameplates for each piece of instrumentation equipment or device mounted on the outside of the panel.
- C. Provide each internal panel device or instrument with a permanent thermal printed metalized tape nameplate with the device identification imprinted. The nameplate shall be located adjacent to the device, on the panel wall or backplane.
- D. Nameplates may not be placed on components or Panduit covers, as these can be removed or lost.

- E. Submit with the Shop Drawings, typed lists indicating all nameplate wording as well as proposed types, sizes and styles and colouring.
- F. When not part of the device or hardware, provide lamacoid nameplates with black background and white lettering.
- G. Fasten lamacoid nameplates with stainless steel screws.
- H. Minimum letter height to be six (6) mm.
- I. Final nameplate lettering to be provided at the shop drawing stage.
- J. Follow the Owner procedure for equipment tag and nameplate schedule.
- K. Follow the Owner wire tagging/labelling convention for control panel wiring and field wiring.

### **PART 3 - EXECUTION**

#### **3.01 General:**

- A. Modify, test, and commission control panels in accordance with requirements of this specification, drawings for construction, and any special details as they apply. Where installation details are not indicated, conform to the manufacturer's instructions.
- B. Provide complete wiring diagrams and leave one copy in the print pocket before delivery.
- C. "As Constructed" wiring diagrams to be corrected to reflect changes made during commissioning and the initial plant operation period. Leave one copy in the print pocket.
- D. Locate and install controllers and panels so as to be easily accessible for maintenance and readability of displays.
- E. Displays and keyboards are to be protected during the construction and commissioning period but remain readily accessible on the panel's exterior.
- F. When drilling conduit entry points in panels, protect internally mounted equipment from vibration, shock, or metal filings. Provide conduit bushings at all conduit entry points.
- G. Provide all concrete coring between floors as required.
- H. Panels, and the conduit installations made to them must maintain the panels appropriate EEMAC rating.
- I. Thoroughly vacuum and clean all Instrument Control Panels prior to commissioning.

#### **3.02 Site Acceptance Testing**

- A. Provide Site Acceptance Test (SAT) to demonstrate the correct operation of control system with both hardware and software in place per the Owner's requirements. Provide site support services upon request by System Integrator during system SAT. Notify the Consultant ten (10) days in advance of SAT such that this test may be witnessed by the

appropriate parties. Submit filled in test forms after commissioning. See Section 13000 for details.

END OF SECTION 13322



**PART 1 - GENERAL****1.01 Reference:**

- A. Section 13000 - Control and Instrumentation applies to and governs the work of this Section.
- B. Section 13322 - Control Panels.

**1.02 Work Included:**

- A. Supply, installation, testing and commissioning of all control panel devices shown on the Drawings, as specified in this Section.

**1.03 Item Summary:**

- A. The following items are described in this Section.
  - 1. AC Control Relays
  - 2. Timing Relays
  - 3. Secondary Circuit Breakers
  - 4. Corrosion Protection
  - 5. Intrinsic Safety Barrier
  - 6. Extended Battery Module (for UPS)

**PART 2 -PRODUCTS****2.01 General:**

- A. Locate instruments on the panel as shown on the Drawings or as may be required by the actual instruments supplied.
- B. Wherever possible, nameplates will be integral with the instruments and switches. Where names cannot be included with the instrument, see Section 13322, for nameplate details.
- C. This specification is intended to show functional description of the devices required and serve as a guide to the instrument supplier in designing the panel. Therefore, is required to submit supplier designed, complete control and wiring shop and loop drawings.
- D. Provide all required current isolators, signal conditioners, interposing relays, etc., and any other instruments and appurtenances shown or not shown but which may be required, in order for the entire panel to operate as intended by these Specifications and as designed.

**2.02 AC Control Relays (NEMA B300 Pilot Duty Rated Crystal Relays):**

- A. Universal pole type (type C) electrically held with 3 poles, convertible from NO to NC by changing wiring connections.

- B. 120 Vac and 24 Vdc General Purpose Relays
- a) Contacts: Three (3) form "C" SPDT dry contacts
  - b) Contact Rating: 10 Amp / 120 Vac / 24 Vdc
  - c) Contact Material: Silver Cadmium oxide (AgCdO)
  - d) Coil Voltage: 120 Vac 60 Hz, 3 VA or 24 Vdc as required
  - e) Surge Suppression: AC surge suppression on Coil where applicable
  - f) Socket: 11 pin octal, DIN rail mounting
  - g) Indication: Status light and mechanical flag
  - h) Typical Mechanical Life: 100 million operations
  - i) Protection Class: Enclosed IP40
  - j) Accessories: - Push to Test button (colour coded)
  - k) - Retaining Clip
- I.D. Labels
- C. Acceptable relay vendors are: Allen-Bradley 700-EF, Potter and Brumfield, Releco
- D. Relays requiring loads greater than 15 A or inductive loads shall be of the type manufactured by Allen Bradley, Series 700, Type EF (or equivalent).

### 2.03 Timing Relays (NEMA B300 Pilot Duty Rated Relays):

- A. Construction: AC or DC operated electronic tube base adjustable timing relay with solid-state timing circuit to operate DPDT output contacts. Timing circuit and output contact completely encapsulated to protect against vibration, humidity, and atmospheric contaminants.
- 1. Operation: on-delay or off-delay, as indicated on drawings. Off delay triggered by an external trigger switch.
  - 2. Potentiometer: top mounted, self-contained to provide time interval adjustment.
  - 3. Supply Voltage: 120 Vac, 60 Hz. / 24 Vdc as required
  - 4. Contact Rating: 10 Amp. 120 Vac / 24 Vdc DPDT
  - 5. Contact Material: Silver Cadmium oxide (AgCdO)
  - 6. Output contact rating: maximum Voltage 120 Vac or 24 Vdc.
  - 7. Timing ranges: minimum 1.0 s, maximum 60 s, unless otherwise specified.
  - 8. Surge Suppression: AC surge suppression on Coil where applicable.
  - 9. Socket: Screw terminal (Guarded Terminal Construction) 11 pin or 8 pin octal, DIN rail mounting.
  - 10. Typical Mechanical Life: 100,000 operations
  - 11. Protection Class: Enclosed IP40
  - 12. Accessories: - I.D. Labels
  - 13. Retaining Clip
- B. Acceptable relay vendors are: Allen-Bradley 700 HT, Omron, Potter & Brumfield

### 2.04 Secondary Circuit Breakers:

- A. Provide rail mounted, thermomagnetic, toggle operated secondary circuit breakers for both 120 Vac and 24 Vdc circuits.
- B. Acceptable vendors are: Allen Bradley Entrelec, Weidmuller, Phoenix.

### 2.05 Corrosion Protection:

- A. Provide Corrosion Inhibiting capsules per panel and enclosure.
- B. Acceptable vendors are: Northern Instruments (Zerust) or Hoffman (AHCI).

**2.06 Intrinsic Safety Barriers**

- A. Common Features: transformer (galvanically) isolated type, 120 Vac power supply.
- B. Do not mount I.S. barriers in an CP, the wiring will get corrupted.
- C. Close couple the I.S. barrier box to the CP with a short conduit nipple.
- D. Locate I.S. relays in separate I.S. relay panel and close couple the I.S. panel to the CP.
- E. Refer to attached Intrinsically Safe Barrier Panel Summary List for details.

**2.07 Extended Battery Module (for UPS)**

- A. Provide and connect one 9SXEBM96 Extended Battery Module (EBM) to the existing UPS.

**PART 3 -EXECUTION****3.01 General:**

- A. As outlined in Section 13000 - Control and Instrumentation.

END OF SECTION 13323.



Equipment:

- - Analogue Input: For Intrinsically Safe Analogue Input signals :
    - 20 - 35 Vdc power supply
    - two wire transmitter
      - • single channel
      - • galvanically isolated
      - • 4-20mA input
      - • 4-20 mA output
  - Manufacturer: Pepperl + Fuchs intrinsic safe barrier m/n KFD2-CR-Ex1.30 200
    - Process Instruments & Components Inc. Tel:(905) 513 7653
  - Tag: Refer to Drawings
  - 
  - 
  -
  
- Analogue Input: For Intrinsically Safe "Smart Transmitter"Analogue Input signals :
  - 20 - 35 Vdc power supply
  - • SMART transmitter
    - single channel
    - galvanically isolated
    - 4-20mA input
    - 4-20 mA output, Digital HART Signal
  - Manufacturer: Pepperl + Fuchs intrinsic safe barrier m/n KFD2-STC3-Ex1
    - Process Instruments & Components Inc. Tel:(905) 513 7653
  - Tag: Refer to Drawings

**Equipment:**

- 
- Digital Input: For Intrinsically Safe Digital Input signals (120 Vac):
- 120Vac power supply to the barrier
  - single channel
  - galvanically isolated
  - one form "C" relay output to safe area
- Manufacturer: Supply Pepperl + Fuchs intrinsic safe barrier m/n KFA5-SR2-Ex1.W  
Process Instruments & Components Inc. Tel:(905) 513 7653
- Tag: LSH-030
- Refer to Drawings
- 
- Digital Input: For Intrinsically Safe Digital Input signals (24 Vdc):
- 24 Vdc power supply
  - single channel
  - galvanically isolated
  - one form "C" relay output to safe area
- Manufacturer: Supply Pepperl + Fuchs intrinsic safe barrier m/n KFD2-SR2-Ex1.W  
Process Instruments & Components Inc. Tel:(905) 513 7653
- Tag: Refer to Drawings

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 13000 - Control and Instrumentation, applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Supply, installation, testing and commissioning of all equipment specified in this Section and on the control and instrumentation Drawings.

**1.03 Intent:**

- A. The intent of this Section is to provide an automated control system for the Rodney WPCP upgrade project.
- B. Be responsible for assembling the PLCs components and verifying their operation by installing the appropriate program code for system testing.

**1.04 Definitions:**

- A. Under this Contract, the "Data Processing System" is responsible for all microprocessor based, automatic control.
- B. Programmable Logic Controllers (PLCs) are microprocessor based programmable products responsible for automatically actuating and monitoring field devices. These can also be referred to as "Process Controllers", "DPUs", "RTUs" or "RPUs".
- C. "Human Machine Interface" (HMI), Man Machine Interface (MMI) or "Operator Interface" (OIT) allows two-way communication between the system and humans.

**1.05 Item Summary:**

- A. The Data Processing System consists of PLCs and Communication Network provided and installed as specified and as indicated on the Drawings.

**PART 2 - PRODUCTS****2.01 PLC General:**

- A. The PLCs provided with microprocessors (CPU's) are to be capable of stand alone operation. In the event of a communication failure, the PLCs will be capable of both controlling the connected equipment and switching to preset default settings/mode.
- B. All PLC equipment shall be CSA / ULc approved for its application.
- C. Provide 25% spare I/O points on the installed I/O cards for each type of I/O but not less than 16 digital inputs, 8 digital outputs, 4 analog inputs and 4 analog outputs.

- D. Provide chassis (racks) of the size and quantity as required to house the required cards. Allow for a minimum 4 spare slots for future expansion. Provide space for one additional PLC/RTU rack.
- E. Provide power supplies and cabling as required. Power supply to be sized to allow for 40% spare capacity.
- F. Organize I/O points in racks so that I/O from two or more pieces of equipment with the same process function are divided among at least two groups of I/O cards in a rack. Organize the I/O points so that if one I/O card fails, at least one piece of equipment from the group that has the same process function will be fully operational.

## 2.02 PLC Hardware:

### A. Microprocessor (CPU):

PLC shall be complete with the following as a minimum requirement:

1. 16 bit data registers
2. Battery backed CMOS RAM program memory with 6 month battery back-up
3. Minimum scan rate of .5 ms/K program
4. Built-in PID control
5. Time-of-day clock/calendar function
6. Remote programming capability via the data communications network
7. Provide adequate memory. Allow for minimum 100% spare memory for future expansion.

### B. Inputs/Outputs:

1. Provide process I/O as shown on the Drawings. Each PLC shall be capable of being expanded to 256 I/O.
2. Analog Inputs (AI) cards/modules to be:
  - a) 14 bit,  $\pm 1.0\%$  accuracy
  - b) Point configurable 1-5 V DC or 4-20 mA DC
  - c) Provisions for board calibration (i.e. span, zero adjustments)
  - d) 8 isolated (4-20 mA) input configuration per card.
3. Analog Outputs (AO) cards/modules to be:
  - a) 13 bit,  $\pm 0.2\%$  accuracy



- b) Point configurable 1-5 V DC, 5 mA load, or 4-20 mA DC, 600 ohm load.
  - c) Provisions for board calibration (i.e. span, zero adjustments)
  - d) Integral fuse
  - e) 4 isolated current (4-20 mA) output configuration per card.
4. Digital Inputs (DI) cards/modules to be:
- a) Nominally 24 VDC isolated
  - b) Opto isolated
  - c) Point configurable dry contact or +24 V DC
  - d) Where required or shown, provide 120 VAC DI
  - e) LED status indicator
  - f) 16 (individually isolated) inputs configuration per card.
5. Digital Inputs (High Speed) to be:
- a) 24VDC input with 30VRMS surge suppression
  - b) State change to occur at:
    - i) 90% rated input voltage for OFF to ON state
    - ii) 10% of rated input voltage for ON to OFF state
  - c) Input frequency response: 10 kHz max.
  - d) Led signal indicator
  - e) Available for connection to open collector (transistor) or dry contact devices
6. Digital Outputs (DO) cards/modules to be:
- a) Nominally 120 VAC isolated (relay output)
  - b) Opto isolated
  - c) Where required or shown, provide 24 VDC DO
  - d) Complete with one per output, DIN rail mounted interposing relay, form C rated (minimum 10 A) for the specified load conditions and LED indication.
  - e) Ability to provide pulse and PDM output, i.e. counts, momentary start-stop, etc. (where required)

- f) LED status indicator
  - g) Integral fuse
  - h) 16 outputs per card.
- 7. All process I/O shall include surge protection in accordance with C 37.90 - 1979 (R 1983)
  - 8. All I/O connections to be pluggable terminations.
  - 9. All process digital inputs and outputs to be fitted with individually fused terminal blocks.

C. System Interface:

- 1. Provide, as a minimum, the following interface:
  - a) One (1) high speed, Ethernet/IP, 10/100 Mbps communication port.
  - b) One (1) high speed, parallel, connection for remote I/O racks.
  - c) One (1) RS232 serial port connection for localized communication, capable of 9600 baud.

D. Power Supply:

- 1. 120 VAC power available for DOs.
- 2. Each microprocessor (CPU) to be connected to a local UPS provided as per Section 13323 - Control Panel Devices.
- 3. Provide a separate battery back-up integral to the CPU, capable of storing and maintaining all configured software in memory for a minimum of 6 months.

**2.03 PLC Software:**

- A. Provide a software package with distribution media, documentation, and end user license for the PLC system. Software to be provided by the same manufacturer as the equipment manufacturer. Provide all software associated with the controllers licensed in the Owner's name, on original storage media in original storage packaging, licensed to: Rodney WPCP. Load and test all software before delivery.
- B. Provide the software package(s) to allow online and offline program development, testing and documentation utilizing a control oriented, menu driven, easy-to-use programming technique. Programming packages to be provided to suit the family of controllers being provided. Provide copy of RSLogix 5000 Enterprise Series software. All supplied software must be the latest released version at the time of the SAT, with update support for the Five (5) year warranty period.
- C. Include diagnostic programs to allow off-line hardware testing of components.

- D. Provide programming and diagnostic software for laptops.
- E. Development software to run on PC system connected to high speed, peer to peer communication system. Uploading and downloading of CPU programs to be done without interruption of SCADA system.
- F. Supply two complete sets of Installation, Programming, and Communications manuals for PLC and for all specialty modules; printed/bound and electronic (CD) format.

**2.04 PLC Acceptable Manufacturers:**

- A. The design of the SCADA system and its controllers is based on the use of Allen Bradley CompactLogix PLCs.

PLC equipment and cards/modules to be as follows:

<u>Part</u>	<u>Part Number</u>	<u>Qty</u>
CompactLogix, Power Supply	1769-PA4	Refer to drawings
CompactLogix, 8-point Analog Input Module	1766-IF8	Refer to drawings
CompactLogix, 8-point Analog Output Module	1769-OF8C	Refer to drawings
CompactLogix, 16-point Digital Input Module	1769-IA16	Refer to drawings
CompactLogix, 16-point Digital Output Module	1769-OA16	Refer to drawings
CompactLogix, Right End Cap	1769-ECR	Refer to drawings
CompactLogix, Left End Cap	1769-ECL	Refer to drawings
Right Bank to Right Bank Expansion Cable	1769-CRR3	Refer to drawings

- B. Provide all required software, hardware and programming needed so as to provide seamless SCADA communication between new PLC(s) and existing SCADA system.
- C. Provide programming software for PLC.
- D. Note: The Package systems being provided by others (Divisions 11, and 16) have been shown on the drawings and or specified also with the AB ControlLogix PLCs. Refer to contract documents for further details.
- E. Submit a System Wiring/Block Diagram approved by the PLC Manufacturer with the shop drawings c/w PLC module model numbers, cable model numbers, etc.

**2.05 Spare Cards/Modules and Miscellaneous Equipment:**

- A. Provide spare cards/modules and equipment, as follows:

<u>Part</u>	<u>Part Number</u>	<u>Qty</u>

CompactLogix, Power Supply	1769-PA4	1
CompactLogix, 8-point Analog Input Module	1766-IF8	1
CompactLogix, 8-point Analog Output Module	1769-OF8C	1
CompactLogix, 16-point Digital Input Module	1769-IA16	1
CompactLogix, 16-point Digital Output Module	1769-OA16	1

B. Provide miscellaneous spare equipment as follows:

- |    |                             |     |   |                  |
|----|-----------------------------|-----|---|------------------|
| 1. | Spare CB (1A and 5A)        | Qty | - | 2 (each)         |
| 2. | Surge Protectors (Ethernet) | Qty | - | 1                |
| 3. | Fuses                       | Qty | - | 5 of each kind   |
| 4. | Pilot Light Bulbs           | Qty | - | 2 of each colour |

C. Spares to be provided loose to customer.

### **PART 3 -EXECUTION**

#### **3.01 General:**

- A. Comply with the execution details as described in Section 13000 - Control and Instrumentation.

END OF SECTION 13324.

**PART 1 - GENERAL****1.01 Reference:**

- A. This Section of the Specifications shall be read in conjunction with Section 13000 - General Control and Instrumentation Clauses, which shall apply to and govern the work of this Section.

**1.02 Intent:**

- A. The intent of this section is included run-time, configuration and application software associated with all equipment.

**PART 2 -PRODUCTS****2.01 General:**

- A. Provide/Modify all run-time software and licenses (if applicable) associated with all equipment, including PLC, network switches, and SCADA.
- B. Provide license for any configuration software needed.
- C. Before purchasing the software, the contractor is to submit a written request to confirm the version to be provided.
- D. The control system application is included as follows:
  - 1. PLC Programming, and program modifications
  - 2. SCADA software development.

**2.02 PLC Programming:**

- A. PLC programming and program modification shall be developed based on the process narratives. Refer to Section 13310 for details.
- B. PLC programming and program modification is to be kept in line with what has been previously developed for the owner. Regardless of previous owner programming, PLC code is to be kept simple without the use of indirect addressing for the purpose of reusing code.
- C. The PLC program should use the physical I/O points throughout the program unless the I/O point is to be debounced with a timer.

**2.03 SCADA software development:**

- A. Modify the SCADA system software to include the additions or corrections as per this project's requirements.

**2.04 Documentation:**

- A. The application software supplier shall supply the following documentation as a minimum:

1. Submit for review prototype of all proposed screens to Engineer for review. Arrange for a meeting with the Owner and Engineer to finalize screens.
2. Flow Chart
  - a) Provide Flow Chart for programming.
3. I/O List
  - a) Provide I/O list.
  - b) The I/O list to be developed in cooperation with the Engineer and should be approved by the Engineer before starting the programming.
  - c) The I/O list is to follow a sequential order. This means that all outputs, inputs, and internal addressing for devices are to follow in the same sequence.
4. PLC Ladder Program
  - a) provide documentation for each network, rung or rungs of PLC Ladder program. The documentation should be describing plainly the intended purpose and operation of the network, rung or rungs.
  - b) Fully document PLC program printout with, as a minimum, identifiers, for each part of the program as described earlier and descriptors or all program elements.
  - c) Copy of the PLC program on a USB memory stick and to be a minimum of 1GB in size.

**2.05 Licenses Software:**

- A. Provide all software associated with the controllers licensed in Owner's name, on original storage media in original storage packaging.

**PART 3 - EXECUTION****3.01 Design Review Schedule:**

- A. Prepare flow chart and display structure and meet with the Engineer for approval.
- B. Upon approval prepare and debug PLC programs and demonstrate program functions to the Engineer for approval.
- C. Revise and update all documentation and issue it as a constructed package.

**3.02 Commissioning:**

A. Refer to Section 01650 - Commissioning.

END OF SECTION 13327

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 13000 applies to and governs the work of this Section.

**1.02 Work Included:**

- A. Provide field devices in applicable Sections 13330 to 13399, as well as other field devices shown on the drawings and specified herein.
- B. Provide services of qualified, manufacturer trained and certified, field personnel to check out, test, calibrate, commission, troubleshoot and adjust instruments and devices until acceptance by the Engineer and Owner.

**1.03 Submittals:**

- A. Shop drawings.
- B. Manufacturer's installation diagrams for field mounted equipment.
- C. O&M Record Documentation including calibration certifications, field calibration sheets and field loop check sheets.
- D. Instrument and instrument panel wiring diagrams indicating connections for I/O shown on the Drawings.

**PART 2 - PRODUCTS****2.01 General:**

- A. Instrumentation equipment to be CSA / ULCC approved for its application.
- B. Unless otherwise shown or specified, enclosures for instruments located indoors in dry non-hazardous areas to be minimum EEMAC 12.
- C. Unless otherwise shown or specified, instruments located outdoors must be suitable for the surrounding climate and appropriately installed with:
  - 1. EEMAC 4 enclosure, including gasketed windows for displays, containing a thermostatically controlled heater and disconnect switch.
  - 2. Provide a combined rain/ice/snow protection shield and sunshade for electronic instruments, which are already provided with sturdy EEMAC 4 enclosures and heaters by the manufacturer. Provide O'Brien model E Series sunshades or approved equal.
- D. Drawing submission must clearly show the enclosure proposed for each instrument.



- E. Unless specified otherwise, provide microprocessor-based transmitters, suitable for operation from a 120 V AC power supply with a 4-20 mA DC linear, isolated output; or transmitters that are 4-20 mA linear, isolated DC loop powered. Transmitters to be capable of driving a minimum load of 600 ohms. Transmitters to have HART communications for calibration purposes.
- F. Provide transmitters complete with direct reading local indicators in metric units. Local indicators to read as follows:
1. Temperature                      Direct Reading in °C
  2. Level                                0 – 100 as a percentage (%) of calibrated range
  3. Flow                                 Direct reading in l/sec
  4. Pressure                            Direct reading in kPa
- G. Wire alarm points in an “energize to trip” configuration.
- H. Unless otherwise shown or specified, provide instruments located hazardous areas with Canadian Electrical Code ratings for class, group, and zone (division) as shown.
- I. Unless otherwise shown or specified, provide instruments located underground or areas subject to flooding with submergence rated (NEMA 6P / IP 68) enclosures.
- J. Provide line voltage powered instruments that are suitable for a 120-Volt AC power supply.
- K. Provide the necessary mounting hardware, electrical connections, transducer junction boxes, power supplies and accessory items or options required to satisfy each application in accordance with manufacturer’s instructions.
- L. Provide mechanical protection for capillaries, sample lines, and transducer cables and adequately secure to eliminate sagging.
- M. Provide suitable shields, stilling wells or mounting plates to protect transducers.
- N. Provide special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joins as required by manufacturer. Provide adequate cable/capillary tubing etc., to allow removal of instrument/transducer from process. Mount instruments in locations acceptable to the Engineer to ensure accurate field measurements.
- O. Provide required process connections, valves, pressure / flow regulators, filters, and miscellaneous mounting hardware not provided with the instrument.
- P. Use full length tubing and minimize fittings and unions as much as possible.
- Q. Provide test/calibration connection with isolating valves and removable end-caps between pressure sensing instruments and root isolation valves. Test connection must be easily accessible.

- R. Locate drain plugs below the lowest tubed fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 cm per meter. Provide drain plugs on tubed instrument systems.
- S. Instruments located on the process side of potable water lines must comply with ANSI / NSF Standard 61, Drinking Water System Components. Materials furnished by the Contractor / Vendor, which are in contact with potable water, are to be certified to meet this standard.
- T. Provide corrosion resistant 316 stainless steel screws, bolts, fasteners, hinges etc. in all applications.

**PART 3 - EXECUTION****3.01 General:**

- A. Install signal cables in metal conduits separate from, and not close to, conduits containing power cables. See Div. 16 specifications for further information.
- B. Provide conduit and conduit fittings located hazardous areas with Ontario Electrical Safety Code ratings for class, group, and zone (division) as shown.
- C. Analog signal cables to be twisted shielded pairs.
- D. Shields to be terminated and grounded to clean signal ground bar at control panels only.
- E. Each device to be tagged with a permanent 316 stainless steel nameplate indelibly marked with its device tag, service, and location.
- F. Provide programming/configuration of microprocessor-based instrumentation.
- G. Field calibrate instruments before start up, and provide an ISO certified calibration certificate for inclusion in the Operating Manual.

END OF SECTION 13329.

**PART 1 -GENERAL****1.01 Reference:**

- A. Section 13000 - Control and Instrumentation applies to and governs the work of this Section.
- B. Section 13329 - Field Instruments
- C. Refer to the attached Pressure Gauge Summary List for details.

**PART 2 - PRODUCTS****2.01 General Common Features:**

- A. Pressure Indicators(s) shall be complete with the following features:
  - 1. See attached Pressure Gauge Summary List for details.
  - 2. Provide a calibration verification certificate.
  - 3. Provide S.S. tag and S.S. wire, and tag with "Tag No." and "Location - Service".
- B. Ensure that gauges on the suction side of pumps are compound type.
- C. Range the dial/gauge so that the maximum pressure is approximately 2/3 the range of the pressure gauge.
- D. Pressure gauges and accessories shall conform to ANSI/ASME B40.1 grade 1A and be CRN approved.
- E. All threaded connections shall conform to ANSI B2.1.
- F. Mount fill and test all pressure gauge and diaphragm seal assemblies at the factory.

**PART 3 - INSTALLATION****3.01 General:**

- A. Installation of all pressure gauges and accessories shall conform to ANSI/ASME B40.1
- B. Diaphragm seal to be provided where gauge/indicator used for no potable water.
- C. Isolation valve (full bore ball valve) to be provided with each gauge by Division 11
- D. Where gauges are to be mounted higher than 2.5 m above the floor, 114 mm gauges are to be replaced with 150 mm gauges. (Ashcroft Duragauge 2462S).
- E. Extend and mount gauges in clearly visible locations. Provide connecting pipe extensions as required. Properly support all gauges and appurtenances.
- F. Mount gauges in liquid service on the side of the pipe.
- G. Mount gauges in gas service on the top of the pipe.
- H. Mounting: see drawings for locations and additional details.

END OF SECTION 13341

<u>Pressure Indicators</u> <u>Summary List</u>	
<b>Type "A"</b>	<b>Phenolic Case Pressure Gauge Specification</b>
	Adjustable, glycerin filled, black Phenolic case c/w pressure relief plug, solid front acrylic window, 115 mm (4.5") dial with black dual reading (PSIG and kPa) markings/numerals on a white brushed aluminum background, micro (friction) adjustable pointer, Grade A phosphor bronze Bourdon tube assembly, all pressurized joints brass/silver brazed including tip/tube, tube/socket and case/socket, overload and vacuum stops built into movement, 1.0% of span accuracy, 12.5mm ( ½") NPT lower process connection, stem mounted. (refer to attached table for gauge ranges)
	Approved manufacturers:
	<b>1st Named:</b> Ashcroft
	Model: 45 - 1279
	<b>Named Alternate:</b> H.O. Trerice
	Model: 450LFSS
	<b>Named Alternate:</b> Weiss Instruments
	Model: NF4UGY1
<b>Type "B"</b>	<b>Stainless Steel Pressure Gauge Specification</b>
	Adjustable, glycerin filled, 100 mm or 115 mm (4" or 4 ½") diameter, each accurate to within 1% of scale range and complete with a type 304 stainless steel case with relief valve and polished stainless steel bayonet, stainless steel rotary movement with stainless steel bushings and socket, 12.5mm ( ½") NPT lower process connection, stem mounted. Provide a clear acrylic window, with black dual reading (PSIG and kPa) markings/numerals on a white brushed aluminum background, and micro (friction) adjustable pointer. (refer to attached table for gauge ranges)
	Approved manufacturers:
	<b>1st Named:</b> Ashcroft
	Model: 35 - 1009 SWL-26
	<b>Named Alternate:</b> H.O. Trerice
	Model: 700 Series
	<b>Named Alternate:</b> Weiss Instruments
	Model: LF4S-2
	<b>Notes:</b>
	1. Process isolation valves supplied by Division 11.
	2. All pressure gauges and accessories to conform to ANSI/ASME B40.1 and be CRN approved. All threaded connections conform to ANSI B2.1.
	3. Provide Ashcroft ½ " S.S. pressure snubber m/n 501112S as required (or equal).
	4. Mount fill and test all pressure gauge and diaphragm seal assemblies at the factory.

<u>Diaphragm Seal</u>	
<u>Summary List</u>	
	<b><u>Type "A" 25 mm (1 Inch) Threaded Diaphragm Seal</u></b>
	316 stainless steel top housing, bottom housing and clamping rings, upper housing with teflon coated 316 stainless steel sealed diaphragm capsule, 12 mm (½") NPT threaded female connection, bleed screw, teflon gasket, rated from vacuum to 2500 psig and -40oC to 200oC, continuous duty. Bottom housing with 316 stainless steel matching connector, 25 mm (1") NPT threaded female process connection (unless noted), 6mm dia. blow-off/flushing port with SS bolts, and DC 200 filled. Removal of top housing and diaphragm will not cause loss of fill fluid. Provide S.S. locking yoke to prevent gauge from turning once installed. Provide Anderson Greenwood Type VA 316S.S. (or equivalent) bleed valve for seal flushing connection.
	<b>1st Named: Ashcroft</b>
	Model: 101 S.S. ½ x 1"
	<b>Named Alternate: H.O. Trerice</b>
	Model: 511SS series
	<b>Named Alternate: Winters</b>
	Model: #70 S.S. ½ x 1"
	<b><u>Type "B" 25 mm (1 Inch) Threaded Diaphragm Sanitary Seal</u></b>
	3 piece quick connect sanitary type all 316 SS materials, upper housing part with teflon coated 316 stainless steel sealed diaphragm capsule, 12 mm (½" NPT) top threaded female connection, bleed screw, teflon gasket, continuous duty type, continuous perimeter edge for clamp. Bottom housing part with 316 stainless steel matching connector with 25 mm (1" NPT) threaded male or female connection, 6mm dia. blow-off/flushing port with SS ball valve, DC 200 filled. Provide both parts with a common stainless steel 50 mm quick connect clamp (by Ladish Co. or Triclover or Cherry Burrell). Removal of top housing and diaphragm will not cause loss of fill fluid.
	<b>1st Named: Ashcroft</b>
	Model: 320 S.S. ½ x 1"
	<b>Named Alternate: H.O. Trerice / Hyett</b>
	Model: 1-SS
	<b>Named Alternate: Winters</b>
	Model: #20 S.S. ½ x 1"
	<b><u>Notes:</u></b>
	1. Process isolation valves supplied by Division 11.
	2. Use HEX HB 24 S.S. (AGCO type VA Equivalent) bleed valve for seal flushing connection.
	3. All pressure gauges and accessories to conform to ANSI/ASME B40.1 and be CRN approved. All threaded connections conforming to ANSI B2.1.
	4. Provide Ashcroft ½ " S.S. pressure snubber m/n 501112S as required (or equal).
	5. Mount fill and test all pressure gauge and diaphragm seal assemblies at the factory.

<u>Pressure Indicators</u>								
<u>Summary List</u>								
Tag No.	Gauge	Seal	Block &	Pressure	Gauge	Process	Process	Piping Line No.
	Type	Type	Bleed	Snubber	Range	Conn. Size	Material	or
			Valve			and Type		Equipment No.
PI-404	Type B	Type A	Provide	Yes	0 to 200 kPa(g) (0-30 psi(g))	12.5mm (1/2") NPT(F)	Air	PI-404

**PART 1 -GENERAL**

**1.01 Reference:**

- A. Section 13000 - Control and Instrumentation applies to and governs the work of this Section.
- B. Section 13329 - Field Instruments and, when required.
- C. Refer to attached Pressure Transmitter Summary List for details.

**PART 2 - PRODUCTS**

The following specifications identify 2 different types of pressure instruments – Gauge and Differential type. All units have common features as noted in 2.01.

**2.01 Common Features:**

- A. 1. Sensor (PE) - wetted parts - 316 SS  
- 316 S.S body
- 2. Transmitter (PIT/PT) - power supply: 12 to 65 V DC  
- output: 4-20 mA isolated
- 3. Accuracy -  $\pm 0.5\%$  of Calibrated Range
- B. Properly support transducers and appurtenances.
- C. The first valve off of the main process line (isolation valve) is by Division 11/15. Provide a manifold c/w a bleed valve with each transmitter.

**2.02 Gauge Pressure Transducer:**

- A. Common features as at 2.01 above.
- B. Refer to attached Pressure Transmitter Summary List for details.

**PART 3 - INSTALLATION**

**3.01 General:**

- A. See drawings for locations and additional details.
- B. Where transmitters are to be mounted higher than 3.0 m above the floor, provide a local 4-20 ma digital read out at 1600 mm level.
- C. Extend and mount transmitters in clearly visible locations. Properly support all gauges and appurtenances.
- D. Provide mechanical protection for capillaries, sample lines, and transducer cables and adequately secure to eliminate sagging.
- E. Ensure that pressure taps on liquid service are on the side of the pipe and pressure taps in gas service are on the top of the pipe.
- F. Range the transmitter so that the maximum pressure is approximately 2/3 the range of the pressure gauge.
- G. Provide Swagelok S.S sample lines and Swagelok 1/2 "S.S. tube fittings



**SECTION 13343 – PRESSURE INSTRUMENTS – TRANSDUCERS/TRANSMITTERS 13343:02**

H. Provide S.S. tag and S.S. wire and tag with “Tag No.” and “Service”

<b><u>Pressure Transmitter Summary List</u></b>			
<b>Tag No:</b>	<b>PIT-401</b>	<b>LE/LIT-031 (DPT)</b>	
Location:	Blowers 1&2&3 Discharge header	ALUM/FERRIC CHLORINE TANK	
Service:	Blower Discharge Flow	Chlorine Disinfection	
P&ID:	I1006	I1005	
<b>Process:</b>			
Fluid:	Air	Alum/Ferric Chlorine	
Temp min/max:	20-150 C	20 to 40 Deg C.	
Level min/max:	N/A		
Pressure Min/max:	0-200 kPa	0-50 kPa	
<b>Sensor:</b>			
Sensor Type:	Al2O3	Al2O3	
Sensor Case:	316L SS	316L SS	
Process Connection:	316L SS, ¼" NPT	316L SS, ¼" NPT	
Gasket:	FKM	FKM	
<b>Transmitter:</b>			
Output:	4 - 20 mA	4 - 20 mA	
Power Supply:	24. Vdc, 2 wire	24. Vdc, 2 wire	
Installation:	on the Air discharge header line	on the Air discharge header line	
Cable length:	As Required	As Required	
Protective Cap:	Yes	Yes	
Mounting Accessories:	Yes	Yes	
Measuring Range:	0-200 kPa	0-2.5 meters	
Accuracy	+/-0.5% of full scale	+/-0.5% of full scale	
<b>Electrical:</b>			
Approval:	CSA / ULc	CSA / ULc	
Enclosure:	IP65	IP65	
Class/Div/Group:	Zone 2	2	
<b>Manufacturers:</b>			
<b>First Name</b>			
<b>Notes:</b>	1. In general all wetted and non-wetted parts shall be 316 S.S.		
	2. All manufactures recommendations for installation must be followed.		
	3. Tap on side of process piping for liquid service, and tap on top for gas service.		
	4. Provide mounting hardware including pipe stand.		
	5. Provide S.S. Tag and S.S. Wire and tag with "Tag No." and "Location + Service"		

**SECTION 13343 – PRESSURE INSTRUMENTS – TRANSDUCERS/TRANSMITTERS 13343:03**

	<b><u>Differential Pressure Level Transmitter</u></b>		
<b><u>Manufacturer:</u></b>	<b>1st Named</b>	<b>Named Alternate</b>	<b>Named Alternate</b>
Manufacturer:	Rosemount	Endress+Hauser	Siemens
Supplier:			
Model Number:	3051		

END OF SECTION 13343

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 13300 - Control and Instrumentation applies to and governs the work of this Section.
- B. This Section to be read in conjunction with Section 13329 - Field Instruments.
- C. Refer to attached Level Float Switch Summary List attached for details.

**PART 2 - PRODUCTS****2.01 General Common Features:**

- A. Provide floats with correct chemical resistance, and density characteristics.
- B. Provide float level switches with a form "C" (N.O./N.C.) contact rated at 3 A, 120 VAC and 0.14A, 24 VDC and complete with integral weights for correct operation.
- C. Submersible cable to be complete with a junction box and fittings. Provide adequate uncut cable as required, plus an additional 2 m. Provide watertight connections in the junction box.
- D. Supply hot-dip galvanized angle wall mounting bracket, with squeeze connections for cable adjustment of level. Size hanger to suit quantity of floats.
- E. Provide an anti-sway ring on each float.
- F. Provide intrinsically safe barrier relays for applications where float is located in a classified/hazardous area. Provide one relay per float.

**PART 3 - EXECUTION****3.01 Installation:**

- A. Locate I.S. relays in separate I.S. relay panel and close couple the I.S. panel to the ICP.
- B. Hang floats in parallel with separation distance between floats to match mounting bracket cable connection distances.
- C. Mount anti sway rings so that the ring is no more than four (4) inches from the top of the float.
- D. Mount sway control rings and hanger brackets using cinch anchors.
- E. Use 24 Vdc or 24 Vac to power the float switches so that under fault conditions, 120 Vac is not applied to the process fluid. If there is no 24 Vdc power supply available, use a 120 Vac/24 Vac transformer to supply 24 Vac. Ensure that the 24 volt output to the float is fused in the ICP and use an interposing relay where I/O is 120 Vac.
- F. Tape back and insulate the unused lead wire.

G. Provide S.S. tag and S.S. wire and tag with “Tag No.” and “Service” at junction box.

END OF SECTION 13362

	<b><u>Level Float Switch</u></b>		
<b><u>Tag No:</u></b>	<b>LSH-030</b>	<b>LSL-031</b>	
Location:	Chemical Containment Area	WAS/RAS Drain Sump	
Service:	Alum/Ferric Chloride	WAS/RAS Sump Level Low	
Vessel/line No.:	Alum/Ferric Chloride Tank	WAS/RAS Drain Sump	
P&ID:	I103	I103	
<b><u>Process:</u></b>			
Liquid:			
Temp min/max:	20 -40 Deg. C.	20 -40 Deg. C.	
Specific Gravity:	.95 to 1.1	.95 to 1.1	
<b><u>Float:</u></b>			
Type:	Pear	Pear	
Material:	Polypropylene	Polypropylene	
Mounting:	6 Position Hanger	6 Position Hanger	
<b><u>Switch:</u></b>			
Type:	Mercury Free Dry Contact NO/NC	Mercury Free Dry Contact NO/NC	
Contact Form:	SPDT Form C	SPDT Form C	
Rating:	5 Amp @ 24 VAC.or VDC.	5 Amp @ 24 VAC.or VDC.	
Differential:	100 mm (4 ")	100 mm (4 ")	
Switch Action:	Switch Opens On High Level	Switch Opens On High Level	
<b><u>Cable:</u></b>			
Material:	PVC	PVC	
Cable Length:	15m Potted at Float	15m Potted at Float	
<b><u>Accessories:</u></b>			
Sway Contrl Rings:	Yes	Yes	
Hanger Bracket:	6 Position Galvanized Hanger	6 Position Galvanized Hanger	
Local 4"X4" Jct Box:	Yes - PVC c/w "C-H" CGB Fitting	Yes - PVC c/w "C-H" CGB Fitting	
Zinc Weights:	No	No	
Interposing Relay:	3PDT Mounted In ICP	3PDT Mounted In ICP	
I.S. Relay:	No	No	
Power Req'd:	24 Vdc or 24 Vac	24 Vdc or 24 Vac	
<b><u>Electrical:</u></b>			
Approval:	CSA / ULc	CSA / ULc	
Enclosure:	NEMA 4x	NEMA 4x	
Type:	Class 1, Zone 2 (I.S.)	Class 1, Zone 2 (I.S.)	
<b><u>Notes:</u></b>			
<ol style="list-style-type: none"> <li>1. Supply Mercury Free contacts.</li> <li>2. Mount sway control rings and hanger brackets / holder using cinch anchors.</li> <li>3. Do not splice the cable between the float and the local junction box.</li> <li>4. Use Light Blue I.S. cable from ICP to float switch for I.S. applications</li> <li>5. Mount barrier in separate Barrier Panel located near ICP.</li> <li>6. Provide S.S. Tag and S.S. Wire and tag with "Tag No." and "Location + Service"</li> </ol>			

<b><u>Level Float</u></b>			
<b><u>Switch</u></b>			
<b><u>Manufacturer:</u></b>	<b>1st Named</b>	<b>Named Alternate</b>	<b>Named Alternate</b>
Manufacturer:	Flygt		
Supplier:			
Model Number:	ENM - 10		

**PART 1 -GENERAL****1.01 Reference:**

- A. Section 13300 - Control and Instrumentation applies to and governs the work of this Section.
- B. This Section to be read in conjunction with Section 13329 - Field Instruments.
- C. Refer to attached Dissolved Oxygen Analyzer Summary List attached for details.

**PART 2 - PRODUCTS****2.01 General Common Features:**

- A. Dissolved Oxygen Analyzer to be complete with the following features:
  - 1. Sensor (AE)
    - Quantity 4
    - Optical fluorescent technology
    - Ruthenium based fluorescent DO sensor not requiring any replaceable membranes, cartridges, fill solutions, membrane, or sensor caps as these types of designs are not acceptable.
    - complete with cable as required
    - -0°C to 60°C temperature range
    - accuracy of  $\pm 1\%$  of full scale
    - can be mounted in a tank.
    - Temperature element [RTD] measurement available as 4 - 20 mA output
    - Built in nozzle for sensor cleaning system by plant are or self-contained air jet pump.
    - The sensor shall not be susceptible to damage by exposure to direct or indirect sunlight nor will exposure to sunlight affect the calibration.
    - provide appropriate sensor mounting to suit application.
  - 2. Transmitter (AIT)
    - Quantity 2
    - Input/Output: Temp, DO, TSS, ORP and pH
    - Eight (8) channel
    - Harsh environment LCD digital display NEMA 250 Type 4X
    - Up to 8 Opto-isolated linear 4-20 milliamp outputs (one for each channel)
    - Up to 8 dry contact 10 amp relay setpoints (one for each channel)
    - one SPDT alarm relay
    - one clean relay
    - range as per Instrument Summary List
    - operating temperature from minus 10°C to 50°C
    - 120 V, 60 Hz

3. Options
  - Heater for transmitter for all outdoor installation
  - Sunshade
  - Deluxe mounting hardware and mounting hardware
  - Jet clean head c/w compressor
  - Junction box

**PART 3 - INSTALLATION**

1. See drawings for transmitter and sensors mounting details and location(s)
2. Mount sensor/compressor on pipe stand.
3. Mount transmitter on pipe stand near one of the sensors.
4. Wire 4-20 milliamp signals, setpoint relays, fault relay and clean relay to the PLC
5. Provide S.S. tag and S.S. wire and tag with "Tag No." and "Service."
6. Provide a calibration verification certificate.
7. In Class 1, Zone 1, Gr. D Hazardous areas, provide a conduit seal if required.

END OF SECTION 13354.



	<b>Dissolved Oxygen</b>		
	<b>Analyzer</b>		
<b>Tag No:</b>	<b>AE-101/AIT-101</b>	<b>AE-102/AIT-102</b>	
Location:	Aeration Basin no.1	Aeration Basin no.1	
Service:	Dissolved Oxygen Analyzer	Dissolved Oxygen Analyzer	
Vessel/line No.			
P&ID:	I101	I101	
<b>Process:</b>			
Fluid:	Activated Sludge	Activated Sludge	
DO Range:	0 to 10 ppm	0 to 10 ppm	
Temp min/max:	5/35 Deg C	5/35 Deg C	
<b>Sensor:</b>			
Type:	Self Cleaning	Self Cleaning	
	Fluorescence Quenching Method	Fluorescence Quenching Method	
Element:	Submersible Dissolved Oxygen Probe	Submersible Dissolved Oxygen Probe	
Cable Length:	As required	As required	
Compensation:	Automatic Temperature & Altitude	Automatic Temperature & Altitude	
Mounting:	Pipe Stand	Pipe Stand	
Options:	c/w 316 SS brackets, accessory kit & all fittings & mounting hardware	c/w 316 SS brackets, accessory kit & all fittings & mounting hardware	
	c/w Jct Box & Env. Conn.	c/w Jct Box & Env. Conn.	
	Jet Clean Head c/w Compressor	Jet Clean Head c/w Compressor	
<b>Transmitter:</b>			
Type:	Eight Channel c/w LCD Indication	Eight Channel c/w LCD Indication	
Output:	D.O. & Temp. 4 - 20 mA isol. (600 $\pm$ )	D.O. & Temp. 4 - 20 mA isol. (600 $\pm$ )	
	3 Sets of On/Off Control Relays	3 Sets of On/Off Control Relays	
	1 Self Cleaning Relay	1 Self Cleaning Relay	
Power Supply:	120 VAC, 60 Hz	120 VAC, 60 Hz	
Enclosure:	Field Mounted Nema 4X	Field Mounted Nema 4X	
Calibr. Range:	0 - 20 ppm Automatic Calibration	0 - 20 ppm Automatic Calibration	
Accuracy:	$\pm$ 1% of range	$\pm$ 1% of range	
Options:	Heater Required	Heater Required	
<b>Electrical:</b>			
Approval:	CSA / ULc	CSA / ULc	
Enclosure:	NEMA 4X	NEMA 4X	
Class/Div/Group:	Zone 2	2	
<b>Notes:</b>	1) Follow all manufacturer's recommendations for installation, calibration, and cabling distance limitations.		
	2) Provide on-site field calibration and training program by Manufacturer's Service Technician, and five year warranty.		
	3) Provide a sensor with a ten year life span.		
	4) Provide sensors with no consumables and no replacement cartridges.		
	5) Provide DUFFIN CREEK Specific mounting hardware. (m/n Aysx-CAN-Deluxe)		

<b>Dissolved Oxygen</b>			
<b>Analyzer</b>			
<b>Tag No:</b>	<b>AE-103/AIT-103</b>	<b>AE-104/AIT-104</b>	
Location:	Aeration Basin no.2	Aeration Basin no.2	
Service:	Dissolved Oxygen Analyzer	Dissolved Oxygen Analyzer	
Vessel/line No.			
P&ID:	I101	I101	
<b>Process:</b>			
Fluid:	Activated Sludge	Activated Sludge	
DO Range:	0 to 10 ppm	0 to 10 ppm	
Temp min/max:	5/35 Deg C	5/35 Deg C	
<b>Sensor:</b>			
Type:	Self Cleaning	Self Cleaning	
	Fluorescence Quenching Method	Fluorescence Quenching Method	
Element:	Submersible Dissolved Oxygen Probe	Submersible Dissolved Oxygen Probe	
Cable Length:	As required	As required	
Compensation:	Automatic Temperature & Altitude	Automatic Temperature & Altitude	
Mounting:	Pipe Stand	Pipe Stand	
Options:	c/w 316 SS brackets, accessory kit & all fittings & mounting hardware	c/w 316 SS brackets, accessory kit & all fittings & mounting hardware	
	c/w Jct Box & Env. Conn.	c/w Jct Box & Env. Conn.	
	Jet Clean Head c/w Compressor	Jet Clean Head c/w Compressor	
<b>Transmitter:</b>			
Type:	Eight Channel c/w LCD Indication	Eight Channel c/w LCD Indication	
Output:	D.O. & Temp. 4 - 20 mA isol. (600 $\pm$ )	D.O. & Temp. 4 - 20 mA isol. (600 $\pm$ )	
	3 Sets of On/Off Control Relays	3 Sets of On/Off Control Relays	
	1 Self Cleaning Relay	1 Self Cleaning Relay	
Power Supply:	120 VAC, 60 Hz	120 VAC, 60 Hz	
Enclosure:	Field Mounted Nema 4X	Field Mounted Nema 4X	
Calibr. Range:	0 - 20 ppm Automatic Calibration	0 - 20 ppm Automatic Calibration	
Accuracy:	$\pm$ 1% of range	$\pm$ 1% of range	
Options:	Heater Required	Heater Required	
<b>Electrical:</b>			
Approval:	CSA / ULc	CSA / ULc	
Enclosure:	NEMA 4X	NEMA 4X	
Class/Div/Group:	Zone 2	2	
<b>Notes:</b>	1) Follow all manufacturer's recommendations for installation, calibration, and cabling distance limitations.		
	2) Provide on-site field calibration and training program by Manufacturer's Service Technician, and five year warranty.		
	3) Provide a sensor with a ten year life span.		
	4) Provide sensors with no consumables and no replacement cartridges.		
	5) Provide DUFFIN CREEK Specific mounting hardware. (m/n Aysx-CAN-Deluxe)		

**SECTION 13381 – DISSOLVED OXYGEN ANALYZER**

13381:05

<b>Manufacturer:</b>	<b>1st Named</b>	<b>Named Alternate</b>	<b>Named Alternate</b>
Manufacturer:	AYSIX	YSI	Endress+Hauser
Supplier:			
Model Number:	Model 2000 Multiparameter Analyzer A6-IIG-2000/model 10		

DIVISION 15

MECHANICAL

## INDEX

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Section 15801 – Metal Ductwork Low Pressure to 500 Pa  
Section 15820 – Duct Accessories  
Section 15825 – Balancing Dampers  
Section 15830 – Electric Heating Devices  
Section 15860 – Fans and Intake Hoods  
Section 15900 – Building System Control  
Section 15990 – Air Balancing

END OF INDEX DIV 15

## PART 1 - GENERAL

### 1.01 Governing Conditions:

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

### 1.02 Work Included:

- A. This Section covers the general requirements for the supply and installation of interior (or attached) piping, and process piping and equipment not covered elsewhere in these Specifications, plumbing, heating, ventilation and air conditioning, building automation, and fire protection systems, together with other works as indicated on the Contract Drawings or as specified.
- B. Obtain necessary permits and pay fees as may be required.
- C. Unless specifically noted otherwise, specifications for pipe apply also to the respective fittings. Where the word piping is used, it means both pipe and fittings.
- D. Supports for pipe and equipment are not shown in detail. Adequately support piping, ducts, and equipment.

### 1.03 Related Work:

- A. Material and Equipment - Section 01600

### 1.04 Codes and Standards:

- A. The applicable standards established by the ANSI, ASME, AWWA, ASTM, ASHRAE, CGSB and the CSA govern the materials and workmanship employed in the manufacture of all equipment. Canadian standards take precedence over American standards in the case of duplication or conflicting requirements.
- B. Ensure that electrical motors and equipment are built to EEMAC (Electrical and Electronic Manufacturers' Association of Canada) standards with Canadian Standard threads and bearings throughout. Ensure that such motorized and electrical equipment are CSA approved or supplied in accordance with the rules and regulations of the ESA (Electrical Safety Authority) and subject to its approval.

### 1.05 Submittals:

- A. Provide a list of equipment tags and piping identification labels to the Engineer for review prior to fabrication.

## PART 2 - PRODUCTS

There are no products in this section.

### PART 3 - EXECUTION

#### 3.01 Bases and Supports:

- A. Install bases, hangers and supports as required for the proper installation of equipment and piping.
- B. Provide 100mm high concrete bases for all equipment unless otherwise specified. Provide base dimensions 50 mm greater than equipment base plate, all around unless otherwise specified by the equipment specification or the manufacturer.

#### 3.02 Fasteners and Anchors:

- A. Use type 316 stainless steel for exterior areas or tank interiors.
- B. Provide non-ferrous material throughout for domestic water plumbing services.

#### 3.03 Seismic Restraints:

- A. Provide seismic restraints and anchors suitable for 'Post-Disaster Building', as per Ontario Building Code Table 4.1.8.5 and CSA S832, for Operational and Functional Components (OFCs).

#### 3.04 Pipe Labels:

- A. Provide pipe identification labels in a visible location at a maximum of 3m intervals and every change in direction. Label to include direction of flow arrow and service (e.g. "Return Activated Sludge"). For all pipes less than 150mm in diameter the label height will equal the radius. For all pipes 150mm and over the label height will be 50mm. Pipe diameter is finished diameter including insulation thickness. Label names to match P&ID pipe system names.
- B. Labels to be colour coded, outdoor grade, self-adhesive, vinyl material meeting ASME 13.1 – Scheme for the Identification of Piping Systems and CAN/CGSB-24.3
- C. Piping label colours in wastewater facilities to match the MECP Design Guidelines for Sewage Works.
- D. Submit label list for review. Include location, service, pipe size, label size, background colour, and text colour.

#### 3.05 Cutting and Patching:

- A. Drill, cut, and patch as shown on the Drawings as specified. Be responsible for coordinating the work of locating holes, recesses, chases, etc., as well as any sleeves and inserts required for the passage of system components through building surfaces.

#### 3.06 Inspection and Tests:

- A. Arrange for necessary inspections and tests required by authorities having jurisdiction. Perform tests and related work in accordance with the rules and regulations of the authorities having jurisdiction.

3.07 Equipment Nameplates:

- A. Provide each item of equipment with registration plates, ULC, CSA, etc., as required. Do not apply insulation or paint over nameplates. Indicate on nameplates, equipment size, model, manufacturer's name, serial number, power requirements, etc. Fasten nameplates with corrosion resistant metal fasteners.

END OF SECTION 15000



PART 1 - GENERAL

## 1.01 Reference:

- A. Section 15000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Piping under this Section includes piping within or attached to structures excluding yard piping as shown on the Drawings.
- B. Design, supply and installation of supports, hangers, braces, etc., required for the proper installation of piping.
- C. Shop and field cutting of pipe as indicated on the Drawings or as preferred by the Contractor's method of construction.
- D. Supply and installation of piping to level indicating transmitters, analyzers, sample taps and other instruments, as shown on the Drawings.
- E. Installation of in-line primary elements and valves supplied under Divisions 13 and 16, if any.
- F. Supply of all items and information required by other trades as work progresses.

## 1.03 Related Work:

- A. Commissioning of the Works - Section 01650
- B. Yard Piping - Section 02600
- C. Instrumentation and Controls - Division 13

## 1.04 Codes and Standards:

- A. ANSI/ASME B31.1 - Power Piping
- B. MMS SP-58 and SP-89 - Pipe Hangers and Supports
- C. OBC - Ontario Building Code
- D. NSF/ANSI 61 - Drinking Water System Components – Health Effects
- E. Where provisions of the pertinent codes and standards conflict with these Specifications and Drawings or with each other, comply with the more stringent provision.

## 1.05 Submittals:

- A. Submit certified Shop Drawings for each type of pipe, consisting of location and type of pipe supports, support spacing, coupling and union locations, flanged connections, locations of tees, equipment and valves for review by the Engineer.

- B. Submit shop drawings for pipe identification markers, flow direction arrows (size, colour, shape, font, and number of stickers), etc.

## PART 2 - PRODUCTS

### 2.01 General:

- A. Comply with the product requirements as specified and/or as indicated on the Drawings.
- B. Select other materials not specifically described but required for proper completion of the work of this Section, subject to the review of the Engineer.

### 2.02 Pipe Materials:

- A. Supply pipe materials as shown in the Pipe Schedule in this Section, as described herein, and as shown on the Drawings.
- B. Pipe sizes shown are nominal sizes in millimeters. Actual pipe dimensions are those commercially available and in accordance with the applicable standards and specifications.
- C. Pipe Specification Numbers refer to the last two (2) digits of the corresponding Section in Division 15.

### 2.03 Gasket Materials:

- A. 3 mm thick neoprene, full face for flat face flanges, unless otherwise specified.
- B. For applications involving potable water or water that will become potable after treatment, which must meet NSF 61 certification requirements, gasket material to be vulcanized synthetic SBR rubber, EPDM, nitrile or Viton. Neoprene gaskets are not acceptable for these applications.

### 2.04 Gaskets for Suction Service:

- A. Provide gaskets designed for full vacuum on all suction lines.

### 2.05 Dielectric Unions:

- A. Provide the following items ahead of copper lines which branch off from steel, stainless steel or cast iron headers:
  1. screwed nipple,
  2. cast iron, bronze-mounted gate valve, Crane fig. 464½ or fig. 465½ or equivalent,
  3. dielectric union.
- B. For cast iron pipe in drainage systems, brass couplings may be used to connect copper lines instead of dielectric unions. No gate valve is required.

### 2.06 Sleeves and Plates:

- A. Sleeves: Schedule 40 galvanized steel pipe of sufficient size to allow free movement for pipes passing through horizontal and vertical surfaces of structures except where shown otherwise on the Drawings.
- B. Seals: Modular pipe seal Model 61 by PSI-Thunderline/Link-Seal or approved equal as indicated on the Drawings unless specified otherwise.
- C. Escutcheon plates: One piece, chrome plated.

### 2.07 Pipe Hangers and Supports:

- A. Concrete supports as per Drawings and as specified.
- B. Plumbing and drainage piping supports to comply with the Plumbing Code (Part 7 of Ontario Building Code).
- C. Process piping supports to comply with:
  - 1. ANSI/ASME B31.1 Power Piping.
  - 2. Manufacturer's Standardization Society of the Valves and Fitting Industry (MSS) standards:
    - a) MSS SP-58, Pipe Hangers and Supports-Material Design and Manufacture.
    - b) MSS SP-69, Pipe Hangers and Supports-Selection and Application.
    - c) MSS SP-89, Pipe Hangers and Supports-Fabrication and Installation.
  - 3. Materials are specified in each pipe specification of this Division.
- D. Provide shop drawings, sealed by a Professional Engineer, for pipe support systems 100 mm and larger. System is to include support selection, placement, anchorage and spacing. Supports by Anvil International or ITT Grinnel. Concrete supports may also be used where applicable and as detailed on the Drawings. Design Drawings for custom fabricated supports shall be sealed by a Professional Engineer.
- E. Hot dip galvanized the pipe supports after fabrication and use stainless steel or galvanized fasteners, unless otherwise specified or noted on the Drawings. For exterior applications or in tank interiors use 316 stainless brackets and anchors unless otherwise specified or noted on the Drawings.

### 2.08 Thrust Collars and Waterstops:

- A. Provide cast in collars and waterstops fabricated from the same metal specifications as the carrier pipe. The size and thickness of collars shall be as indicated on the drawings or as a minimum provide 12mm thick material.

PART 3 - EXECUTION

## 3.01 Delivery, Storage and Handling:

- A. Protect pipes and appurtenances before, during, and after installation and protect the installed work of other trades from the work of this Section.

## 3.02 Examination:

- A. Prior to installation of the work of this Section, carefully inspect the installed work of other trades and verify that other work is complete to a point where this installation may properly commence. Field verify dimensions shown on the Drawings.
- B. In the event of a discrepancy, immediately notify the Engineer. Do not proceed with fabrication or installation in areas of discrepancies until such discrepancies have been fully resolved.

## 3.03 Installation:

- A. Install piping to the dimensions noted on the Drawings, true to line, grade and elevation.
- B. Ensure that joints are well made and free from stress due to misalignment, lack of support, etc.
- C. Install piping to provide free movement of the pipe due to thermal expansion/contraction, except at anchoring points.
- D. Do not install insulation until field-testing of the system and review by the Engineer is completed.

## 3.04 Pipe Hangers and Supports:

- A. Install pipe hangers and supports in accordance with MSS SP-89 and reviewed shop drawings.
- B. Adequately support pipe for weight, hydraulic forces and vibration using specified pipe hangers, brackets or braces.
- C. Install pipe supports whether indicated on the Drawings or not, as necessary to adequately support the pipe as shown and/or as specified. Hot dip galvanize the pipe supports after fabrication and use stainless steel or galvanized fasteners, unless otherwise specified or noted on the Drawings. For exterior applications or in tank interiors use 316 stainless brackets and anchors unless otherwise specified or noted on the Drawings.
- D. Support insulated piping using pipe hangers in direct contact with the pipe and/or using supports welded to the pipe and protruding through the insulation. Do not support insulated piping on the insulation or the external coating for the insulation.
- E. Process piping support spacing:

1. The maximum spacing of hangers and supports to comply with MSS SP-58. Spacing less than Table 4 in MSS SP-58 may be required to conform to building structure limitations.
  2. Support pipe at every branch and elbow.
- F. Plumbing and drainage piping supports to follow the Plumbing Code.
- G. Hanger rods may be attached to beam or joist clamps, bolted brackets or concrete inserts. Do not use ramset or similar devices.
- H. Do not weld hangers, brackets and other supporting components to structural steel.
- 3.05 Sleeves and Plates:
- A. Terminate sleeves in walls and ceilings flush with surfaces except where specifically noted otherwise. Have floor sleeves protrude 50 mm above the finished floor except where specifically noted otherwise. Where floor sleeve pass through containment areas, ensure that the sleeve extend to the height of the containment wall unless specifically noted otherwise. Provide welded puddle flanges for pipe sleeves.
  - B. Install escutcheon plates on un-insulated piping in finished areas where such piping passes through horizontal or vertical surfaces and secure to the surface allowing for pipe movement.
- 3.06 Couplings:
- A. Provide mechanical restraint for all couplings.
  - B. Provide the manufacturer's recommended clearances between pipe ends where piping is joined with groove-type couplings. Grooved ends to be clean, straight and free from deformation.
  - C. Provide rigid piping passing from a structure to a trench condition with a flexible coupling within 500 mm of external face of structure. Provide restraining rods for all such couplings. Submit to the Engineer, shop drawings of the restraint system sealed by a Professional Engineer.
  - D. Where restrained joints are required, weld restraint rings to the pipe outside diameter in accordance with the couplings manufacturer's latest installation instructions. Submit to the Engineer, shop drawings of the restraint system stamped by a licensed Professional Engineer.
- 3.07 Vents and Drains:
- A. Install plugged vents and drains respectively at high and low points of the process and service piping where drain/vent valves are not provided. Locate drains to permit the complete drainage of systems. Locate vents for the complete filling of systems.

### 3.08 Piping Connections:

- A. Install piping connections to equipment and/or other piping using suitable insulating material such that conditions for galvanic corrosion are eliminated. Provide 25 mm NPT taps including a 25 mm nipple and cap for pump suctions and discharges. Ensure that materials used are compatible with the specified piping material.
- B. Couplings, tapped saddles, valves, flexible connectors and fittings must be of material similar to that of the piping system, and have pressure and temperature ratings equivalent to the piping system in which they are installed.

### 3.09 Flushing:

- A. Refer to Section 01650 for flushing requirements.

### 3.10 Pipe Pressure Testing:

- A. Pressure test piping to 150% of the maximum working pressure as listed in the pipe schedule at the end of this Section.
- B. Have the testing procedure reviewed by the Engineer prior to commencement of the work. Repair leaks to the satisfaction of the Engineer.
- C. Test all pipes with water. Air and gas are not permitted for testing. At completion of testing, drain water from the piping and blow the pipes clear of moisture with compressed air to the satisfaction of the Engineer.
- D. Allowable Leakage:
  - 1. No leakage is allowed in piping installed under this Division.
  - 2. If a section of piping leaks under test, discover the cause; make required repairs, and re-inspect/re-test that section.

### 3.11 Pipe Disinfection:

- A. For disinfection of piping system (including valves, fittings and appurtenances), refer to Section 01650.

### 3.12 Cleaning:

- A. Remove all shipping labels, manufacturer labels and markings and layout markings.

### 3.13 Painting:

- A. Refer to Section 09900 for painting requirements.

### 3.14 Data Forms:

- A. Table 1: NOMINAL PIPE SIZE NOMENCLATURE CHART

[Metric size (mm), Imperial size (in)]

Metric Size	Equivalent Imperial	Metric Size	Equivalent Imperial	Metric Size	Equivalent Imperial	Metric Size	Equivalent Imperial
6.4	1/4	80	3	375*	15 *	700	28
10	3/8	90	3-1/2	400	16	750	30
12	1/2	100	4	450	18	800	32
20	3/4	125	5	500	20	900	36
25	1	150	6	525*	21*	1050	42
32	1-1/4	200	8	550	22	1200	48
40	1-1/2	250	10	600	24	1500	60
50	2	300	12	650	26	1800	72
65	2-1/2	350	14	675*	27*		

B. Table 1: PIPE SCHEDULE - Division 15

Note: Piping not located within the confines of the building is included in Section 02600.

Service	Description	Pipe Joint Type	Max. Working Pressure (kPa)	Specification No. & Material
Plumbing	Domestic water	Lead free solder or grooved couplings	1034	15063 Copper
	Drains / Vents below slabs or concealed	Gasket or solvent weld	gravity	15071 PVC Sewer
	Drains / Vents exposed	Soldered for copper, mechanical joint for Cast-iron	gravity	15063 Copper / 15069 Cast-iron
	Drains (Pressurized / Pumped)	Soldered Flanged	1034	15063 Copper 15066 Stain. Steel
	HVAC Condensate drain	Soldered	1034	15063 Copper
	Hydronic	Screwed or welded	1034	15062 Mill Steel
Chemical	Alum chemical and vent lines	Solvent welded, threaded at equipment joints and unions	690	15065 PVC Pipe
<b>WATER APPLICATION</b>				
	Effluent water to screen system	Welded, flanged or grooved couplings as shown on the drawings	700	15066 Stain. Steel
<b>WASTEWATER APPLICATION</b>				
Aeration	Piping from blower to aeration tanks	Welded, flanged or grooved couplings as shown on the drawings	100	15066 Stain. Steel Type 304 L
Decant	Decant pump discharge piping	Mechanical joint restrained, flanges as shown on drawings	100	02600 Yard Piping PVC DR 26 Pressure Pipe

END OF SECTION 15060



## PART 1 - GENERAL

### 1.01 Reference:

- A. Sections 15000 and 15060 apply to and govern the work under this Section.

### 1.02 Work Included:

- A. Provide copper pipe, fittings in sizes 10 mm to 100 mm and supports required for the process, plumbing, drainage and vent systems as shown on the Drawings and specified herein.
- B. Connection of piping under this Section to required process equipment, pumps, taps, plumbing fixtures, vents, etc.

### 1.03 Submittals:

- A. Submit certified shop drawings giving details, design, method of construction and type of pipe joints.

### 1.04 Codes and Standards:

- A. Ensure that materials and fabrication methods conform to the following codes except as modified by this specification. Use the latest issues and revisions of codes and standards applicable at time of tender.

## PART 2 - PRODUCTS

### 2.01 Piping Specifications:

- A. No. 63, Copper Piping

### 2.02 Materials:

#### A. Pipe:

1. Pipe other than DWV (Drain Waste Vent): Seamless copper tube, type K or L, hard or soft temper, conforming to ASTM B88. NSF/ANSI 61 certified for piping that comes into contact with potable water or water that will become potable.
2. DWV pipe: seamless copper tube conforming to ASTM B306.

#### B. Fittings:

1. Cast solder-joint water fittings: Conforming to ANSI B16.18 for Cast Copper Alloy Solder Joint Pressure Fittings. NSF/ANSI 61 certified for fittings that come into contact with potable water or water that will become potable.
2. Wrought solder joint water fittings: Conforming to ANSI B16.22 for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings. NSF/ANSI 61 certified for fittings that come into contact with potable water or water that will become potable.

3. Cast solder joint drainage fittings: Conforming to CSA B158.1 Cast Brass Solder Joint Drainage, Waste and Vent Fittings.
  4. Wrought solder joint drainage fittings: Conforming to ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
  5. Do not use solder joint drainage fittings for water systems.
- C. Solder Joints:
1. For copper water piping, use a 95/5 antimonial tin solder conforming to ASTM B32.
  2. For copper drainage piping, use a 50/50 solder conforming to ASTM B32.
- D. Threaded Joints:
1. For threaded joints, use 100% teflon tape on male thread only.
  2. Use dielectric fittings between copper and ferrous piping.
- E. Pipe Hangers:
1. Provide pipe supports and hangers as indicated on the Drawings and as specified in Section 15060.

### PART 3 - EXECUTION

#### 3.01 Delivery and Storage:

- A. After review by the Engineer, deliver and store the pipe and pipe fittings at the job site, in the required quantities.

#### 3.02 Installation:

- A. Ensure that installation of copper tubing for drainage, vent and water systems complies with Plumbing Code (Part 7 of the Ontario Building Code).
- B. Supports:
1. Adequately support pipe for weight, hydraulic forces and vibration using specified pipe hangers, brackets or braces.
- C. Unions:
1. Install unions as specified in this Section and as shown on the Drawings at every equipment to facilitate removal, without cutting of pipe.
  2. Install unions in pipe runs at intervals not exceeding the following distances:
    - a) 20 m for pipe size 12 to 67 mm

- b) 15 m for pipe size 80 to 100 mm
- 3. Use threaded all-bronze unions with ground seat with 1034 kPa rating.

END OF SECTION 15063.

PART 1 - GENERAL

## 1.01 Reference:

- A. Sections 15000 and 15060 apply to and govern the work under this Section.

## 1.02 Work Included:

- A. Provide rigid PVC pipe and fittings in sizes 12 mm to 300 mm as indicated on the Drawings and as specified herein.
- B. Provide related gaskets, fasteners, anchors, and supports.

## 1.03 Submittals:

- A. Submit certified shop drawings of piping prior to installation, giving details, isometric drawings showing lengths, centre lines, valve dimensions, pump centre lines, etc., and showing all pipe supports, spacing and type, connections, drains and tap-ins. Specify methods of construction and types of joints.
- A. Submit manufacturer solvent welding primer and solvent cement product information.

## 1.04 Codes and Standards:

- A. This section contains references to documents and standards. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

PART 2 - PRODUCTS

## 2.01 Piping Specification:

- A. No. 65, Rigid PVC Pipe and Fittings.

## 2.02 Materials:

- A.

Item	Description	Standard
Pipe	Rigid polyvinyl chloride (PVC) Sch 40, plain end for solvent weld.	ASTM-D1784 ASTM-D1785 Type 1, Gr.1 (12454-B) CSA 137.3
Fittings	12 - 65 mm, Sch 40 PVC, solvent weld, with threaded connections to equipment and to valves without built-in unions.	ASTM-D2464 PVC I (12454-B)

Item	Description	Standard
	80 - 300 mm, Sch 40 PVC, solvent weld, with flat face flanges drilled to ANSI B16.1, Class 125, at valves, equipment and as required for disassembly.	ASTM-D2467 PVC I (12454-B)
Unions	12-65 mm, Sch 40 PVC with Buna-N O-ring seal	ASTM-D2464 PVC I, (12454-B)
Gaskets	Full face, 3 mm thick.  For applications involving potable water or water that will become potable after treatment, which must meet NSF 61 certification requirements, gasket material to be EPDM, nitrile or viton. Neoprene gaskets are not acceptable for these applications.  For applications involving chemicals, gasket material to be compatible with chemical carried.	
Bolts, Nuts, Washers	Hex bolts and nuts, washers, all cadmium plated.	ASTM A307 Gr.B
Solvent Cement	Primer shall be used for all joints  Solvent cement to match manufacturers maximum recommended pipe size (interference fit) for each piping size  <u>Chemical Applications:</u> Xirtec 24 or Weld-On 72 CPVC for all joints (for both CPVC and PVC Pipe)	ASTM D2564
Couplings	25 to 300 mm to AWWA C606 standard for grooved and shouldered joints, flexible type "Victaulic Style 77"	ASTM A536 Gr. 65-45-12

### 2.03 Pipe Supports:

- A. 12 to 65 mm pipe size: Unistrut 41 mm series channel, with P2558 clamps, wall brackets, all hot dip galvanized. Cadmium plated threaded rods, bolts, and nuts. Provide concrete inserts and beam clamps as required.
- B. 80 to 300 mm pipe size: Anvil (Grinnell) Fig. 260 Clevis hangers, with support channels, Fig. 195 wall clamps, as required, all galvanized. Use Fig. 167 Shield, galvanized, of suitable size at all supports. Provide beam clamps and concrete inserts as required.

## PART 3 - EXECUTION

## 3.01 Installation:

- A. Install piping as shown on the Drawings and as specified. Make joints to ANSI/ASTM-D2855.
- B. Solvent Welded Joints:
  - 1. Cut pipe square, remove burrs, raised beads, dirt grease and moisture before welding solvent welded joints. Use applicator sized to ½ the pipe diameter to apply primer into socket fitting and pipe. Remove any puddles of primer from the socket. Apply a 2<sup>nd</sup> application of primer on the socket, then apply solvent welded cement to fitting socket and pipe while primer surface is still wet.
  - 2. Allow twice the manufacture recommended set and cure time for PVC piping on chemical applications.

## 3.02 Supports:

- A. Adequately support pipe for weight, hydraulic forces and vibration using specified pipe hangers, brackets or braces.
- B. Provide independent supports for all valves and instruments on PVC piping. PVC piping shall not be used to support valves and instruments.
- C. Provide concrete pads for floor-mounted supports.

## 3.03 Unions and Flanges:

- A. Install unions and flanges as specified in this Section and as shown on the Contract Drawings at every equipment to facilitate removal, without cutting of pipe.
- B. Install unions and flanges in pipe runs at intervals not exceeding the following distances:

Pipe Size	Maximum Distance
12 to 65 mm dia.	20,000 mm
80 to 100 mm dia.	15,000 mm
150 to 200 mm dia.	10,000 mm
250 to 300 mm dia.	6,000 mm

END OF SECTION 15065.

PART 1 - GENERAL

## 1.01 Reference:

- A. Sections 15000 and 15060 apply to and govern the work under this Section.

## 1.02 Work Included:

- A. Provide stainless steel piping in sizes 12 mm and larger, as shown on the Drawings and specified herein.
- B. Provide related gaskets, fasteners, anchors, and supports.

## 1.03 Codes and Standards:

- A. Type and size of weld to follow Technical Standards and Safety Authority (TSSA) Procedure Qualification Report (PQR).
- B. Welder's qualifications pursuant to the Boilers and Pressure Vessels Act.

## 1.04 Submittals:

- A. Provide isometric drawings showing the length center line, valve dimensions, pump center lines, method of construction, type of joints, welding rod material and metallurgical test reports, as specified.
- B. Prior to welding, submit copies of the Technical Standards and Safety Authority (TSSA) Procedure Qualification Report (PQR) for each type and size of weld required.
- C. Prior to welding, submit copies of welder's identification pursuant to the Boilers and Pressure Vessels Act.
- D.

PART 2 - PRODUCTS

## 2.01 Piping Specifications:

- A. No. 66 Stainless Steel Pipe and Fittings.

## 2.02 Stainless Steel Pipe and Fittings:

- A.

Item	Description	Standard
Pipe	12 - 65 mm, NPS Sch 40S, seamless or welded, material as shown in the Pipe Schedule, screwed, plain or beveled ends.	ASTM A312, ASTM A530
	80 mm and larger, NPS Sch 10S, material as shown in Pipe Schedule, grooved or beveled ends.	ASTM A240, ASTM A778

Item	Description	Standard
Fittings	<p>12 - 65 mm, NPS Sch 80S, material as shown in Pipe Schedule, screwed or socket weld or butt weld.</p> <p>80 – 600 mm, NPS Sch 10S, smooth flow, material as shown in Pipe Schedule, beveled ends; mitered fittings not acceptable unless shown on the Drawings.</p> <p>Over 600 mm or where shown on drawings for Smaller sizes, NPS Sch 10S, material as shown in Pipe Schedule, mitered, fabricated to ANSI/AWWA C208, beveled ends.</p> <p>80 to 300 mm fittings, NPS Sch 10S, pipe joint type and material as shown in Pipe Schedule.</p>	<p>ASTM A403</p> <p>ANSI B16.9 (socket weld)</p> <p>ANSI B16.11 (butt weld)</p> <p>ASTM A240</p> <p>ASTM A240</p>
Flanges	80 mm and larger, stainless steel, slip-on, bored to suit pipe or weld neck where required. Flat face to valves, equipment and orifice flanges. Dimension to AWWA C207, Class B for rated pressure of 590 kPa or less and Class D for higher pressures. Drilled to ANSI B16.1 for 1 MPa rating.	Alloy Steel: A182, A350,
Gaskets	3 mm thick neoprene, full face for flat face flanges, unless otherwise specified for a particular service. For applications involving potable water or water that will become potable after treatment, which must meet NSF 61 certification requirements, gasket material to be vulcanized synthetic SBR rubber, EPDM, nitrile or viton. Neoprene gaskets are not acceptable for these applications.	
Nuts	Heavy hex. Threaded to ANSI B1.1, Class 2.B fit. Sizes 25 mm (1") and smaller coarse thread, and 8-pitch thread for 28 mm (1 1/8") and larger dia bolts AISI type 303 Grade 8F or 8FA, or AISI type 304 Grade 8 or 8A.	ASTM A194
Bolts, Stud Bolts, Anchor Rods	Heavy hex machine bolt, or stud bolt, to ANSI B18.2.1, threaded to ANSI B1.1, class 2A fit. Sizes 25 mm (1") and smaller coarse thread and 8-pitch thread for 28 mm (1-1/8") dia and larger bolts. AISI type 303 or 304.	ASTM A320 B8F, B8FA, B8, B8A ASTM A193 B8 or B8A
Anchor Rods	Threaded, material AISI type 303, 304 or 316, coarse thread, ANSI B1.1, Class 2A fit. Size 28 mm and above, 8-pitch thread.	ASTM A320

### 2.03 Thrust Collars and Waterstops:

- A. Where specified and/or indicated on the drawings, process piping passing through concrete walls to be furnished with waterstop/thrust collars.



- B. Collars to be fabricated from metal similar to that to which it is welded. The size and thickness of collars is as indicated on the drawings.

#### 2.04 Couplings:

- A. Provide Victaulic where specified, indicated on the Drawings, and as detailed below.

- B. Restrained Victaulic coupling:

1. Coupling body material is steel hot dipped galvanized after fabrication or type 316L stainless steel. Bolts and nuts are zinc electroplated steel or stainless steel. Collar rings for the "Victaulic" style 44 couplings to be made of steel or stainless steel to AWWA C606-97, type "D" and to be manufactured and welded to the pipe in accordance with the coupling manufacturer's dimensions. Material of collar rings to be carbon steel to ASTM A36, A105, A182, A350 or type 316L stainless steel. The gasket material to be grade "E" EPDM. Neoprene gaskets are not acceptable.

- a) Bolted split sleeve body material shall be carbon steel to ASTM A36 and epoxy coated to AWWA C210 or fusion bonded epoxy coated to AWWA C213. Carbon steel zinc plated bolts, nuts and washers to ASTM A193 – Grade B7, 194 – Grade 2H and F436 SAE respectively. The gasket material to be EPDM. Neoprene gaskets are not acceptable.

2. Submerged or Buried Couplings

- a) Where couplings are noted be buried or submerged:

- i) Coupling body material shall be 316L stainless steel. Bolts and nuts Type 316L stainless steel per ASTM F593 and F594, Group 2. The gasket material to be grade "E" EPDM. Neoprene gaskets are not acceptable.

- ii) Bolted split sleeve body, shoulders and sealing plate material shall be Type 316L stainless steel to ASTM A240. Type 316 Stainless steel bolts, nuts and washers to ASTM A193 – Grade B8M, 194 – Grade 8M and SAE respectively. The gasket material to be EPDM. Neoprene gaskets are not acceptable.

- iii) Where the coupling is noted to be buried, wrap all exposed metal or stainless steel piping and coupling with Petrolatum Tape.

3. Select Victaulic coupling styles as per table below:

Service	Pipe Size	Coupling Style	Other
Pressurized Rigid and Restrained	50 to 300 mm	89	
Pressurized Rigid and Restrained	350 to 600 mm	W89	

Pressurized Rigid and Restrained	40 to 300 mm	489	Stainless steel housing
Pressurized Rigid and Restrained	350 to 500 mm	W489	Stainless steel housing
Pressurized Flexible and Restrained	20 to 150 mm	77	
Pressurized Flexible and Restrained	350 to 1270 mm	W77	
Pressurized Flexible and Restrained	20 to 150 mm	77S	Stainless steel housing
Pressurized Flexible and Restrained	25 to 150 mm	07	
Pressurized	350 mm and above	44	Type "D" ring to AWWA C606-97*

C. Non-Restrained couplings:

1. Exposed Stainless Steel pipe

- a) Bolted split sleeve body material shall be carbon steel to ASTM A36 and epoxy coated to AWWA C210 or fusion bonded epoxy coated to AWWA C213. Carbon steel zinc plated bolts, nuts and washers to ASTM A193 – Grade B7, 194 – Grade 2H and F436 SAE respectively. The gasket material to be EPDM. Neoprene gaskets are not acceptable.

2. Submerged or Buried Stainless Steel pipe

- a) Bolted split sleeve body, shoulders and sealing plate material shall be Type 316L stainless steel to ASTM A240. Type 316 Stainless steel bolts, nuts and washers to ASTM A193 – Grade B8M, 194 – Grade 8M and SAE respectively. The gasket material to be EPDM. Neoprene gaskets are not acceptable.

- b) Wrap buried couplings with petrolatum tape.

3. Select Victaulic coupling styles as per table below:

Service	Pipe Size	Coupling Style	Method
Pressurized or gravity	200 to 3600mm	Style 230	Plain end pipe

	75 to 2400mm	Style 230S (SS)	Plain end pipe
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#### 2.05 Shop and Field Welding:

- A. Carry out welding of stainless steel as specified under Part 3. Shop assemble pipe and fittings and weld in an accredited welding shop by certified welders for specified type of medium. The field welds are allowed only where pipe assemblies are too large or awkward to install. Obtain approval of the Engineer for field welds. All welds, including fittings and spool piece assemblies, will be the full-penetration welded butt joints, except for the flanges and collar rings.
- B. For pipe wall thickness up to 4.76 mm (3/16") and the root pass on thicker materials use Inert-Gas Tungsten-Arc (TIG) welding process. Subsequent passes by the Gas-Metal-Arc (MIG) process.
- C. Filler metal specification:
  1. Shielded Metal Arc Welding (SMAW):
    - a) electrode E308L for type 304L stainless steel pipe,
    - b) electrode E316L for type 316L stainless steel pipe.
  2. Tungsten Inert Gas (TIG) or Metal Inert Gas (MIG) welding use:
    - a) bare wire filler metal type ER 308L for type 304L stainless steel pipe
    - b) ER316L for type 316L stainless steel pipe.
- D. All welding to be shop welding, except with written permission of the Engineer. Drinking water piping to be welded by a fabricator who can supply NSF 61 certified products and assemblies.

#### 2.06 Pipe Drains:

- A. Provide S.S. half couplings and threaded plugs at the bottom of the pipe at low points in the piping and between isolating valves for the purpose of draining the piping. Exact location of S.S. half couplings to be chosen by the Engineer during shop drawing submission.

### PART 3 - EXECUTION

#### 3.01 Welding Qualifications:

- A. Welders to be qualified for welded fabrication under the Boiler and Pressure Vessels Act and have:
  1. Engineering and supervisory personnel listed with the Technical Standards and Safety Authority (TSSA) as meeting the requirements of the appropriate Clauses of the above Act.

2. Welding procedures whether deemed prequalified or not, accepted by the TSSA under the provisions of the appropriate Clauses of the above Act filed with its records.
3. Tested and qualified welders and welding operators in accordance with the provisions of the above Act.

### 3.02 Preparation:

- A. Ensure that surfaces and edges to be welded or grooved are free from indentations, projections, burrs, tears, cracks, and other defects that may adversely affect the quality and/or strength of the weld or groove. Keep surfaces to be welded or grooved free from scale, dirt, grease, slag or other foreign material that may impair the quality or the weld or groove.
- B. Grind edges prepared by carbon arc gouging to sound metal to eliminate carbon pick-up. Use stainless steel wire brushes to clean surfaces and follow by wiping dry with a chloride free cleaner.

### 3.03 Welds:

- A. Welds to comply with the requirements of the PQR welding procedure obtained under the above-mentioned qualifications and shall comply with Sec. IX, Part A, of the ASME Boiler and Pressure Vessel Code.
- B. The workpiece temperature to be at least 10°C prior to commencing welding and where multi-pass welding is required. Ensure that the interpass temperature does not exceed 175°C.
- C. Where inert gas shielding is used apply gas on both sides of the weld and continue the application until the weld has cooled sufficiently to avoid discolouring and oxidation.
- D. Collapsible dams or partitions containing back-up gas may be used where it is not practical to fill large sections with gas.
- E. After welding, completely remove slag and weld splatter from welds. Welds that have a reinforcement exceeding 3.0 mm to be smooth, on both sides as the case may be. Finished welds to be smooth and free from pinholes, heat tint, undercut and overlap.

### 3.04 Pipe Tolerances:

- A. Finished pipe sections to be truly straight with walls parallel to the axis of the pipe. Any pipe section with a fault in alignment exceeding 3.5 mm for each 3000 mm in length from a line parallel to the axis of the pipe will be rejected.
- B. Special sections of pipe are not allowed to vary from the specified length by more than 3.5 mm.

**3.05 Grooving:**

- A. Groove pipe in accordance with the recommendations of the coupling, fitting or valve manufacturer based on the type of pipe, wall thickness, outside diameter and related tolerances.
- B. Use equipment and roll sets recommended by the coupling, fitting or valve manufacturer to achieve the appropriate groove and ensure proper joint performance.

**3.06 Finish:**

- A. Have the finished pipe sections thoroughly pickled, passivated, scrubbed and washed until all discolouration and iron picked up during manufacture is completely removed. Treat field welds with pickling paste, scrub with stainless steel wire brush and thoroughly wash. Wash completed pipelines inside and out to remove dirt picked up during shipping and installation, including the removing of stains or discolouration made on the pipe during construction.

**3.07 Precautions:**

- A. Exercise care during handling and installation of stainless steel pipe to avoid the contact of stainless steel with non-stainless steel tools, wire ropes, etc., as ferrous metal contamination may leave marks caused by rusting of embedded steel.

**3.08 Pipe Supports:**

- A. Adequately support pipe for weight, hydraulic forces and vibration using specified pipe hangers, brackets or braces.
- B. Hangers to be Anvil (Grinnel) Fig. 260 or equal for horizontal pipe and Fig. 261 riser clamps for vertical pipe. Where pipe is insulated use Fig. 167 or equal. All hangers and pipe supports to be stainless steel.
- C. Hanger rods may be attached to a beam or joist clamps, bolted brackets or concrete inserts. Ramsets or similar devices are not permitted.
- D. Do not weld hangers, brackets and other support components to structural.

**3.09 Unions and Flanges:**

- A. Install unions and flanges as specified in this Section, as shown on the Drawings, and as follows:
  - 1. At every equipment to facilitate removal, without cutting of pipe.
  - 2. In pipe runs at intervals not exceeding the following distances:

Pipe Size	Maximum Distance
12 – 67 mm	20,000 mm
80 – 100 mm	15,000 mm
150 – 200 mm	10,000 mm

250 – 300 mm	6,000 mm
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3.10 Field Testing by Owner:

- A. The Owner may employ a testing agency to perform radiographic inspection of up to ten percent (10%) of butt welds in steel and stainless steel piping, at their own cost. Provide proper access and co-operate to facilitate this testing.
- B. Bear the cost of repairing and retesting of welds that failed during testing. In addition, pay for an additional test on another weld of the Engineer's choice. Should this test show weld failure, repeat the process until an acceptable weld is found. At this point the testing will revert to the original 10% above by the Owner.

END OF SECTION 15066.

PART 1 - GENERAL

## 1.01 Summary:

## A. Section Includes:

1. Materials and installation for copper tubing and fittings for refrigerant.

## B. Related Sections:

1. Section 01410 – Regulatory Requirements
2. Section 01420 – Reference Standards
3. Section 01740 – Cleaning
4. Section 15670 – Ductless Split AC

## 1.02 References:

## A. American Society of Mechanical Engineers (ASME)

1. ASME B16.22-[01], Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
2. ASME B16.24-[02], Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
3. ASME B16.26-[88], Cast Copper Alloy Fittings for Flared Copper Tubes.
4. ASME B31.5-[01], Refrigeration Piping and Heat Transfer Components.

## B. American Society for Testing and Materials International (ASTM)

1. ASTM A307-[04], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
2. ASTM B280-[03], Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

## C. Canadian Standards Association (CSA International)

1. CSA B52-[99], Mechanical Refrigeration Code.

## D. Environment Canada (EC)

1. EPS 1/RA/1-[96], Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

## E. Health Canada / Workplace Hazardous Materials Information System (WHMIS)

1. Material Safety Data Sheets (MSDS).

F. Province of Ontario Boiler Pressure Vessel and Compressed Gas Regulation (TSSA).

1.03 Submittals:

A. Submittals in accordance with Section 03130 - Submittal Procedures.

B. Co-ordinate submittal requirements and provide submittals required by Section 01330 – Submittal Procedures.

C. Product Data:

1. Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

D. Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics (TSSA applicable) and physical properties.

E. Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

F. Instructions: submit manufacturer's installation instructions.

G. Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.04 Quality Assurance:

A. Pre-Installation Meeting:

1. Convene pre-installation meeting one (1) week prior to beginning [work of this Section and on-site installations.

a) Verify project requirements.

b) Review installation and substrate conditions.

c) Co-ordination with other building subtrades.

d) Review manufacturer's installation instructions and warranty requirements.

B. Health and Safety:

1. Do construction occupational health and safety in accordance with Section 01701 - Safety Requirements.

C. Trades people to be journeyman and graduate from a recognized college refrigeration trade program.



## 1.05 Delivery, Storage and Handling:

## A. Waste Management and Disposal:

1. Separate waste materials for reuse and recycling.
2. Remove from site and dispose of packaging materials at appropriate recycling facilities.
3. Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
4. Separate for reuse and recycling and place in designated containers, steel, metal, plastic waste in accordance with Waste Management Plan (WMP).

PART 2 - PRODUCTS

## 2.01 Tubing:

## A. Processed for refrigeration installations, deoxidized, dehydrated and sealed.

1. Hard copper: to ASTM B280, type ACR B (nitrogenised).
2. Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

## 2.02 Fittings:

## A. Service: design pressure 2070 kPa and temperature 121° C.

## B. Brazed:

1. Fittings: wrought copper to ASME B16.22.
2. Joints: silver solder, 15% Ag-80% Cu-5%Por copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

## C. Flanged:

1. Bronze or brass, to ASME B16.24, Class 150 and Class 300.
2. Gaskets: suitable for service.
3. Bolts, nuts and washers: to ASTM A307, heavy series.

## D. Flared:

1. Bronze or brass, for refrigeration, to ASME B16.26.

### 2.03 Pipe Sleeves:

- A. Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

### 2.04 Valves:

- A. 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- B. Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## PART 3 - EXECUTION

### 3.01 Manufacturer's Instructions:

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

### 3.02 General:

- A. Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 230501 - Installation of Pipework.

### 3.03 Brazing Procedures:

- A. Bleed inert gas into pipe during brazing.
- B. Remove valve internal parts, solenoid valve coils, sight glass.
- C. Do not apply heat near expansion valve and bulb.

### 3.04 Piping Installation:

#### A. General:

- 1. Soft annealed copper tubing: bend without crimping or constriction, hard drawn copper tubing: do not bend. Minimize use of fittings.

#### B. Hot gas lines:

- 1. Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
- 2. Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
- 3. Provide inverted deep trap at top of risers.

4. Provide double risers for compressors having capacity modulation.
    - a) Large riser: install traps as specified.
    - b) Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.
- 3.05 Pressure and Leak Testing:
- A. Close valves on factory charged equipment and other equipment not designed for test pressures.
  - B. Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.
  - C. Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.
- 3.06 Field Quality Control:
- A. Site Tests/Inspection:
    1. Close service valves on factory charged equipment.
  - B. Ambient temperatures to be at least 13° C for at least 12 hours before and during dehydration.
  - C. Use copper lines of largest practical size to reduce evacuation time.
  - D. Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
  - E. Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
  - F. Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
    1. Twice to 14 Pa absolute and hold for 4 h.
    2. Break vacuum with refrigerant to 14 kPa.
    3. Final to 5 Pa absolute and hold for at least 12 h.
    4. Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
    5. Submit test results to DCC Representative.
  - G. Charging:

1. Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
2. With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
3. Re-purge charging line if refrigerant container is changed during charging process.

H. Checks:

1. Make checks and measurements as per manufacturer's operation and maintenance instructions.
2. Record and report measurements to DCC Representative.

I. Manufacturer's Field Services:

1. Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
2. Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
3. Schedule site visits, to review Work, at stages listed:
  - a) After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
  - b) Twice, during progress of Work at 25% and 60% complete.
  - c) Upon completion of the Work, after cleaning is carried out.
4. Obtain reports, within 3 days of review, and submit, immediately, to DCC Representative.

3.07 Demonstration:

A. Instructions:

1. Post instructions in frame with glass cover in accordance with Section 01780 - Closeout Submittals and CSA B52.

## 3.08 CLEANING

- A. Perform cleaning operations as specified in Section 01740 and in accordance with manufacturer's recommendations.
- B. On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 15073.

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide valves and operators as shown on the drawings and specified herein.

### 1.03 Related Work:

- A. Electric Actuators - Section 11007

### 1.04 Submittals:

- A. Show valve operators and their orientations.
- B. Submit NSF 61 certification for all valves in contact with potable water, water that will become potable after treatment, or chemical additives for water treatment.

## PART 2 - PRODUCTS

### 2.01 Equipment:

#### A. General:

1. The Contractor is responsible for identifying all valves required based on the drawings and specifications. The Contractor is to perform a take-off from the drawings to confirm the valve count and provide all valves on the drawings and in the specifications. If a valve list or schedule is provided it is not to be considered complete. Smaller diameter valves are typically not listed.
2. The process drawings take precedence over any valve list or schedule.
3. The valve list and specification sheets are intended to be a guide. Supply valves and operators as shown or implied on the drawings and specifications, and as required to provide a functional and safe piping system.

- B. Supports to be the same as those used in the piping system where the valve is located. Where possible, provide supports for piping as close to valves as possible.

#### C. Gaskets:

1. Unless otherwise specified, provide full face gaskets.
2. For applications involving potable water, water that will become potable after treatment, or chemical additives for water treatment, gasket material to be vulcanized synthetic SBR rubber, EPDM, nitrile or Viton and be certified to NSF 61. Neoprene gaskets are not acceptable for these applications.

## 2.02 Coating:

- A. Polyamide Epoxy coating as a minimum coating for any steel or cast valve.
- B. Field repairs per manufacturer direction.

## 2.03 Motorized Actuators:

- A. Motorized valve actuators to be in accordance with AWWA C-540 and Section 11007.

## 2.04 Manual Operators:

- A. Butterfly valves: Provide manual hand wheel operators: Geared type and sized for the maximum torques listed in AWWA Standard C504.
- B. Other valves: Select hand wheel operators so that the force necessary to operate the valve exerted on the rim of the wheel does not exceed 180 N, except for seating or unseating. Provide operators capable of withstanding a force of up to 890 N on the rim without damage. Provide valve position indicators on all butterfly valves and where noted on the valve Specification Sheets, or Valve List.
- C. Provide a chain actuator on all manually operated valves whose spindle centerline is 1.8 meters or higher above finished floor level. Chain: Rustproof, endless type, extending to within one meter above the floor. In cases where the afore-mentioned chain interferes with normal traffic areas, provide wall hooks to secure the chain in a non-obstructing position.
- D. Provide floor stand operators complete with valve position indicator, stem extensions and intermittent bushings on all valves covered by grating, plating or platforms, except where noted on the drawings.
- E. Provide universal joints on extension stems for installations where the valve location and the floor stand operator do not line up.
- F. Provide valve keys of a suitable length to provide operation at 1.0m above grade or floor. Key to fit AWWA square operating nuts.
- G. Where position indication of manual valves is shown on the Drawings, provide Westlock Control Accutrak position monitors with local display. Device to meet electrical classification of the installation area.

## 2.05 ANSI / NSF Standard 61 Compliance:

- A. For applications involving potable water, water that will become potable after treatment, or chemical additives for water treatment, valves, trim, gaskets, coatings be certified to NSF 61 and valves shall be certified Lead-Free in accordance with NSF/ANSI 372.

## 2.06 Direction of Opening:

- A. Provide manually operated valves, which open by turning the operating nut in a COUNTER-CLOCKWISE DIRECTION. Have the direction of operation and the number of turns to fully open or close the valve clearly marked.

## 2.07 PVC Ball Valves:

- A. Service: Chemical services and as shown on the Drawings.
- B. Materials:
  - 1. Body: PVC, type I, Grade I, ASTM D-1784, CELL Class, 12454-A
  - 2. Stem: PVC
  - 3. Seat: Teflon
  - 4. Seals: EPDM
- C. Compatibility with Fittings:
  - 1. sizes 6-65 mm: socket ends to ASTM D-2467, with union fittings both ends.
  - 2. sizes 80mm and up: Flanged ends to ANSI class 150, one piece
- D. Pressure Rating: 1500 kPa
- E. Flange Gasket Material: EPDM or Viton
- F. All valves to be hand lever operated unless otherwise shown on drawings.
- G. Valves for sodium hypochlorite service to be provide with drilled ball, vented ball or similar pressure control and seals to match service.
- H. Acceptable manufacturers:
- I. First named: Chemline Safe-block True Union series
- J. Acceptable alternate: Hayward TBH series, George Fisher 546 series, IPEX VXE series

## 2.08 Stainless Steel Ball Valves:

- A. Service: Corrosive areas and services such as effluent lines, sample lines, pipe drain valves, gauge connections, instrumentation connections, air release connections and as shown on the Drawings.
- B. Size 6-75 mm
  - 1. Materials:
    - a) Body: two-piece 316 Stainless steel
    - b) Stem: 316 Stainless steel
    - c) Seat: PTFE
    - d) Ball: Full port



2. Compatibility with Fittings: Threaded, ANSI B2.1.
3. Pressure Rating: 1380 kPa
4. Ball valves to be provided with union fittings on each end.
5. Acceptable manufacturers:
  - a) First named: Apollo 76F
  - b) Acceptable alternate: Watts S-FBV-1, Bray FlowTek Series S80

C. Size above 75mm

1. Materials:
  - a) Body: ASTM A351 CF8M
  - b) Stem: ASTM A276 Type 316
  - c) Seat: PTFE
  - d) Ball: Full port, ASTM A276 Type 316
2. Compatibility with Fittings: Flat Face Flanged, ANSI class 150.
3. Pressure Rating: 1380 kPa
4. Provide gear operator and handwheel
5. Acceptable manufacturers:
  - a) First named: Apollo 87A-200 Series
  - b) Acceptable alternate: Bray FlowTek Series F15

2.09 Flex Check Valves:

- A. Service: Pump discharge lines for sump pump and as shown on the Drawings
- B. Materials:
  1. Disc: Buna-N
- C. Compatibility with Fittings: Flanged ANSI Class 125
- D. Pressure Rating: 1200 kPa
- E. Provide mechanical valve position indicator
- F. Provide screwed backflow or backflushing actuator
- G. When installed in the vertical orientation, provide backflow or backflushing actuator.

- H. Provide oil filled cushion, surge protector or bottom mounted buffer
- I. Provide dry contact position sensors for full open and full closed indication.
- J. Acceptable manufacturer:
  - 1. First named: Val-Matic (Swing-Flex)
  - 2. Acceptable alternate: Cla-Val (Flex Check 584 series), deZuric-Apco (100, 100SR series), Pratt RD-Series

#### 2.10 Butterfly Valves (Process Water):

- A. Service: Exposed process water and aeration piping in buildings and chambers and as shown on the drawings.
- B. Materials:
  - 1. Body:
    - a) Below 300 mm: Cast iron with lug body
    - b) 300mm and above: Ductile iron with flanged ends
  - 2. Stem: AISI Type 304 with stainless steel, with self-lubricating bushings.
  - 3. Disc: Cast iron, ductile iron or bronze.
  - 4. Seat Ring: AISI Type 316 SS on iron discs
  - 5. Seat: EPDM, Hypalon, or Buna
  - 6. Coating: NSF 61 Certified, fusion bonded or two-part epoxy on interior and exterior.
- C. Compatibility with Fittings:
  - 1. Flanged, ANSI B16.1, Class 125 for interior piping.
- D. Conformance to Standards: AWWA C-504, Class 150B for all sizes.
- E. Actuator or hand wheel/lever to AWWA C504 and as shown on the drawings or indicated on valve list.
- F. Valves that are buried, in manholes, chambers or tanks the valve and operator shall be suitable for submerged use.
- G. Valves to be provided with operating nut extensions and operating wheel.
- H. Provide mechanical stops in the operator or on the valve body to limit the disc rotation between the fully open and fully closed positions.

- I. Provide extension stem and adjustable valve box for all direct buried valves or valves in chambers.
- J. Ensure that adjustable side of the seal is always oriented towards the accessible side (Victaulic coupling, gate, etc.)
- K. Wafer or lug body valves are not acceptable.
- L. Acceptable Manufacturers:
  - 1. First Named: Pratt
  - 2. Acceptable alternates: Clow, DeZurik (BAW), Mueller, VAL-Matic, Crispin, Golden Anderson

#### 2.11 Globe Valves:

- A. Service[SM1] [SH2] : Process air as shown on the drawings.
- B. Materials:
  - 1. Body: Stainless Steel 316
  - 2. Stem: Stainless Steel 316
  - 3. Disk: Stainless Steel 316
  - 4. Compatibility with Fittings:
    - a) 65 mm and smaller: threaded ANSI
    - b) 80 mm and larger: flanged ANSI B16.1 Class 125
- C. Temperature Rating: 10oC to 80oC
- D. Pressure Rating: 1380 kPa
- E. Non-rising stems for all globe valves unless otherwise shown on the drawings.
- F. Acceptable Manufacturers
  - 1. First named: Crane, Jamflow, Appollo, or approved equivalent

### PART 3 - EXECUTION

#### 3.01 Installation:

- A. Install valve supports, whether indicated on the Drawings or not, as necessary to adequately support the valves as shown and in conjunction with the piping system.
- B. Cover valves when not being installed, to prevent exposure of seals to sunlight or bright artificial light.

- C. Do not use the valve ports, handwheels or actuators as lifting points to install the valves.
- D. Do not rest valves on operating shafts, handwheels, cylinders or other parts prone to damage.
- E. Ensure that seals are adequately protected and will not become damaged during welding. Do not permanently weld pipe flanges on plug valves and butterfly valves. Tack welding for alignment purposes is acceptable.
- F. Align adjacent pipe flanges to ensure that they “match up” to valve flanges. Avoid realignment of pipe to make valve flanges fit which may cause excessive strain to be transmitted to valves.
- G. Inspect pipeline prior to installation and clean out foreign objects or debris that may be present.

### 3.02 Testing:

- A. Test valves as integral components of the piping system where they are located.

END OF SECTION 15100

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide thermal insulation for piping and piping accessories as shown on the drawings and specified herein.

### 1.03 Codes and Standards:

- A. Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

### 1.04 Definitions:

- A. "CONCEALED" means insulated mechanical services in suspended ceilings, non-accessible chases and furred-in spaces.
- B. "EXPOSED" means "not concealed" as defined herein.

### 1.05 Quality Assurance:

- A. Work to be performed by Heat and Frost Insulator Journeypersons and apprentices under their direction.
- B. Provide Certificate of Qualification and Certification of Apprenticeship on request.

## PART 2 - PRODUCTS

### 2.01 Insulation Requirements:

- A. Provide insulation on all systems listed below. Insulation is omitted from drawings for clarity.
- B. Insulation is not required on chrome plated piping and fittings.
- C. Do not insulate pipes buried deeper than 1.5 m to obvert unless shown on the drawings or specified.
- D. Insulate all pipes that are heat traced.
- E. All materials to meet maximum 25 flame spread and maximum 50 smoke developed ratings in accordance with CAN/ULC-S102 and NFPA 255.
- F. Surface temperature on the outside of insulation shall not exceed 66°C (150°F).
- G. Preformed Insulation: Sectional insulation up to NPS 12, sectional or curved segmented above NPS 12.

System	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
		<1	1 & <1.25	1.25 & <2	2 & <4	4 & <6	8 & over
Domestic hot water (DHW)	A-3	25	25	25	38	38	38
Domestic cold water (DCW) and service water	A-3	20	20	20	25	25	38
Condenser water (exterior)	A-3	50	50	65	65	65	65
Condenser water (interior)	A-3	25	25	25	25	25	25
Heat traced process lines	A-3	25	25	25	25	25	25
Cooling coil condensate drain	A-3	25	25	25	25	25	25
Blower outlet piping (interior)	A-3	25	25	25	25	25	25
Blower outlet piping (exterior above grade)	A-3	25	25	25	25	25	25
Refrigerant hot gas, liquid, suction	A-6	25	25	25	25	25	25
Refrigerant hot gas, liquid, suction	A-6	25	25	25	25	25	25

## 2.02 Material:

### A. TIAC Code A-3: Rigid moulded mineral fibre

1. Interior Concealed Acceptable Manufacturers:
  - a) Johns Manville Micro-Lok HP
  - b) Owens Corning Fiberglas SSL II with AJS Max
2. Interior Exposed Acceptable Manufacturer:
  - a) Johns Manville Micro-Lok HP with Zeston 2000 PVC jacketing
3. Exterior above grade Acceptable Manufacturers:
  - a) Insulation: Johns Manville Micro-Lok Plain
  - b) Jacket: ITW Pabco/Childers .016" (0.41mm) thick stucco embossed aluminum
4. Exterior buried Acceptable Manufacturers:
  - a) Insulation: Pittsburgh Corning FOAMGLAS ONE
  - b) Jacket: Pittwrap HS (heatseal)

- B. TIAC Code A-6: Flexible tubular elastomer.
  - 1. Interior Acceptable Manufacturers:
    - a) Armacell UT/Solaflex
    - b) K-Flex Insul-Tube
  - 2. Exterior Acceptable Manufacturer:
    - a) K-Flex Clad Al Tube
- C. Insulate expansion joints and bellows with 'FIRWIN' (416-745-9389) removable blanket insulation suitable for the service temperature.

### PART 3 - EXECUTION

#### 3.01 Pre- Installation Requirement:

- A. Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

#### 3.02 Installation:

- A. Install in accordance with TIAC National Standards.
- B. Include valves, valve bonnets, strainers, flanges and all fittings unless otherwise specified.
- C. Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- D. Do not use staples or screws.
- E. Extend insulation through sleeves in walls (except fire walls) or other openings to form continuous insulation and vapour barrier.
- F. Cut back existing insulation a sufficient distance to make/form a neat and firm butt joint between old and new insulation.
- G. Install hangers and supports outside vapour retarder jacket. Do not penetrate the vapour barrier or insulation with supports. Use saddles on all supports.
- H. Where piping is indicated to be heat traced, provide oversized insulation to accommodate heat tracing cable.
- I. Terminate insulation at each end of unions and flanges on hot lines.
- J. Vertical Pipe over NPS 3: Use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5 m centres and at each valve and flange.

- K. Expansion joints in insulation: terminate single layer and each layer of multiple layers in straight cut at intervals recommended by manufacturer. Leave void of 25 mm between terminations. Pack void lightly with P3 flexible mineral insulation. Install 'FIRWIN' (416-745-9389) removable blanket insulation properly on expansion joints/ bellows to allow adequate movement of expansion joint without damaging the insulation.

END OF SECTION 15260



## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Provide thermal insulation for ductwork as shown on the Drawings and specified herein.

### 1.03 Codes and Standards:

- A. Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

### 1.04 Definitions:

- A. "CONCEALED" means insulated mechanical services in suspended ceilings, non-accessible chases and furred-in spaces.
- B. "EXPOSED" means "not concealed" as defined herein.

### 1.05 Quality Assurance:

- A. Work to be performed by Heat and Frost Insulator Journeypersons and apprentices under their direction.
- A. Provide Certificate of Qualification and Certification of Apprenticeship on request.

## PART 2 - PRODUCTS

### 2.01 Insulation Requirements:

- A. Provide insulation on all systems listed below. Insulation is omitted from drawings for clarity.
- B. All materials to meet maximum 25 flame spread and maximum 50 smoke developed ratings in accordance with CAN/ULC-S102 and NFPA 255.

### 2.02 Acceptable Manufacturers:

#### A. First Named:

1. Rectangular Duct Insulation – Interior Exposed and Concealed: Manson AK Board with ASJ facing.
2. Finish – Interior Exposed:
  - a) Rectangular ducts: 186 g/m<sup>2</sup> fire retardant canvas lagged in place 75 mm overlap.

## B. Acceptable Alternate:

1. CertainTeed Corporation

**PART 3 - EXECUTION**

## 3.01 Installation:

- A. Install in accordance with TIAC National Standards.
- B. Board type insulation shall be butted firmly together and impaled over welded pins placed 300 mm to 450 mm on centres, minimum 2 rows per side and secured by speed clips. Seal seams with reinforced foil tape.
- C. Blanket type insulation shall be held in place with flame resistant quick tacking adhesive spot daubed at 150 mm centres or in 100 mm wide strips at 300 mm intervals. Secure flexible duct liner with welded pins only at 300 mm O.C. Ensure that the insulation does not sag or bulge.
- D. AK Flex insulation shall be banded in place with 12 mm stainless steel bands at 300 mm on centres. Where banding is impractical use welded pins and speed clips.
- E. Cover exposed duct insulation with 186 g/m<sup>2</sup> canvas neatly pasted on the 75 mm minimum overlap at joints. Lag in place and flow coat with fire retardant lagging adhesive.
- F. Cover exposed ductwork and plenums outdoors with fibreglass fabric lagged into a coat of specified vinyl acrylic mastic. Finish with a flow coat of the same mastic. As an alternative recover exposed ductwork using a self-adhesive five-ply aluminium foil/film facing 'VentureClad' 1577CW as manufactured by Venture Tape Corp.
- G. Apply duct insulation to the following in thickness shown:

Location	Thickness
Exhaust and relief ductwork at outside walls, from inside face of building wall or roof to 1.5 m upstream and including dampers and plenums.	50 mm
Outside/Fresh air intake ductwork including dampers and plenums	50 mm
Last 1.5 m of exhaust ductwork at outside wall or roof	50 mm

END OF SECTION 15270.

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide portable fire extinguishers as shown on the Drawings and specified herein.

### 1.03 Standards and Codes:

- A. Comply with the requirements of the Ontario Building Code, ANSI/NFFA-10 Portable Fire Extinguishers and authorities having jurisdiction.

### 1.04 Submittals:

- A. Submit shop drawings of all products specified in this Section.

## PART 2 - PRODUCTS

### 2.01 Material:

- A. Provide 10 lbs. dry chemical type fire extinguishers, 4A60BC, ULC labeled.
- B. Provide high impact flame retardant ABS surface and flush mount cabinet for each extinguisher. Colour to be red. Flame retardant. Model ECS-999

### 2.02 Acceptable Manufacturer:

- A. First named:
  - 1. Fire extinguisher: National Fire Equipment Ltd.
  - 2. Cabinet: National Fire Equipment Ltd.

## PART 3 - EXECUTION

### 3.01 Installation:

- A. Install the fire extinguishers as shown on the contract drawings.

END OF SECTION 15304

## PART 1 - GENERAL

A. Section 15000 applies to and governs the work under this Section.

### 1.02 Work Included:

A. Provide:

1. Domestic hot and cold-water systems.
2. Plumbing fixtures and drainage control equipment.
3. Quality Assurance:

B. Comply with the requirements of the Ontario Building Code Part 7, the National Plumbing Code and all local requirements. Submit drawings and specifications to Authorities Having Jurisdiction and arrange and pay for required permits. Adjust work as required to obtain approvals.

### 1.03 Submittals:

A. Submit shop drawings for:

1. Layout of plumbing systems including vents
2. Domestic hot water heaters
3. Tempered Water mixing stations
4. Plumbing fixtures

## PART 2 - PRODUCTS

### 2.01 Pipe and Fittings:

A. See Pipe Schedule in this Section.

B. Unions:

1. Provide unions to facilitate the removal of equipment for service. Use threaded, all bronze unions with ground seat, 1,034 kPa rating.

## PART 3 - EXECUTION

### 3.01 General Installation:

A. The Drawings indicate the general location and route to be followed by piping. Piping is shown diagrammatically and except where definite locating dimensions are given, pipes and fittings shall be installed in such a way as to conserve headroom, to allow proper and convenient servicing of equipment and to interfere as little as possible with the free use of the space throughout which they pass.

- B. Provide a layout that gives easy access to all equipment requiring adjustment or maintenance.
- C. The mechanical Contract Drawings do not show all structural, process, electrical or architectural details. Consult all Contract Drawings and take field measurements to confirm layout.
- D. Install cleanouts as indicated in the Contract Drawings, and in accordance with the Ontario Building Code. Provide a cleanout inside the building as close as possible to the location where the building drain exits the building. Provide access for all cleanouts to facilitate regular cleaning.

### 3.02 Electrical and Control Equipment:

- A. Do not install any plumbing or drainage inside electrical, control, communications, or generator rooms unless providing service to the room.
- B. Avoid installation of any plumbing or drainage above electrical equipment and cables; maintain minimum separation from electrical equipment and cables.

### 3.03 Testing:

- A. Test pressure shall be 1,050 kPa and shall be held for two hours without loss.
- B. Drains shall be tested as required by the local Plumbing Inspector and the Ontario/National Building Code.
- C. Provide the Engineer with 48 hours' notice of tests.

### 3.04 Pipe Schedule:

Service	Nominal Size mm	Pipe Material	Pipe Fittings	Pipe Joint	Max W.P. kPa	Specification No.
Sanitary Drainage Exposed	100 150 200	Cast-iron/ PVC Type DWV	Cast-iron/ PVC	Hub & Spigot or M.J./ Press or Solvent Welded	-	15069, 15065
Condensate Drainage	25 32	Copper Type 'K'	Copper Cast Brass	Solder 95/5	-	15063
Sanitary Drainage Buried	100 150 200 250	Cast-iron		Hub & Spigot Gasketed		15069

Service	Nominal Size mm	Pipe Material	Pipe Fittings	Pipe Joint	Max W.P. kPa	Specification No.
Domestic Water	80 50 40 32 25	Copper Type `K' or `L'	Copper/ Cast Brass	Solder 95/5	1,034	15063

END OF SECTION 15400

## PART 1 - GENERAL

### 1.01 Governing Conditions:

- A. The General Conditions, Supplemental Conditions, Form of Tender, Information for Tenderers, and the requirements of Division 1, in addition to all Addenda, apply to and govern each Section of this Division.

### 1.02 Reference:

- A. This Section of the Specifications shall be read in conjunction with Section 15000 - General Mechanical Clauses, which shall apply to and govern the work under this Section.

### 1.03 Description:

#### A. Work Included:

- 1. Supply and installation of domestic water heater(s) as specified and shown on the Drawings.

#### B. Related Work Described Elsewhere:

- 1. Plumbing - Section 15400
- 2. Electrical - Division 16

### 1.04 Quality Assurance:

- A. Comply with the requirements of the Ontario Plumbing Code and the Canadian Plumbing Code, CSA B-51 latest version and all local requirements.

### 1.05 Submittals:

- A. Submit shop drawings of Domestic Water Heaters.

## PART 2 - PRODUCTS

### 2.01 Materials:

- A. Domestic electric hot water heater, CSA approved, 1034 kPa rated, glass lined, magnesium anode rod, fiberglass insulated steel tank with a drain valve, temperature and pressure relief valve, an adjustable thermostat with over-temperature protection, outer casing with baked enamel finish.

#### B. Ratings:

- 1. HWT-101, Rheem Heavy Duty Electric Commercial Water Heater, Model As per the Contract Drawings.

2.02 Alternate Approved Manufacturers:

- A. Equivalent equipment by A.O. Smith or John Wood equally acceptable.

PART 3 - EXECUTION

3.01 Installation:

- A. Install water heater(s) in location shown.
- B. Pipe relief valve to within 150 mm of finished floor.
- C. Provide disconnects at the location of the tanks.
- D. Adjust thermostats of both tanks to 71°C to have enough tempered water available for the emergency showers.

END OF SECTION 15424.



## PART 1 - GENERAL

### 1.01 Reference:

- A. This Section of the Specifications shall be read in conjunction with Section 15000 - General Mechanical Clauses, which shall apply to and govern the work under this Section.

### 1.02 Work Included:

- A. Supply and install all plumbing fixtures and miscellaneous items specified herein at the locations indicated on the Drawings.

### 1.03 Related Work:

- A. Plumbing and Drainage - Section 15400
- B. Electrical - Division 16

### 1.04 Quality Assurance:

- A. Fixtures shall be free of flaws or imperfections of any kind. Imperfections on any fixture shall be sufficient reason for rejection and such fixtures shall be replaced at the Contractor's expense. All fixtures, fittings and trim shall be CSA certified.

### 1.05 Submittals:

- A. Submit certified shop drawings of all products specified.

## PART 2 - PRODUCTS

### 2.01 Materials:

- A. Emergency Eye/Face Wash/Shower Combination 'EW/SH' or EW-SH

- 1. Bradley Halo Model S19314FW with bright yellow plastic bowl and shower head; shower valve operated by pull rod and triangular handle, pipe stand with floor flange, eyewash bowl, with twin, soft flow eyewash heads and protective spray head covers, face spray ring, integral flow control, flow switch MODEL S19-319D, hand and foot operated assembly with stay-open ball valve, sign, trap, waste tail piece, 32 mm water supply and 32 mm waste. Provide this fixture to match all the requirements of latest edition of ANSI Z358.1 "Standard for Emergency Eyewash and Shower Equipment". Haws products are equally acceptable

- B. Tempered Water Mixing System 'TWMS'

- 1. Bradley Model S19-2200-STD-PA-IO-SS, emergency fixture water mixing valve shall consist of liquid filled thermal motor and a piston control mechanism with positive shut-off of hot water when cold water supply is lost to prevent scalding. The valve shall allow cold-water flow in the event of loss or interruption of the hot water supply or thermostatic failure. The valve shall control outlet temperature

over a wide flow range and shall be suitable for drench shower and/or eyewash applications. Provide lockable surface mounted stainless steel cabinet to house this water mixing system including isolation valves on piping. Approved equals by Haws, Leonard or Powers are acceptable.

C. Hose Bibs 'HB'

1. Acorn "NEPTUNE" #8121 CP Hose Valve, C.P. heavy duty polished cast brass body with integral cast flange, vandal-resistant lock shield bonnet with removable wheel handle, 19mm NPT female inlet and hose end vacuum breaker.

D. Expansion Tank 'EXT'

1. Tanks to meet ASME standard.
2. Tank to be NSF61 for potable water applications.
3. The tanks shall comply with the condition of service requirements indicated below:

Application	DCW system
Number of tanks required	1
Pre-charge pressure, psi	38
System fill pressure, psi	40
Tank design pressure, psi	150
Minimum operating temperature, C	30
Maximum operating temperature, C	80
System volume, L	Refer to the Contract Drawing

4. Acceptable Manufacturers:
  - a) A.O. Smith.PMI Series
  - b) Bell & Gossett ASME WTA
  - c) Taco CA series
  - d) Armstrong ASME series

### PART 3 - EXECUTION

3.01 Examination:

A. Inspection:

- B. Before installation of the work of this Section, carefully inspect the installed work of other trades and verify that all such work is complete to the point where this installation may commence properly.
- C. Verify that the plumbing fixtures may be installed in strict compliance with all pertinent codes and regulations and in accordance with the design.
- D. Discrepancies:
- E. In the event of a discrepancy, immediately notify the Engineer.
- F. Do not proceed with installation in areas of a discrepancy until all such discrepancies have been resolved.

### 3.02 Installation:

- A. Install and connect plumbing fixtures. Furnish supports required to set the fixtures.
- B. Fit escutcheons on service connections to fixtures where they pass through the walls or floors. Escutcheons shall be chrome-plated brass with setscrew. Split stamped escutcheons will not be accepted.
- C. Remove all paper, marks and nametags and clean out all traps. Protect all fixtures to prevent waste of any kind being poured down them during construction.

### 3.03 Emergency Eye/ Face wash/Shower Combinations:

- A. Exercise the emergency eyewash/shower units at least once a month for the period it takes to get mixed temperature water to the eyewash and showers. This will make sure the mixing valve is exercised and will not stick in one position and is ready for emergencies. Install Emergency Eyewash/Shower Combination unit to match all the requirements of latest edition, ANSI Z358.1 "Standard for Emergency Eyewash and Shower Equipment".

END OF SECTION 15450.

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 15000 applies to and governs the Work of this Section.

## 1.02 Work Included:

- A. Provide Indoor Air Conditioner (AC) and Outdoor Condensing Unit (CU) as shown on the Drawings and specified herein.

## 1.03 Codes and Standards:

- A. Equipment to meet the following codes:
  1. ASME B31.5, Refrigeration piping and heat transfer components
  2. CSA B52, Mechanical refrigeration code
  3. Province of Ontario boiler, pressure vessel and compressed gas regulations (TSSA)

## 1.04 Submittals:

- A. Provide a copy of this specification section, addenda and referenced sections with each paragraph check-marked to indicate compliance. Check marks (✓) shall denote full compliance with a paragraph. Underline all deviations and provide a detailed justification for each deviation.
- B. Submit the following:
  1. Complete specifications of systems.
  2. Piping diagrams with piping lengths.
  3. Refrigerant charge per system including CSA B52 analysis.
  4. Equipment, filters, auxiliaries and hardware and recommended ancillaries, which are mounted, wired and piped ready for final connections.
  5. Complete internal panel wiring and any external panel wiring, both as schematics and as actually assembled.
  6. Dimensions, and construction details, recommended method of installation with proposed support, sizes and location of mounting bolt holes.

## 1.05 Maintenance Data:

- A. Provide brief description of the systems and include same at beginning of maintenance manual, properly indexed with details of function, operation, control and service for each piece of apparatus.

- B. Include names and addresses of spare parts suppliers.
- C. Ensure that maintenance data consists of more than general advertising information. Include the following:
  - 1. Provide manufacturer's name, type, year, serial number, capacity and identification to related systems.

#### 1.06 Quality Assurance:

- A. Equipment to be CSA certified.
- B. Wiring to be in compliance with the National Electrical Code (NEC).
- C. Ensure that the units are rated in accordance with ARI Standard 210 and bear the ARI label.
- D. Ensure that system efficiency meets the minimum efficiency requirement of the latest edition of ASHRAE 90.1

#### 1.07 Warranty:

- A. Provide a manufacturer's warranty for a period of one (1) year from date of installation for the Split Systems. Provide a minimum warranty of five (5) years from the date of installation for the compressor.

## PART 2 - PRODUCTS

#### 2.01 System Description:

- A. Indoor/outdoor Split Systems, consisting of one indoor fan-coil unit, one outdoor condensing unit with rotary compressor and required refrigerant piping/tubing.
  - 1. Ensure that the unit is listed and rated per ANSI/AHRI Standard 1230-2010 and meets or exceeds minimum IEER performance requirements as scheduled.
  - 2. Provide units CSA approved, ANSI/UL STD 1995 and ETL listed and bearing the cETL label.
  - 3. Wiring to be in accordance with the NEC.
  - 4. Have the units manufactured in an ISO 9001 and ISO 14001 certified facility.
  - 5. Equipment to comply with CSA B52.

#### 2.02 Equipment, Refrigerant Tubing and Condensate Pump:

- A. Indoor Air Conditioner (AC):
  - 1. General:

- a) Provide AC factory assembled, wired and run tested, piped and wired internally ready for field connections.
  - b) Provide the AC with a self-diagnostic function, 3-minute time delay mechanism, an auto start function, and emergency operation function and a test run switch.
  - c) Provide the AC with a capacity control from 25% to 100%.
2. Air Filters:
- a) Filter the return air by means of easily removable washable filters.
3. Coil:
- a) Evaporator coil - non-ferrous construction with aluminum plate fins on copper tubing.
  - b) Tube joints - brazed with phoscopper or silver alloy.
  - c) Pressure test the coils at the factory and provide certified test reports to the Engineer.
  - d) Provide a condensate pan with drain under the coil. Drain to be insulated and piped to nearest sanitary drain.

B. Outdoor Condensing Unit (CU):

1. General:
  - a) CU air-cooled condensing system with a variable speed inverter-driven scroll compressor using R-410A refrigerant.
  - b) Ensure that the unit is specifically designed for use with the indoor evaporators and matches it's capacity.
  - c) Provide the CU with customizable operating modes featuring manual setting of target evaporating and condensing temperatures.
  - d) Ensure that the CU is equipped with a circuit board that interfaces to the indoor unit and performs all functions necessary for proper operation.
  - e) Provide the CU completely factory assembled, piped and wired ready for field connections. Test run each unit at the factory and provide certified test reports to the Engineer.
  - f) Provide the CU with a capacity control from 8% to 108%.
  - g) If the CU is a cooling only system (without heat-pump), ensure that it is capable of operating to minus 40°C ultra-low ambient temperature.

- h) Refrigerant circuit to include all inverter scroll compressors, motors, fans, coils, electronic expansion valves, solenoid valves, 4-way valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, liquid receiver and suction accumulator.
2. Unit Cabinet:
- a) Casing to be fabricated of galvanized steel, bonderized and finished with a powder-coated baked enamel.
3. Fan:
- a) Provide the unit with one or more propeller-type fans, direct drive 350W or 750W with a motor sized for an ESP of 0.32 inches WC.
  - b) Provide night setback control.
  - c) Motor to have inherent protection and permanently lubricated bearings.
  - d) Fan motor to be mounted for quiet operation.
  - e) Fan to have a raised guard to prevent contact with moving parts.
  - f) The outdoor unit to have horizontal discharge airflow.
4. Coil:
- a) CU coils - fabricated from copper tubes expanded into fins.
  - b) Heat exchanger on the CUs - manufactured from Hi-X seamless copper with N-shape internal grooves. Fins to be covered with anti-corrosion coating.
  - c) Treat pipe plates with powdered polyester resin. Finished resin thickness - 2 to 3 microns.
  - d) Coil to be protected with an integral metal guard.
  - e) Control refrigerant flow from the compressor by means of a metering device.
5. Compressors:
- a) Compressors shall be inverter scroll-type.
  - b) Compressor to be capable of changing speed to follow variations in total heating and cooling load as determined by the suction gas pressure as measured in the condensing unit.
  - c) Sampling of evaporator and condenser temperatures to be made every 20 seconds.

- d) The inverter-driven compressor to be high efficiency reluctance DC, hermetically sealed scroll G or J type.
- e) Provide neodymium magnets in the rotor construction.
- f) Provide compressor motors with a cooling system using discharge gas to avoid sudden changes in temperature.
- g) Equip each compressor with a crankcase heater, high pressure switch, and thermal overload protector.

C. Refrigerant piping:

- 1. Refrigerant piping shall be copper to comply with ASTM B280 ACR.
- 2. Refrigerant piping up to 5/8 inch dia. to be type L; piping above 5/8 inch dia. to be type K copper.
- 3. Brazing rods for joints to be 15% silfoss.
- 4. Use Y style piping joints from the manufacturer only.
- 5. Provide isolation valves on both indoor and outdoor unit refrigerant lines. The valves to be bi-flow self-seating valves rated for R-410A with operating pressures up to 650 psi.

D. Controls:

- 1. AC to be provided with individual zone controller.
- 2. Controller to be able to function as follows:
  - a) The controller is to have dual or single Cool and Heat setpoints for occupied periods, and independent setback setpoints for unoccupied periods.
  - b) The controller to have the ability to digitally prohibit individual buttons and functions.
  - c) The controller to have a self-diagnosis function that constantly monitors the system for malfunctions (total of 80 components).
  - d) Provide an LCD digital display to allow the temperature to be set in 1°F units.
  - e) The controller to be equipped with a thermostat sensor.
  - f) The controller to have the ability to automatically changeover the mode of operation with dual or single setpoints.
  - g) Controller to have built-in 7 day, weekday plus Saturday Sunday (5+1+1), weekday plus weekend (5+2) and everyday (1) scheduler.



- h) Controller to have a simple display mode, displaying only the operation mode, the setpoint(s), and the room temperature.
- E. The system to automatically restart after a power failure without any reprogramming.
- F. Provide the following safety devices: high/low pressure sensor and switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protection for compressor and fan motors,
- G. Oil recovery cycle to occur automatically 2 hours after start and then 8 hours after.
- H. Electrical:
  - 1. Provide the power supply to the condensing unit as scheduled.
  - 2. Provide independent electrical power for fan coils 120/208/230 volts, single phase, 60 hertz.
  - 3. Individual breakers and disconnect switches for each fan coil are required, and are to be provided and installed under Division 16.
  - 4. Electrical power for condensing units to be 208/230/600 volts, 3 phase, 60 hertz.
  - 5. The control voltage between the indoor and outdoor unit to be 16VDC non-shielded 2-conductor cable.
  - 6. Provide control wiring - two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-cable wire, thus simplifying the wiring operation.
  - 7. Install control in a daisy chain configuration from indoor unit to indoor unit then to the outdoor unit. Control wiring to run from the indoor unit terminal block to the specific controller for that unit.

### 2.03 Acceptable Manufacturer:

- A. As per Contract Drawings.

## PART 3 - EXECUTION

### 3.01 Installation:

- A. Installation contractor to be TSSA-certified. Register the project with TSSA. Provide the TSSA Certificate of Authorization as part of the Operation and Maintenance manuals.
- B. Ensure that the installation, including safety pressure relief valves, conforms to CSA B52 and ASME B31.5. Welding material and procedures to comply with ASME Section 9.
- C. Provide split HVAC systems complete in all details, together with minor details not specifically mentioned or shown but which may be reasonably inferred as necessary to complete each portion and place in successful operating service.

- D. Follow manufacturer's installation instructions in regard to supports, refrigerant piping installation and insulation, condensate drainage and controls. Coordinate location of equipment with all trades as not to interfere with new equipment locations.
- E. Use refrigeration best practice to allow for expansion and contraction.
- F. Pressure test systems to 550 psi.
- G. Provide wiring recommended by the manufacturer.
- H. Identification:
  - 1. Provide engraved lamacoid plates for equipment provided under this Section. White background and black letters 7mm high. Fasten mechanically with screws or rivets.

### 3.02 Quality Assurance:

- A. Brazed joints to feature nitrogen purging to minimize oxidation.
- B. Do not install third party components in field piping.
- C. Insulate indoor high/low pressure gas lines, liquid and suction lines individually with a minimum ½ inch thickness.
- D. Insulate outdoor high/low pressure gas lines, liquid and suction lines individually with a minimum ¾ inch thickness. Protect exposed insulation using aluminum, sheet metal, canvas, plastic cover or painted with UV coating.
- E. Provide pipe clamps and pipe supports a maximum of 6 feet apart.
- F. Coordinate with the manufacturer final pipe lengths for refrigerant charge estimation. Charge the system before manufacturer's commissioning.
- G. Install all oil traps as requested by the manufacturer
- H. Use liquid refrigerant to charge the system.

### 3.03 Start-Up:

- A. The manufacturer to provide a factory-trained service technician to start-up each unit.
- B. The manufacturer to provide instruction to the Owner on proper unit operation and maintenance.

END OF SECTION 15670

## PART 1 - GENERAL

### 1.01 Governing Conditions:

- A. The General Conditions, Supplemental Conditions, Form of Tender, Information for Tenderers, and the requirements of Division 1, in addition to all Addenda, apply to and govern each Section of this Division.

### 1.02 Reference:

- A. This Section of the Specifications shall be read in conjunction with Section 15000 - General Mechanical Clauses, which shall apply to and govern the work under this Section.

### 1.03 Work Included:

- A. Ductwork, low pressure to 500 Pa.
- B. Install automatic dampers supplied by Section 15900 as directed by that Section.

### 1.04 Standards:

- A. SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- B. SMACNA HVAC Duct Leakage Test Manual.
- C. ASHRAE Handbook, Fundamentals, and Systems Volumes.

### 1.05 Shop Drawings and Product Data:

- A. Submit shop drawings and product data in accordance with Section 01300 - Submittals.
- B. Indicate following:
  - 1. Sealants
  - 2. Tape
  - 3. Proprietary Joints
- C. Submit shop fabrication drawings and installation drawings of any portion of the ventilation system as may be requested by the Engineer to show the work as it relates to other trades.

## PART 2 - PRODUCTS

### 2.01 Ductwork sealing classification as follows:

<u>Maximum</u>	<u>SMACNA</u>
<u>Pressure</u>	<u>Seal</u>

---

<u>Pa</u>	<u>Class</u>
500	C
250	C
125	C
125	Unsealed

2.02 Seal Classification:

- A. Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- B. Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
- C. Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed.
- D. Unsealed seams and joints.

2.03 Sealants and Tapes:

- A. See Section 15820 - Duct Accessories for sealants, tapes and application.

2.04 Duct Leakage:

- A. In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.05 Fittings:

- A. Fabrication: to SMACNA.
- B. Radiused elbows: standard radius or short radius with single thickness turning vanes.
- C. Square elbows: to 400 mm with single thickness vanes.
- D. Square elbows: over 400 mm with double thickness vanes.
- E. Main supply duct branches with splitter damper. If splitter damper not used provide branch and main duct dampers.
- F. Sub branch duct with 45° entry and balancing damper on branch or sub branch duct with square connection, volume extractor and branch duct balancing damper.
- G. Transitions:
  - 1. Diverging: 15° maximum included angle.
  - 2. Converging: 30° maximum included angle.

- H. Offsets: square elbows with vanes or full radiused elbows as indicated.
- I. Obstruction deflectors: maintain full cross sectional area. Maximum included angles as for transitions.

#### 2.06 Fire Stopping:

- A. Retaining angles all around duct, on both sides of fire separation.
- B. Fire stopping material and installation must not distort duct.

#### 2.07 Galvanized Steel:

- A. Lock forming quality: to ASTM A52SM-86, Z90 zinc coating.
- B. Thickness: to ASHRAE and SMACNA.
- C. Fabrication: to ASHRAE and SMACNA.
- D. Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
  - 1. Acceptable material for proprietary joints: Ductmate Canada Ltd - or Exanno Nexus.

#### 2.08 Hangers and Supports:

- A. Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
- B. Hanger configuration: to ASHRAE and SMACNA. Maximum size duct supported by straphanger: 500 mm.
- C. Hangers:
  - 1. Dry Locations: black steel angle with black steel rods as listed below.
  - 2. Damp Locations: Stainless steel angle with stainless steel rods as listed below. (Screen and Grit building)

Duct Size	Angle Size	Rod Size	
	(mm)	(mm)	(mm)
up to 750		25x25x3	6
751 to 1050		40x40x3	6
1051 to 1500		40x40x3	10
1501 to 2100		50x50x3	10

2101 to 2400	50x50x5	10
2401 and over	50x50x6	10

D. Upper hanger attachments:

1. For concrete: manufactured concrete inserts.  
Acceptable material: Anvil fig. 152 or fig. 282.
2. For steel joist: manufactured Joist clamp or steel plate washer.  
Acceptable material: Anvil fig. 60 for plate washer.
3. For steel beams: manufactured beam clamps:  
Acceptable material: Anvil fig. 86 or fig. 95

### PART 3 - EXECUTION

3.01 General:

- A. Install ducts in accordance with ASHRAE and SMACNA as indicated.
- B. Do not break continuity of insulation vapor barrier with hangers or rods. Insulate straphangers 100 mm beyond insulated duct (cold ducts only).
- C. Support risers in accordance with ASHRAE and SMACNA as indicated.
- D. Install breakaway joints in ductwork on each side of fire separations.

3.02 Hangers:

- A. Strap hangers: install in accordance with SMACNA.
- B. Angle hangers: complete with locking nuts and washers.
- C. Hanger spacing: as follows: Duct Size / Spacing

<u>(mm)</u>	<u>(mm)</u>
to 1500	3000
1501 and over	2500

3.03 Watertight Duct:

- A. Provide watertight duct for:
  1. Fresh air intake.
  2. Wash/shower room exhaust.

- B. Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.
- C. Slope horizontal branch ductwork down towards fume hoods served. Slope header ducts down toward risers.

#### 3.04 Leakage Tests:

- A. In accordance with SMACNA HVAC Duct Leakage Test Manual, 1985.
- B. Make trial leak test to demonstrate workmanship.
- C. Install no additional ductwork until trial test has been passed.
- D. Test section minimum of 30 m long with not less than 3 branch takeoffs and 2 90° elbows.

#### 3.05 Motorized Dampers:

- A. Install motorized dampers supplied by Section 15900 as directed by that Section.

END OF SECTION 15801.

## PART 1 - GENERAL

### 1.01 Governing Conditions:

- A. The General Conditions, Supplemental Conditions, Form of Tender, Information for Tenderers, and the requirements of Division 1, in addition to all Addenda, apply to and govern each Section of this Division.

### 1.02 Reference:

- A. Section 15000 applies to and governs the work under this Section.

### 1.03 Work Included:

- A. Ductwork accessories.

### 1.04 Shop Drawings:

- A. Submit shop drawings in accordance with Section 01300 Submittals.
- B. Indicate:
- C. Flexible connections.
- D. Sealants and tapes.
- E. Certification of Ratings:
- F. Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

### 1.05 Maintenance Data:

- A. Provide maintenance data for incorporation into manual specified in Section 01700 - Contract Close-out.

## PART 2 - PRODUCTS

### 2.01 Flexible Connections:

- A. Frame: galvanized sheet metal frame .667 mm thick with fabric clenched by means of double locked seams.
- B. Material: Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1.3 kg/m<sup>3</sup>.
- C. Connectors shall have a flame-spread rating of not over 25 without evidence of continued progressive combustion and a smoke-developed rating of not over 50 as per test conducted in accordance with ASTM E84, NFPA 255.



## 2.02 Sealant:

- A. Oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.
- B. All duct joints shall be sealed according to SMACNA Duct Construction Standard.
- C. Sealant shall have a flame-spread rating of not over 25 on any exposed surface in any direction and a smoke-developed rating of not over 50 as per test conducted in accordance with ASTM E84, NFPA 255
- D. Acceptable material:
- E. Applied during assembly: Duro Dyne S-2 or Foster 30-02.
- F. Applied after assembly: Transcontinental Equipment Limited (416) 661-6226 "Multi-Purpose" applied with "Permascreen" open weave poly tape.

## 2.03 Tape:

- A. Polyvinyl treated, open weave fiberglass tape, 50 mm wide.
- B. Tape shall have a flame-spread rating of not over 25 on any exposed surface in any direction and a smoke-developed rating of not over 50 as per test conducted in accordance with ASTM E84, NFPA 255.
- C. Acceptable material: Duro Dyne FT-2.

**PART 3 - EXECUTION**

## 3.01 Flexible connections:

- A. Install in following locations:
- B. Inlets and outlets to supply air units and fans.
- C. Inlets and outlets of exhaust and return air fans.
- D. Length of connection: 100 mm.
- E. Minimum distance between metal parts when system in operation: 75 mm.
- F. Install in accordance with recommendations of SMACNA and the manufacturer of equipment connected on both ends through duct work.
- G. When fan is running:
- H. Ducting on each side of flexible connection to be in alignment.
- I. Ensure slack material in flexible connection.

## 3.02 Sealing and Taping:

- A. Apply sealant to outside of joint to manufacturer's recommendations.
- B. Bed tape in sealant and re-coat with minimum of [1] coat of sealant to manufacturers recommendations.

END OF SECTION 15820.

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide balancing dampers as shown on the Drawings and specified herein.

### 1.03 Standards:

- A. SMACNA HVAC Duct Construction Standards, Metal and Flexible, except where specified otherwise.

## PART 2 - PRODUCTS

### 2.01 All Balancing Dampers:

- A. Provide a locking manual quadrant.
- B. For all insulated duct provide a standoff bracket sized for the insulation thickness.
- C. Provide oilite bronze or synthetic bearings.
- D. To be factory manufactured.

### 2.02 Acceptable Manufacturers for Single and Multi-Blade Dampers:

- A. First Named: Greenheck
- B. Acceptable alternates: Ruskin, Nailor

## PART 3 - EXECUTION

### 3.01 Installation:

- A. For supply, return and exhaust systems, balancing dampers are to be located in each branch duct. For each grille, register and diffuser connection the balancing damper is to be located as close as possible to the main ducts to minimize noise at the diffuser. Install one balancing damper in the main duct if no branch is connected to the main duct. Provide a balancing damper on every duct terminated without a volume damper, grille, diffuser or register.
- B. Install at safe distance from transitions, fittings, equipment, sensors and any accessories to avoid interferences for full operation from 100% closed position to 100% open position.
- C. Tighten quadrant locks to maintain the damper position after air balancing.
- D. Provide a separate screw to permanently lock the position setting of all dampers installed to convey outside supply air once balancing is complete.

END OF SECTION 15825

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Provide electric heating units as shown on the Contract Drawings and specified herein.
- B. Wiring to be completed under Division 16.

### 1.03 Submittals:

- A. Submit drawings for heaters. Include installation instructions and mounting details.

## PART 2 - PRODUCTS

### 2.01 Materials:

- A. Provide manufacturer supplied disconnect switch, fan switch and pilot light. All accessories to match electrical classification of heater.
- B. Provide remote wall mounted thermostat
- C. Provide manufacturer supplied built-in thermostat.
- D. For explosion proof classified locations provide explosion proof wall mounted thermostat and explosion proof built-in disconnect switch. Heaters and all accessories shall be suitable for Class –1, Div–1, Group-D hazardous area.
- E. All heaters shall be provided with built in overload relay, contactor, local disconnect, control transformer and ON/OFF indication.
- F. Provide heater with OSHA approved blade guard.
- G. For units installed in any location with exposed process liquids or chemical storage, provide a chemically resistant coating on coils, heat exchangers, louvers, fan blades, fan guard and all exposed metal parts.
- H. Approved manufacturers: as per the Contract Drawings.
  - 1. Ouellette
  - 2. Ruffneck

## PART 3 - EXECUTION

### 3.01 Installation:

- A. Mounting hardware, brackets and fasteners to be 316 stainless steel. Provide manufacturer supplied mounting brackets.

- B. Minimum mounting height above floor for unit heaters is 2.1m.

END OF SECTION 15830.

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 15000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Provide Fans, as shown on the Drawings and specified herein.

### 1.03 Codes and Standards:

- A. AMCA Fan Room Sound Test Codes.
- B. ANSI/AMCA Fan Rating Test Codes.
- C. AMCA Fan Sound Test Codes.
- D. ANSI/ASHRAE Fan Rating Test Codes.

### 1.04 Submittals:

- A. Provide a copy of this specification section, addenda and referenced sections with each paragraph check-marked to indicate compliance. Check marks (✓) shall denote full compliance with a paragraph. Underline all deviations and provide a detailed justification for each deviation.
- B. Submit:
  - 1. Equipment performance ratings, duct and power connections.
  - 2. Dimensions, construction details, installation recommendations, support.
  - 3. Fan curves with point of operation, sound data, required power and voltage.

## PART 2 - PRODUCTS

### 2.01 General:

- A. Capacity, static pressure, RPM, power, model and sizes as shown in the schedules.
- B. Units shall bear AMCA certified sound rating and performance seals.
- C. Fans shall be statically and dynamically balanced and constructed in conformity with AMCA codes.
- D. Drives shall be designed for 150% of motor nameplate rating.
- E. Fan motor shall be VFD rated where indicated in the drawing, schedule, sequence of operations or in the schematic drawing.

- F. Fan motor shall be two speed where indicated in the drawing, schedule, sequence of operations or in the schematic drawing.
- G. Fan and motor/starter electrical classification to match the area where it is installed as per the Contract Drawings.
- H. All fans without ducts or dampers on inlet or outlet including fans in plenums shall have protective screens on openings.
- I. Provide vibration isolators.
- J. Provide fans for each type from one manufacturer.
- K. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number.
- L. All fans to have factory installed disconnects.
- M. Flame spread rating of FRP used in exhaust fans shall not be more than 25 in conformance with CAN/ULC-S102.2
- N. Provide OSHA fan guards for all fans installed within 2.5m of floor.

#### 2.02 Roof Exhaust Fans:

- A. Spun aluminum housing with a rigid internal support structure, backwards inclined aluminum centrifugal fan and bird screen.
- B. Resilient mounted fan and motor complete with factory installed and wired disconnect switch under hood.
- C. Direct drive or belt drive, standard or up-blast with models and types as scheduled.
- D. Fans shall bear the AMCA seal and manufacturers nameplate containing the model number and serial number.
- E. Acceptable Manufacturers:
  - 1. First Named: Greenheck
  - 2. Acceptable Alternates: Penn, Loren Cook, Carnes.

#### 2.03 Wall Propeller Fans:

- A. Direct driven fan with high efficiency venturi inlet and aerodynamically designed blades to reduce incoming air turbulence.
- B. Fans to have the following features:
  - 1. Permanently lubricated sealed ball bearings
  - 2. 100% speed controllable.



3. External rotor motor with automatic reset thermal overload protection.
  4. Formed galvanized steel wall panel with venture features and baked powder coat finish
  5. Suitable for airstreams up to 38°C
  6. Tested and approved by UL and CSA.
  7. Terminal box with pre-wired electrical strip.
  8. Three year warranty.
- C. Provide back draft dampers where indicated.
- D. Acceptable Manufacturers:
1. First Named: Greenheck
  2. Acceptable Alternates: Penn, Loren Cook, Carnes.
- 2.04 In-line Centrifugal Fans:
- A. Characteristics: for centrifugal fans construction.
  - B. Casing: All Aluminum construction.
  - C. Wheel: Aluminium backwards inclined and aerodynamic straightening vanes.
  - D. Drive: belt drive or direct drive as indicated.
  - E. Capacity and Classification as shown on the drawings.
  - F. Special coatings as shown in the schedule.
  - G. Acceptable Manufacturers:
1. First Named: Greenheck
  2. Acceptable Alternates: Penn, Carnes.

### PART 3 - EXECUTION

#### 3.01 Fan Installation:

- A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions. All equipment shall be installed level and plumb. Fan, motors and enclosures shall be anchor-bolted to a concrete pad. All grounding strap shall be tied to a suitable ground.

#### 3.02 Field testing:

- A. The equipment shall be tested in operation to demonstrate smooth operation, freedom from vibration and objectionable noise, and to demonstrate conformance to the specified ratings.

3.03 Field painting:

- A. Equipment shall be field painted in accordance with the Contract Documents, except that fiberglass materials shall not be painted. Fiberglass color shall be impregnated in the exterior gel coat.

END OF SECTION 15860.

PART 1 - GENERAL

## 1.01 Reference:

- A. This Section 15000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Provide all components required to complete temperature control systems as shown on the Contract Drawings and specified herein.
  - 1. Automatic Temperature Controls and Interlocks.
  - 2. Motorized dampers.
  - 3. Air conditioning systems.
  - 4. Fans.

## 1.03 Related Work:

- A. Power wiring up to equipment terminals, disconnect switches and terminal boxes is specified under Division 16.
- B. Process and Service Valves 15100

## 1.04 Quality Assurance:

- A. The work under this Section shall be performed by a recognized Design and Contracting Firm regularly employed in the manufacturing and installation of electric, electronic, and pneumatic temperature control equipment. The Automatic Controls contractor shall be Automation Engineering Associates Ltd (416 252-5069), Siemens Landis Division, Johnson Controls Ltd., or Honeywell Ltd.

## 1.05 Submittals:

- A. Submit certified shop drawings including the following:
  - 1. General arrangement of each control system and panel clearly showing all internal and external components and wiring. Identify all components in accordance with specifications and sequence of operation.
  - 2. Electrical connection wiring diagrams of control panels showing internal wiring connections between all components and outgoing terminal blocks.
  - 3. Complete sequence of operations for all components of affected system.
  - 4. Motorized damper schedule with construction details and dimensions. Identify dampers in accordance with specifications and drawings.
  - 5. Specifications and data sheets for all control system components, including relays, switches, thermostats, controllers, damper operators, flow switches,

sensors and similar components.

6. Submit specific product data and shop drawings for each type and rating of Variable Frequency Drive (VFD) indicated. Include manufacturer, dimensions, weight, mounting arrangements, required clearances and service space, ratings, listings, enclosure types, conduit entry locations and sizes, schematic power and control wiring diagrams and complete list of all features and components (standard and optional). Any exceptions to the specification shall be clearly noted in the submittal.

## PART 2 - PRODUCTS

### 2.01 Materials - General:

- A. Select all other materials, not specifically described, but required for proper completion of the work of this Division, subject to the approval of the Engineer.

### 2.02 Materials - Mechanical:

#### A. Automatic Control Dampers:

1. Control dampers shall be low leakage insulated type where exposed to outside air temperatures. Damper leakage shall be less than 0.6% of total flow based on 250 mm w.g. static pressure difference across damper section and 10.16 m/s design approach air velocity. Dampers shall be manufactured from extruded aluminum. Channel frame 100 mm deep. Damper frame and blades 12 GA. Contractor shall provide an adequate support structure for the motorized dampers.
2. Modulating control dampers shall be opposed blade.
3. Two-position control dampers shall be parallel blade.
4. Damper blades shall be thermally broken and seals shall be manufactured off extruded silicone for severe cold conditions and secured in an integral slot within the extrusions.
5. Bearing shall be synthetic. Blade linkage hardware shall be constructed of corrosion resistant zinc plated steel and brass.
6. The control manufacturer shall coordinate, supply and supervise damper installation and guarantee the performance of the installed dampers in accordance with the leakage and pressure drop requirements indicated.
7. Acceptable manufacturer: Insulated dampers shall be Tamco Series 9000; non-insulated dampers shall be Tamco Series 1000.

### 2.03 Materials – Electrical:

#### A. Electrical Wiring Material:

1. Electrical wiring shall conform to the requirements of Division 16 Electrical.

**B. Temperature Sensors/Controllers:**

1. The HVAC systems shall be controlled by means of electronic temperature sensors and controllers as indicated in the control diagrams, schematics, drawings and sequence of operations.
2. Two position, one or two stage, temperature controllers shall be used for room ventilation.

**C. Damper Motor Actuators:**

1. Two position electric motor actuators shall be 120V spring return operators with solid state drives of correct size, stroke and positioning power.
2. Modulating electric motor actuators shall be 24V spring return operators with solid state drives of correct size, stroke and positioning power
3. Operators shall incorporate sturdy housing and mounting bracket with external stops.
4. Provide multiple motors where additional torque is required to operate the damper sections.
5. Actuators for hazardous classified areas shall have suitable approval to meet the area classification requirements.
6. Acceptable manufacturer: Damper motors shall be direct drive and equal to Belimo Air Controls Inc or Schishek.

**D. No-air flow switches (Air proving switch) with alarm:**

1. Provide UL listed / CSA approved air proving flow switch complete with alarm for all belt driven equipment to work the interlocking system in any condition if the belt fails.
2. No-air flow switches shall be Vapac make or approved equal by engineer

**PART 3 - EXECUTION****3.01 Installation:**

- A. Supply and install temperature control system complete in all details, substantially as shown or described, together with minor details not specifically mentioned or shown but as may be reasonably inferred as necessary to complete each portion and place in successful operating service.
- B. Automatic Dampers and Control Valves:
  1. Automatic control valves and dampers shall be installed as per the instructions of manufacturer. Balance the pressure and flow using circuit balancing valves in each circuit. Common port of the three way valve shall be installed as per the recommendations of the manufacturer.

C. Damper Installation:

1. Z-plates and fasteners provided by Tamco to interconnect damper sections are for alignment purposes only and may not be considered as structural supports.
2. Follow the manufacturer's installation guidelines and add structural supports as indicated.

D. No-air flow switches (Air proving switches) with alarm:

1. Install the switch on supply ducts, exhaust ducts and plenums of belt driven fans and air handling units to work the interlocking system properly.
2. Install the alarm system to alarm if the belt fails and there is no air flow.
3. Interlock the no-air flow switch with system equipment to work the interlocking if the belt fails.
4. Follow the instructions of manufacturer for proper installation of the switch.

E. Instruction, Adjustment and "As Constructed" Drawings:

1. On completion of the job, adjust, ready for use, all thermostats, damper motors, and relays provided under this Section.
2. Provide three complete instruction manuals, which will include "as constructed" Control Drawings, covering the project.
3. Instruct the Owner's operating personnel in the operation and function of the system at the completion of the project.

F. Wiring:

1. All electrical wiring required within the control system shall be provided under this Section. This to include wiring between control system components such as low and high limit protection, thermostats, alarms, float and flow switches, valves, and motor starters, etc. as required to furnish the control function specified.
2. Provide control circuit transformers as required and wire to building electrical panel with a separate 15 Amp breaker.
3. Provide all necessary relays required for the work of this Section.
4. Wiring shall be installed in conduit and shall conform to CSA, ULC and local code requirements as well as requirements specified in Division 16.

G. Identification:

1. Provide engraved lamacoid plates for all equipment provided under this Section. Fasten mechanically with screws or rivets.

### 3.02 Operations and Maintenance Training:

- A. Provide the services of an experienced manufacturer service representative to instruct the Owners staff on operations and maintenance. Training sessions consisting of two person-days and two site trips. Provide an electronic copy of the training session. Training days are in addition to any other commissioning time required. Training to be complete prior to commissioning.

### 3.01 Commissioning:

- A. Provide the services of an experienced manufacturer service representative for testing, commissioning and start-up as follows:
  - 1. Two person-days, two trips for installation assistance and inspection.
  - 2. Two person-days, two trips for functional and performance testing.
  - 3. Two person-days, two trips for commissioning and completion of a certified installation report.
  - 4. Two person-days, two trips for facility start-up.
- B. Provide a report from the service representative certifying the following:
  - 1. Proper installation procedures are being followed.
  - 2. Completeness of installation.

### 3.02 Sequence of Operation:

### 3.03 BLOWER ROOM:

- A. All temperature setpoints are to be adjustable.
- B. AC-101 will maintain the room temperature at 23°C setpoint through room thermostat during summer. AC turns ON when room temperature is more than 23°C and turns OFF when temperature is 21°C.
- C. Exhaust fan EF-101 normally stays OFF, exhaust fan can be turned ON through manual switch or by the reverse acting thermostat in case of room overheat. When the switch is ON, Damper MD-101 opens then fan EF-101 turns ON, when the switch is OFF, Fan EF-101 stops then MD-101 closes.
- D. Unit heater EUH-101 cycles ON and OFF to maintain room temperature at 18°C through its own thermostat.
- E. Additional hard-wired interlocks shall also be provided as indicated in the drawings.

### 3.04 PUMP ROOM:

- A. All temperature setpoints are to be adjustable.
- B. System operates via a hand/off/auto/manual switch.
- C. Fan SF-101 is interlocked with MD-103 so that the damper opens when the fan turns ON, and the damper closes when the fan turn OFF.
- D. Normally SF-101 and EF-102 run on low flow via the switch auto mode. When the switch is in auto mode, the fans SF-101 and EF-102 cycle high and low to maintain the room temperature below 24°C during summer.
- E. During emergency, both fans can be turned on to high flow using auto high mode or manual high switch. When unoccupied switch shall be set back to auto mode and system will run on low flow.
- F. Unit heaters EUH-103 and EUH-104 cycle ON and OFF to maintain the room temperature at 18°C through their own thermostat.
- G. Additional hard-wired interlocks shall also be provided as indicated in the drawings.

### 3.05 ALUM ROOM:

- A. All temperature setpoints are to be adjustable.
- B. System operates via a hand/off/auto/manual switch.
- C. Fan EF-103 is interlocked with MD-102 so that the damper opens when the fan turns ON and the damper closes when the fan turns OFF.
- D. Normally EF-103 runs in low flow, when room is occupied, the fan EF-101 could turn to high flow through high / low manual switch. When unoccupied fan shall turn back to low flow through manual switch.
- E. High: When the switch is in high mode, the fan EF-103 turns to high flow.
- F. Unit heaters EUH-102 cycles ON and OFF to maintain the room temperature at 18°C through its own thermostat.
- G. Additional hard-wired interlocks shall also be provided as indicated in the Contract Drawing.

### 3.06 FRP HEADWORKS BUILDING:

- A. All temperature setpoints are to be adjustable.
- B. System operates via a hand/off/auto/manual switch.
- C. MD-201 and MD-202 and EF-201 are interlocked so that the damper opens when the fan turns ON, and the damper closes when the fan turns OFF.



- D. During emergency, fan can be manually turned on to provide ventilation. Otherwise, when unoccupied switch shall be set back to auto mode and system will run automatically.
- E. Baseboard heater EBH-201 cycles ON and OFF to maintain the room temperature at 18°C through its own thermostat.
- F. Additional hard-wired interlocks shall also be provided as indicated in the drawings.

END OF SECTION 15900.

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 15000 applies to and governs the work under this Section.

## 1.02 Work Included:

- A. Air balancing.
- B. The cost of the “Independent Company” testing adjusting and balancing shall be carried by the contractor.

## 1.03 Quality Assurance:

- A. All ventilation systems shall be balanced in accordance with ASHRAE Standard 111 and SMACNA's HVAC Systems - Testing, Adjusting and Balancing at least to the extent necessary to verify conformance with the outdoor, space supply, space return and exhaust airflows requirements specified in the drawings.
- B. The Work of this Section shall be carried out by an independent air-balancing firm / company performing TAB as per the standards of AABC/NEBB/SMACNA or ASHRAE. Personnel performing TAB to be the member in good standing of AABC or NEBB qualified to the standards of AABC or NEBB.
- C. To perform the required professional services, the Balancing Company shall have on staff, a minimum of one person certified by AABC or NEBB for testing, adjusting and balancing.
- D. The work of this Section shall be carried out by an independent air-balancing firm acceptable to the Engineer and certified as above.
- E. The work shall be witnessed by the Engineer. The Contractor is to provide two (2) week notice as part of the overall construction schedule.

## 1.04 Submittals:

- A. Submit an outline of proposed procedure.
- B. Submit current instrument calibration certification from an independent testing agency for instruments proposed for the work of this Section.
- C. Submit certified air balancing report stamped and signed by a AABC / NEBB certified person for testing, adjusting and balancing.
- D. Submit final certified air balancing report after necessary adjustment as instructed by the Engineer.

## PART 2 - PRODUCTS

### 2.01 Materials:

There are no materials specified under this Section.

## PART 3 - EXECUTION

### 3.01 Air Balancing:

- A. Systems shall be balanced so that fans run at lowest possible speed and static pressure, which will deliver the specified air quantities under maximum load operating conditions.
- B. Test and balancing procedures shall follow guidelines recommended by ASHRAE and SMACNA.
- C. Review the Drawings, Specifications and the installation, and report problems requiring correction. Do not proceed until satisfied that systems are complete and ready for balancing.
- D. Balance the air for all chemical rooms and hazardous classified (Class-1, Div-1, Class-1, Div-2) rooms to create and maintain differential pressure of at least 25 Pascal (positive or negative as indicated) inside the room compared to the adjacent when all doors and windows of the room are tightly closed with weather strips and all HVAC systems are running. Submit the report of pressure balancing.
- E. Test fan systems and make all adjustments necessary to bring air-handling system to within  $\pm 10\%$  of specified performance. Adjust all supply and return registers, grilles, diffusers and duct dampers, and change or adjust sheaves and belts to achieve specified airflow and pressure.
- F. Provide permanent screw locking arrangement for the dampers installed to convey outdoor air after air balancing to avoid shifting the damper position due to air pressure.
- G. When all systems are operating as specified, submit a preliminary report, which shall include:
  1. Schematic ducting diagrams indicating achieved air quantities at terminals and system total performance including fan capacity established by duct traverse, and fan inlet and outlet static pressures.
  2. Pressure drop across filters and cooling coils at maximum system airflow tabulated against manufacturer's pressure drop ratings at the same airflow. State observed filter condition at the time pressure drop readings are taken.
  3. Readings for maximum, minimum and "auxiliary" flow rates where these are specified for air terminal devices, to verify that intended performance has been achieved.
  4. Specified and measured fan rpm, motor nameplate rpm and full load amps, measured actual running amps per phase, measured voltage per phase and installed starter overload heater sizes.

5. Sheave sizes to percentage taken up if adjustable, belt sizes, quantities and types. For direct driven fans adjust the VFDs.
- H. Perform spot checks on 5% of the system as selected by the Engineer. In the event that spot checks differ from the preliminary report by more than 5%, retest the system and resubmit the report. Contractor shall inform engineer at least one week advance for time and schedule of spot check testing and also provide all required instruments for spot checks.
- I. When spot checks agree with preliminary report, submit a certified final report containing the same information as the preliminary report in final form.
- J. Mark final balance position neatly on all valves and dampers with a permanent contrasting marker.

END OF SECTION 15990.

DIVISION 16

ELECTRICAL

## INDEX

SECTIONS

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Section 16122 – Wires and Cables 0-1000V  
Section 16131 – Junction and Pull Boxes  
Section 16132 – Outlet Boxes Conduit Boxes and Fittings  
Section 16141 – Wiring Devices  
Section 16151 – Wiring and Box Connectors  
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Section 16440 - Disconnect Switches  
Section 16450 - Grounding Secondary  
Section 16461 – Dry Type Transformers  
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Section 16536 – Emergency Lighting Equipment  
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Section 16825 - Control Devices  
Section 16850 – Heat Tracing System

END OF INDEX DIVISION 16

PART 1 - GENERAL

## 1.01 Governing Conditions:

- A. Division 1 shall be read in conjunction with and shall apply to and govern every Specification of this Division.

## 1.02 Work Included:

- A. This Section covers the general requirements for the supply and installation of all electrical equipment work specified herein and as shown on the drawings; also electrical wiring and connections to electrical and instrumentation equipment specified under other Divisions and/or detailed on the contract drawings and/or supplied by the Owner.
- B. The major work including, but not limited to the following:
  - 1. Underground feeder services (trenching, ducts, cabling and backfilling).
  - 2. Electrical services distribution and decommissioning.
  - 3. Electrical services lighting and power systems.
  - 4. Lighting system complete with controls and wiring
  - 5. Low voltage services and controls.
  - 6. Power supply to process and HVAC equipment.
  - 7. Coordination with Section 13000 – Control and Instrumentation.
  - 8. Control / Instrumentation System conduits, installation and wiring.
  - 9. All required ESA inspections, permits and certificates.
  - 10. Coordination with pre-selected equipment suppliers.
  - 11. Heat tracing of new piping as shown on drawings.
  - 12. Extension of existing heat tracing to cover new piping for areas shown on drawings. Replacement of existing heat tracing equipment with hazardous area rated equipment near Aeration tank and Pump Room. Coordination with heat tracing supplier for a fully functional system.
  - 13. Replacement of existing non hazardous area rated equipment near Aeration tank and Pump Room (conduit, junction boxes, switches etc) with appropriate classified area rated equipment. See drawings for more details.

## 1.03 Scope of Work:

- A. The scope of work covered by this Specification includes the purchase and installation of equipment and services on site, as follows:

- B. Provide all labour, materials, equipment, tools, tests, commissioning and services required to complete the work of Division 16 in accordance with the Specifications and the drawings.
  - C. Examine the drawings, in conjunction with the specifications, to determine the scope of work. Be sure to reference Division 11 - Equipment, Division 13 – Control & Instrumentation and Division 15 - Mechanical for work related to this Division.
  - D. Installation of grounding system including the grounding electrodes and the connections with all equipment installed.
  - E. Installation of duct banks to be in compliance to the Ontario Electrical Safety Code and to the Electrical Safety Authority standards complete with warning tape and markers.
  - F. Installation of conduits and cable trays, including boring and putting sleeves as required.
  - G. Installation of all lighting fixtures (indoor and outdoor), poles, photoelectric and motion controls and switches as indicated in 'E' drawings.
  - H. All disconnects and local motor starters for fans, unit heaters and duct heaters as indicated in 'E' drawings.
  - I. Setting, parameterization and calibration of all equipment under this project (new and existing).
  - J. All receptacles, 600 V and 120 V, as indicated in 'E' drawings. Note the receptacle requirements for indicated services (i.e. isolated grounds, GFI and explosion proof).
  - K. Rooftop receptacles for maintenance of HVAC equipment as per OESC Rule 26-704.
  - L. Wiring of all operator hand switches, pushbuttons and pilot lights as outlined in Division 13 and Controls drawings.
  - M. All wiring between field instrumentation and control panels, PLC, RTU's, etc., is included.
  - N. All necessary wiring terminations and connections to make the project complete and functional.
  - O. At least 20% spare wires (but not less than 2) in each instrumentation and control cable/wire runs.
- 1.04 Seismic Restraints:
- A. Provide seismic restraints and anchors suitable for 'Post-Disaster Building', as per Ontario Building Code Table 4.1.8.5 and CSA S832, for Operational and Functional Components (OFCs).
  - B. All Major Electrical Equipment to have certificate of Seismic Compliance meeting the requirement defined by the International Building Code (IBC). Provide approval certificate and install corresponding name plate on the equipment.

1.05 Power Interruption:



- A. Maintain facility in service throughout construction.
  - B. Power interruptions to be kept to a minimum. Coordinate power interruptions with the Plant operation staff and all other trades. Submit requests for electrical interruptions indicating the date, time and estimated duration of the interruption at least two weeks prior to the requested shutdown date. Do not commence work until review is complete.
- 1.06 Material and Equipment:
- A. Use equipment approved and certified by CSA / ULC. If unavailable, obtain approval by special inspection of the ESA and the local hydro utility for alternate equipment.
  - B. Factory assembled control panels and component assemblies should be certified by CSA.
- 1.07 Codes, Permits and Inspection:
- A. Ensure that all materials and work meet the requirements of the Ontario Electrical Safety Code (OESC) and all local, municipal, provincial and federal by-laws and regulations.
  - B. Obtain all necessary permits and pay all fees for the work of this division.
  - C. On completion of the work, submit all final certificates.
  - D. Submit to Inspection Authority and the Supply Authority the required quantity of drawings and specifications for examination and approval prior to commencement of work.
- 1.08 Electrical Safety Authority (ESA) Meetings
- A. The Engineer or their site representative will attend all meetings with the ESA Inspector. Provide 48 hours' notice of meeting times.
- 1.09 Examination of Site and Documents:
- A. Examine the site and all drawings and specifications of other Divisions and become familiar with local conditions, building construction and finish affecting the work under this Division. Inform the Engineer of any omissions, discrepancies, defects or interferences affecting the work before the tender closes.
- 1.10 Drawings:
- A. The electrical drawings are diagrammatic and intended to convey the scope of work. The drawings indicate general arrangement of equipment, conduit runs and approximate sizes and locations of equipment. Coordinate with other divisions to ensure correct final locations as per Codes and field requirements.
  - B. Follow the electrical drawings in laying out the work. The electrical drawings do not show all details which may affect the installation. Check all other division's drawings before proceeding with the electrical work.
  - C. All wiring, terminations and connections shown on single line diagrams, block diagrams, riser diagrams and/or layout drawings shall be included in the contract.

## 1.11 Submittals:

- A. Provide a copy of the specification section, addenda and referenced sections with each paragraph check-marked to indicate compliance. Check marks (✓) shall denote full compliance with a paragraph. Underline all deviations and provide a detailed justification for each deviation.
- B. Provide the following information on all submittals:
  - 1. Manufacturer's and Supplier's name.
  - 2. Catalogue model number.
  - 3. Project number and name.
  - 4. Number identifying item on the drawings and/or in the specifications such as equipment, item number, panel identification letters, etc.
  - 5. Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
  - 6. Where applicable, include wiring, single line and schematic diagrams.
  - 7. Include wiring diagrams or diagrams showing interconnections with other Sections.
  - 8. In wiring diagrams, include all interconnecting Field equipment wiring along with wiring tags and terminal numbers on the field equipment.
  - 9. Highlight the specific make / model of the equipment being provided and cross out the details that are not related to the exact make / model being supplied.
- C. Submit samples of material and equipment where specified or as may reasonably be requested by the Engineer for their review before ordering same. The Engineer may retain the samples at their discretion until the completion of the contract.
- D. Submit shop drawings for, but not limited to, the following items:
  - 1. Motor Starters including VFD's, Distribution Panelboards, Disconnect Switches, Transformers, Lighting fixtures, Wiring Devices and Engineering Studies.
- E. Submit conduit, cable tray and wiring layout drawing. Show conduit and cable sizes. Drawings shall be on the same size sheets as the contract drawings.

## 1.12 Painting:

- A. Touch up all prefinished electrical equipment marred during installation or shipment listing the same colour and type of finish as originally used in the factory.

## 1.13 Protection:

- A. Protect exposed line equipment during construction for personnel safety.

- B. Shield and mark live parts "Live 600 Volts", or with appropriate voltage.
- C. Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of the electrician.

#### 1.14 Tests:

- A. Conduct and pay for tests of the following:
  - 1. Distribution system including phasing, voltage, grounding and load balancing. Power system quality survey as voltage drop and harmonic voltage spectrum.
  - 2. Circuits originating from branch distribution panels.
  - 3. Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - 4. Emergency and Exit Lighting.
  - 5. Functional tests for protection devices at MCC's.
  - 6. Functional tests and calibration of metering devices
- B. Furnish manufacturer's certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions.
- C. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- D. Submit test results for Engineer's review.

#### 1.15 Insulation Resistance Testing:

- A. Megger circuits, feeders and equipment up to 350 V with 500 V instrument.
- B. Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- C. Check resistance to ground before energizing.
- D. Replace cables if the resistance to ground is less than 0.5 mega-ohms for circuits or feeders up to 350 V, and if resistance to ground is less than 1.0 mega-ohms for circuits or feeders, 350-600 V.
- E. No electronic equipment will be meggered unless specifically directed by the vendor.

#### 1.16 Equipment Identification:

- A. Electrical nameplates to be in compliance with OESC.

- B. Provide nameplates for all electrical equipment supplied under this Division. Ensure that nameplates list equipment association and function. Include equipment Tag ID on all nameplates.
- C. Nameplates to be outdoor grade lamicoid, 50 mm square minimum or sized to suit text and location, 1.6mm thick, beveled edge, white background with 4mm high black letters.
- D. Fasten nameplates to equipment using 2 self-tapping stainless-steel screws or manufacturer supplied self-adhesive backing for clean flat surfaces. For equipment with no suitable flat surface attach the nameplate in some convenient location with black heavy-duty zip-ties.
- E. Coordinate the type and naming convention with the Engineer, prior to submitting shop drawings. Submit a nameplate list for review. List to identify equipment name, location, nameplate size, nameplate text, fastening method.
- F. Provide nameplates for all light switches and receptacles. Text to include panel and circuit numbers. Letter height to be 3mm.
- G. Provide nameplates for all cables, conduits and cable trays at the source and load location and at every 10 meter (or less) regular intervals and also inside the electrical Manholes.

#### 1.17 Care, Operation and Start-Up:

- A. Instruct the Engineer and Owner's operating maintenance staff in the operation, care and maintenance of all equipment and systems provided under this Division.
- B. Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation and to check, adjust, balance and calibrate components.
- C. Provide these services for such period, and for as many visits as necessary to put equipment into reliable operation, and ensure that operating personnel are familiar with all aspects of its care and operation.
- D. The Owner has the privilege of the trial usage of electrical system of parts thereof for the purpose of testing and learning the operational procedures.
- E. Carry out the trial usage over a length of time as deemed reasonable by the Engineer at no extra cost.
- F. Provide supervision for these operations. Do not waive any responsibility for trial usage.
- G. Trial usage shall not be construed as acceptance by the Owner.
- H. Keep a record of dates and durations of each instruction period, together with the name(s) of the person(s) to whom the instructions were given. Forward one (1) signed copy of such record to the Engineer.

1.18 Conflicts:

- A. If there are any conflicts between the specification and Contract Drawings, or within the specifications or Contract Drawings themselves, the more stringent requirements hold.

1.19 Abbreviations:

- A. The abbreviation used in the specifications and drawings for Division 16 are as follows:

1. ANSI American National Standard Institute
2. CBM Certified Ballast Manufacturer
3. CSA Canadian Standard Association
4. EEMAC Electrical and Electronic Manufactures Association of Canada
5. IEEE Institute of Electrical and Electronic Engineers
6. OESC Ontario Electrical Safety Code
7. OPSD Ontario Provincial Standard Drawings
8. ESA Electrical Safety Authority
9. OBC Ontario Building Code

1.20 Operation and Maintenance Data:

- A. Submit Four (4) copies of manufacturer's maintenance instructions for each piece of apparatus, equipment, and systems to the Engineer. Include installation, operation and maintenance data and the names and addresses of spare parts suppliers and service organizations, in the instructions.
- B. General advertising literature will not be accepted. Data shall refer only to specific model and type of equipment installed.

1.21 Final Inspection:

- A. Make request, in writing, to the Engineer to arrange for a final inspection of all electrical systems with timetable.
- B. Do not issue this written request until:
  1. All deficiencies noted during the job inspection have been completed.
  2. All systems have been balanced and tested and are ready for operation.
  3. Operating and maintenance instructions have been submitted and reviewed.
  4. Identification of equipment and raceways is complete.

5. Certificates have been submitted.
6. Spare parts and replacement parts specified have been provided and receipt of same acknowledged.
7. Record drawings are completed and reviewed.
8. Owner's operating personnel have been instructed.
9. Framed Single line electrical diagrams are hung.

#### 1.22 Guarantee:

- A. Guarantee all equipment and material supplied and installed under this Division against any and all defects, deficiencies in equipment design, materials and workmanship which are not detected prior to formal acceptance of the system, but which may develop within one year after such acceptance. Make good any such defects and deficiencies at no additional cost to the Owner.
- B. This general guarantee shall not act as a waiver of any specified guarantee for any greater length of time.
- C. Guarantee any part of work accepted by the Owner, before completion of whole work, for one year from date of acceptance of that part of work.
- D. The guarantee period shall not be presumed to commence where any equipment is operated temporarily for the purpose of testing or checking out systems.

#### 1.23 Grounding:

- A. Ground electrical system and equipment to the requirements of the Electrical Safety Authority.
- B. The ground wire in multi-conductor cables shall serve as the equipment grounding conductor where used. Where flexible conduit or PVC is used, install a separate copper ground wire sized according to Table 16 of OESC.
- C. Solidly ground all equipment, transformer neutrals (or as shown in the drawings).
- D. Use stranded copper with green insulation for ground conductors.

#### 1.24 Co-ordination:

- A. Confer with all trades installing equipment which may affect the work of this Division, and arrange equipment in proper relation with equipment installed under other Divisions of the Contract.
- B. The Contractor will coordinate with Division 3 to provide cable penetrations and and termination to the process equipment at the right location.
- C. Relocate equipment and/or material installed, but not coordinated with the work of other Divisions as directed by the Engineer without extra cost.

- D. X-ray existing floor, walls, and ceiling before cutting or drilling to avoid conflict with any existing utilities. Re-route if necessary.

#### 1.25 Cleaning:

- A. At completion, clean lighting reflectors, lenses, and other lighting.
- B. All panels to be vacuumed out prior to commissioning.

#### 1.26 Co-ordination of Protective Devices:

- A. Ensure circuit protective devices such as over-current trips, relays and fuses are installed to correct values and settings.

- B. Pre-Service Testing:

1. All pre-service testing shall be coordinated by and paid for by the Contractor.
2. Clean the inside of all switchboards, panels, bus ducts, etc., using industrial type vacuum cleaners and other appropriate equipment.
3. The following tests shall be made, prior to putting the equipment into service, to ensure that the distribution equipment has been installed in a satisfactory manner and suitable for placing into service, without either endangering personnel or the system.
  - a) Lighting/Power Panel Boards:
    - i. Test and verify system circuit breaker settings and ground fault protection.
    - ii. Test system circuit breaker functions, i.e., trip, close, electrical operation etc.
  - b) Motor Control Centres
    - i. Test and verify the system circuit breaker and protection devices settings and ground fault protection.
    - ii. Test system circuit breaker functions i.e. trip, close, electrical, circuit operation.
    - iii. Check operation of all motor starters including variable speed controllers.
  - c) Grounding
    - i. Check grounding of all devices for mechanical soundness and resistivity.
  - d) Submit all test results to the Engineer.

## 1.27 Power System Studies:

- A. Conduct Power System Studies for the entire facility. Obtain all necessary verified data required to run the study including field verification. Perform the following:
  - 1. Short Circuit Study for Line to Line, Line to Ground and 3 Phase faults.
  - 2. Selective Coordination Study and device evaluation report
  - 3. Arc Flash Study and Hazard Analysis
- B. The study shall include High Voltage Hydro supply, 600 V and 208 / 120 V system and to be submitted for approval at the same time as the Electrical Distribution Equipment and the shop drawings. It will be the contractor's responsibility to obtain and field verify the data and incorporate in the Study. The Coordination study data shall be presented in tables and on composite charts (for phase and ground) and shall include and not be limited to the following:
  - 1. Settings and TCC curves of the protection devices.
  - 2. Maximum available short circuit currents (phase and ground). Provide correspondence with Hydro as an Appendix to the report.
  - 3. The continuous and momentary ratings for the 600 V and 208 V buses, bus ways and feeders.
  - 4. Cable damage curves for 600 V and 208 V system.
  - 5. The largest load and the largest motor, with the acceleration time, FLC, LRC and inrush currents. Include its upstream feeder damage curve.
  - 6. The cable damage curve for the smallest size feeder and its protection device TCC.
- C. Implement the coordination study in full and set all the protection devices as per the recommendations in the Study.
- D. Attach approval correspondence with the supply utility as an Appendix to the report.
- E. Install Arc Flash Labels on the equipment as per the recommendation of the study.
- F. Approved Vendors for the Study:
  - 1. Brosz Technical Services
  - 2. Enkompass Power and Energy Corp.
  - 3. Eaton Canada
  - 4. Eastenghouse Inc., Mississauga Ontario
  - 5. Schneider Canada



6. Ainsworth
  - G. Drawings and reports must be sealed by a Professional Engineer.
  - H. Submit the study along with the main electrical distribution equipment shop drawings.
- 1.28 Workmanship:
  - A. Install equipment, cable tray, conduit and cables in a workman-like manner to present a neat appearance and to function properly. Install runs parallel and perpendicular to building planes. Conceal conduit in chases, behind furring, or above ceiling, except in unfinished areas. Install exposed systems neatly and group to present a neat appearance.
- 1.29 Fireproofing:
  - A. When cables or conduits pass through floors and fire rated walls, pack space between wiring and sleeve with approved material and seal with caulking compound. Use Hilti Firestop Solution products (or Owner approved equivalent) for each specific application.
- 1.30 Wiring and Terminal Block Identification:
  - A. Identify wiring with permanent, indelible, identifying markings on both ends of phase conductors of feeders, branch circuit wiring, all control wiring and instrumentation wiring.
  - B. Maintain phase sequence and colour coding throughout.
  - C. Colour code: to CSA C22.1:
    1. Phase A: red
    2. Phase B: black
    3. Phase C: blue
    4. Neutral: white
- 1.31 Wiring Terminations:
  - A. Lugs, terminals, screws used for termination or wiring to be suitable for either copper or aluminum conductors.
- 1.32 Manufacturers and CSA Labels:
  - A. Manufacturers' nameplates and CSA labels to be visible and legible after equipment has been installed.
- 1.33 Warning Signs:
  - A. Provide warning signs, as specified or to meet requirements of Inspection Department and Engineer.
  - B. Use decal signs, minimum 175 x 250 mm size.

## 1.34 Location of Receptacles:

- A. Locate receptacles as shown on the drawings.
- B. Do not install receptacles back to back in wall; allow minimum 150 mm horizontal clearance between boxes.
- C. Change location of receptacles at no extra cost or credit, providing distance does not exceed 3.0 m and information is given before installation.
- D. Locate light switches as shown on the drawings.
- E. Install receptacles at least 1500mm from sink.

## 1.35 Mounting Heights:

- A. Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.
- B. If mounting height of equipment is not indicated verify before proceeding with installation.
- C. Install electrical equipment at the following heights (in mm) unless indicated otherwise:
  - 1. Local switches: 1200
  - 2. Wall receptacles:
    - a) General: 300, otherwise 1200
    - b) Above top counters of splash back: 175
    - c) In mechanical rooms: 1200
    - d) Outdoor 1200
  - 3. Panelboards: max. 2000 mm at the top, or as required by Code.
  - 4. Thermostats: 1400
  - 5. Disconnects: 1400

## 1.36 Inserts, Sleeves, Escutcheons and Curbs, Equipment Supports and Hangers:

- A. Use only factory made threaded or toggle type inserts, as required, for support and anchors, properly sized for the load to be carried. Place inserts only in portions of the main structure and not in any finishing material.
- B. Use factory made expansion shields where inserts cannot be placed, but only where reviewed by the Engineer and for light weights.
- C. Do not use powder activated tools except with written permission of the Engineer.

- D. Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.
- E. Bring conduits and pipes through walls and floors as required, without sleeves, unless otherwise shown. Sleeves are not required in walls and dry area floors, where conduit is installed ahead of wall construction.
- F. Provide all supports required for the erection and support of the electrical work. Construct supports of steel, masonry, or concrete as noted or required. Steel supports in contact with water or high humidity shall be galvanized after fabrication or be of galvanized members bolted together using cadmium plated bolts. Place supports in floor base prior to concrete pouring where the closest vertical structure is not suitable for supporting electrical work.
- G. Ensure that the load onto structures does not exceed the maximum loading per square foot as shown on structural drawings or as directed by the Engineer.
- H. Support all hangers directly from the structure only. Do not support from other pipes, ducts, equipment, suspended ceilings, etc., except where expressly allowed.
- I. Suspend hanger rods generally from approved inserts in concrete or by beam clamps. Welding to steel structural members shall be done only with prior approval of welding method by the Engineer.
- J. For rod hangers use round steel galvanized threaded rod supports, minimum 10 mm diameter. Use clevis type conduit attachment.

#### 1.37 Flashing:

- A. Flash all electrical parts passing through or built into roof, an outside wall or a waterproof floor.

#### 1.38 Delivery, Receiving and Storage of Equipment:

- A. Arrange with Equipment Suppliers for delivery of all items of equipment to the site of work at the appropriate dates on the Contractor's construction schedule.
- B. Arrange for delivery of all anchor bolts, templates, embedded metal, etc., required during the concreting and other construction.
- C. Receive equipment at the site, unload it, examine it upon arrival for damage or deficiency in conjunction with the Engineer and be responsible for its safekeeping, storage and installation. Immediately notify the Engineer and the Supplier of any damages or deficiency of the equipment delivered.
- D. For the purpose of this contract, equipment storage, safekeeping and location of equipment from one area of the site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the site until the date of completion and takeover by the Owner.

## 1.39 Working Drawings:

- A. Within sixty (60) days of the date of execution of the Contract, submit Two (2) sets of working drawings of the electrical work to the Engineer for review. Show the general arrangement, outline dimensions and weights of each piece of apparatus in order to accurately locate same and to design such structures, foundations and external wiring or piping as may be required for installation and connection. Show all conduit and cable tray runs in proper relationship to the structure and to the equipment being supplied.
- B. Each drawing shall be clearly referenced to the project with its contract number and applicable section number.
- C. One copy of each drawing will be returned to the Contractor stamped "FOR REVIEW" or otherwise marked with the required changes. Drawings requiring changes shall be revised by the Contractor and Two (2) copies of each resubmitted to the Engineer for review.
- D. Electrical construction shall not commence until the working drawings have been reviewed by the Engineer and therefore no change shall be made in them without written permission. In the event of any such alterations or changes being authorized by the Engineer, Two (2) copies of each of the revised drawings and specifications, indicating these changes, shall be immediately furnished to him at the Contractor's expense.
- E. The Contractor shall not make any claim for changes required to the work which was undertaken prior to receipt of the Engineer's approval.
- F. Review of the Contractor's working drawings by the Engineer shall not relieve the Contractor of the responsibility for the corrections thereof, or from results arising from error or omission of details of design. Review of working drawings shall in every case be subject to final review of the equipment and materials after these have been put in commission, all guarantees have been fulfilled and the general operation of the equipment and materials has been found satisfactory to the Engineer.
- G. Four (4) additional copies of all final reviewed working drawings shall be furnished to the Engineer at the Contractor's expenses.

## 1.40 Single Line Diagrams:

- A. Provide a framed single line diagram 610 mm x 458 mm under plastic in each electrical room. The single line diagrams shall show the complete power distribution system and the local equipment.

## 1.41 Warranty and Maintenance:

- A. The Warranty period commences at Substantial Performance of the entire project, unless otherwise agreed to by the Owner in writing.
- B. Unless otherwise specified, provide a one (1) year warranty for all components of the work.
- C. Provide the required guarantee/warranty certificates and/or written documentation as specified.

## 1.42 Testing &amp; Commissioning Forms:

- A. Use the testing and commissioning forms appended to the relevant specification sections as minimum to record the field observation during commissioning. In addition, Contractor should also use other forms as recommended by the manufacturer or their own standard forms.

END OF SECTION 16000

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Related Work:

- A. Section 02220 – Excavation
- B. Section 02221 – Backfilling and Filling

### 1.03 Codes and Standards:

- A. Follow the requirements of OPSD Section 2100.

## PART 2 - PRODUCTS

### 2.01 Markers:

- A. 150 mm wide polyethylene Cable Marker Tape, RED in colour with the following imprinted continuously over its entire length: "CAUTION BURIED ELECTRIC LINE BELOW".

## PART 3 - EXECUTION

### 3.01 Direct Buried Cable:

- A. After the bedding specified in Section 02220 and Section 02221 is in place, lay cables maintaining 75 mm clearance for each side of trench to nearest cable. Do not pull cable into trench.
- B. Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- C. Underground cable splices not acceptable.
- D. Minimum permitted radius at cable bends for rubber or plastic, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- E. Maintain 75 mm minimum separation between cables of different circuits. Maintain 300 mm horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position. At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

### 3.02 Cable Ducts:

- A. Do not pull spliced cables inside ducts.
- B. Install multiple cables in duct simultaneously.

- C. Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- D. To facilitate matching of colour coded multi-conductor control cables, reel off in same direction during installation.
- E. Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.
- F. After installation of cables, seal duct ends with duct sealing compound (Polywater FST-250 or approved equivalent).

### 3.03 Markers:

- A. Install marker tape half-way below finished grade above all underground ducts, conduits and cables.

### 3.04 Precast Concrete Brick:

- A. Install precast Bricks to provide additional protection and marking if shown on drawing. The bricks to be Model# CM2 or CM4 from Utility Structure Inc (USI) or approved equal. The bricks should cover the entire width of the trench and extend at-least 50 mm beyond the cables on each side.

### 3.05 Testing:

- A. Perform tests in accordance with Section 16000.
- B. Perform tests using qualified personnel only. Provide necessary instruments and equipment for testing.
- C. Check phase rotation and identify each phase conductor of each feeder.
- D. Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 mega-ohms.
- E. Pre-acceptance tests:
  - 1. After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - 2. Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- F. Acceptance Tests:
  - 1. Ensure that terminations and equipment are disconnected.
  - 2. Solidly ground, shields, ground conductors, metallic armors and cables, not under testing.
  - 3. Use Testing and Commissioning Form 16106-A, to record test results and submit to the Engineer for approval.

- G. Provide Engineer with list of test results showing location at which each test was made, circuit tested and insulation resistance of each length of cable.
- H. Remove and replace entire length of cable if cable fails to meet any of the test criteria.



16106-A WIRE AND CABLE INSULATION RESISTANCE TEST DATA FORM

Wire or Cable No.: \_\_\_\_\_

Temperature, °C \_\_\_\_\_

Location of Test

Insulation  
Resistance,  
mega-ohms

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

CERTIFIED \_\_\_\_\_  
Contractor's Representative

Date \_\_\_\_\_

WITNESSED \_\_\_\_\_  
Owner's Representative

Date \_\_\_\_\_

END OF SECTION 16106

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Related Work:

- A. Section 02220 – Excavation
- B. Section 02221 – Backfilling and Filling

### 1.03 Codes and Standards:

- A. Follow the requirements of OPSD Section 2103 and OPSD 2123

## PART 2 - PRODUCTS

### 2.01 PVC Conduits:

- A. Schedule 40 Rigid PVC conduits for direct burial. CSA C22.2 No. 211.2

### 2.02 PVC Conduit Fittings:

- A. All fittings to be schedule 40 unless otherwise specified.
- B. Rigid PVC couplings, reducers, bell and fittings, plugs, caps, adaptors as required to make a complete installation.
- C. Rigid PVC 90° and 45° bends as required.
- D. Rigid PVC 5° angle couplings as required.
- E. Watertight expansion joints, to be placed every 10 meters.

### 2.03 Solvent Weld Compound:

- A. Use solvent weld compound approved for rigid PVC conduit.

### 2.04 Markers:

- A. 300 mm wide polyethylene cable marker tape, red in colour with the following imprinted continuously over its entire length: "CAUTION BURIED ELECTRIC LINE BELOW".

### 2.05 Precast Concrete Brick:

- A. Install precast Bricks to provide additional protection and marking if shown on drawing. The bricks to be Model# CM2 or CM4 from Utility Structure Inc (USI) or approved equal.
- B. The bricks should cover the entire width of the trench and extend at-least 50 mm beyond the cables on each side.

### PART 3 - EXECUTION

#### 3.01 General:

- A. After sand bedding specified in Section 02220 and Section 02221 is in place, lay conduits according to manufacturer's instructions, maintaining a 75 mm clearance from each side of the trench to the nearest conduit.
- B. Duct installation profiles to be as per OPSD 2103.02.
- C. Seal joints in ducts with approved joint sealing compound. Ensure PVC welds are solid and complete to maintain a watertight seal.
- D. Maintain 75 mm spacing between conduits minimum.
- E. Install a marker tape 300 mm below finished grade above underground conduits.
- F. Ensure a full, even support every 1.5 m throughout the trench length.
- G. Cap ends during construction to prevent the entry of foreign materials into the conduit.
- H. Slope conduits/ducts with a 1 to 400-slope minimum.
- I. Clean the inside of ducts before laying.
- J. Before pulling cables, pull a stiff bristled brush through each duct to remove any foreign matter.
- K. In each duct run, pull nylon rope continuous throughout the run with 3 m spare rope at each end.
- L. Slope and lay duct banks in straight lines such that there will be no low lying pockets. Slope runs toward manholes.
- M. Accurately taper duct ends with the correct tapering tool approved by the manufacturer for lengths of ducts which are of less than standard lengths
- N. Fit all ducts terminating to manholes or buildings with approved duct bell-ends.
- O. Refer to OPSD 2123.01 for termination of direct buried ducts in electrical manholes and OPSD 2123.03 for entry of direct buried ducts inside electrical handholes.
- P. Rod duct lines before installing cables or fish wires. Install non-metallic fish cords in all duct runs. Fish cord: Brantford No. 450 polypropylene Twine or approved equivalent.

- Q. When duct runs pass under roadways or come out of manholes and are plugged at either side for future use, cap at either end with suitable end-caps and seal against the entry of moisture or earth.
- R. After installation of cables, seal duct ends with duct sealing compound (Polywater FST-250 or approved equivalent).
- S. Use interlocking duct spacers in duct banks to maintain a minimum vertical and horizontal separation, between ducts. Place spacers on both sides of couplings.

### 3.02 Inspection:

- A. Inform the Engineer and ESA so that inspection of ducts may be done prior to and during placement of concrete.

END OF SECTION 16107

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Related Work:

- A. Section 01040 - Coordination

### 1.03 Location of Conduits:

- A. Conduit locations, where shown on the drawings, are schematic only. Install actual conduit runs to suit the site conditions, except where full details are given, in such cases installation shall be as shown on the drawings. The termination of conduits, where shown, are for the general type of equipment. Ensure that they comply with the requirements and the actual equipment which is to be installed.

### 1.04 Codes:

- A. All conduits to meet CSA Specification C22.2.
  - 1. No.45, for galvanized steel; and PVC coated Rigid Steel
  - 2. No.211.2, for PVC.
  - 3. No. 56 for liquid tight flexible metal conduit.

## PART 2 - PRODUCTS

### 2.01 Conduits:

#### A. Metallic Conduit:

- 1. Rigid galvanized steel
- 2. Liquid Tight flexible metal conduit

#### B. PVC Coated or Epoxy coated Rigid Steel Conduit:

- 1. Acceptable Manufacturers:
  - a) Plasti-Bond REDH2OT from Crouse-Hinds / Eaton
  - b) Ocal from Thomas&Betts
  - c) Green-Guard from Columbex Inc.

#### C. Non-Metallic Conduit:

- 1. Rigid PVC, Schedule 40, FT4 rated

## 2.02 Application:

- A. Install conduit as follows unless otherwise specified in the drawings.
  - 1. Rigid PVC Schedule 40 conduits – Use at the following unclassified (non-hazardous) locations.
    - a) Indoor, exposed installation.
    - b) Concrete encased or direct buried installations.
    - c) Chemical areas.
    - d) Open type conduits for TECK cable support indoors.
  - 2. Rigid galvanized steel conduits;
    - a) Hazardous classified Zone 2 (Class 1 Division 2) areas.
    - b) Communication wiring.
    - c) VFD load side wiring (unless otherwise shown on the drawing).
    - d) Mechanical Rooms.
    - e) Staircases and exit areas.
  - 3. Liquid tight Flexible conduit (one meter or less application)
    - a) From junction box to the equipment
    - b) From junction box to light fixtures
  - 4. PVC Coated or Epoxy Coated Steel conduit
    - a) Hazardous classified Zone 1 (Class 1 Division 1) areas.
    - b) OESC Category 2 areas.
    - c) Outdoor exposed installations.
    - d) Direct buried communication wiring (where specified on drawings)
- B. Minimum Size of conduits
  - 1. The minimum size shall be 19 mm for all types of conduits.

## 2.03 Conduit Fastenings:

- A. For PVC Coated Rigid Steel conduits, use fastening material with similar coating.

- B. One-hole rigid PVC or malleable iron straps to secure surface conduits 50 mm and smaller. Two holes PVC or steel straps for larger conduits. Use PVC straps for rigid PVC and iron or steel straps for rigid galvanized steel.
- C. Beam clamps to be used to secure conduits to exposed steel work.
- D. Channel type supports for two or more conduits.
- E. 6 mm diameter rod to support suspended channels.

#### 2.04 Conduit Fittings:

- A. Fittings, as required, for use with conduit specified, with coating same as conduit.

#### 2.05 Expansion Fittings for Rigid Conduit:

- A. Provide expansion fittings as per manufacturer's recommendations.
- B. Expansion fittings with bonding for metallic conduits where conduit crosses a structural expansion joint Water tight, complete with grounding strap and clamps.
- C. All conduit fittings and covers below grade shall be watertight to NEMA 4X unless otherwise specified or noted on the Drawings.
- D. Provide expansion joint when underground conduit / ductbank rises above grade before connection to the upstream equipment (pullbox etc.)

### PART 3 - EXECUTION

#### 3.01 Installation:

- A. Conduits to be installed concealed in walls for finished areas such as offices, washrooms, control rooms, board rooms, hallways, laboratories, lunchrooms etc. Install conduit into the walls, ceilings or floors in accordance with Section 01040.
- B. Provide exposed conduits in process and unfinished areas. Wherever equipment to be powered is not wall-mounted, route the conduit along the ceiling of the room below the equipment then stub up to the equipment location. In case there is no room below the equipment, route the conduit exposed to the nearest wall and cast the conduit in the concrete floor and stub up to equipment control panel/disconnect/terminal location. Coordinate equipment stub ups with the equipment suppliers prior to installation.
- C. When installed outdoors, paint metallic rigid galvanized steel conduits with weather resistant paint. Use a compatible paint primer and two coats of paint.
- D. Paint fire alarm system conduits red.
- E. Paint conduits installed indoors to match the surrounding walls excluding those with special color requirements (fire alarm etc).

- F. Do not install conduit exposed on the exterior surface of the building. Either conceal conduits in finished areas or expose conduit on the inside of the building and stub outside to designated equipment.
- G. Wherever conduit is to be encased in concrete, ensure that joints or connections are watertight. For epoxy / PVC coated RGS, after cleaning the threads have been screwed on tightly, paint the joint with epoxy paint and allow drying before being encased. Treat outside of conduit boxes similarly after connecting the conduit and before their encasement. Before concrete is poured, pack all outlet boxes tightly with paper and have open ends of conduit capped to prevent concrete entry. Use proper solvent weld for joining rigid PRV conduit.
- H. Install expansion sleeves with bonding wherever conduits cross a structural joint.
- I. Ensure that exposed conduit runs are neat in appearance and run parallel to the structural lines of the building. Use only approved conduit fittings and covers. Fasten exposed conduit by cinch or expansion anchors only, using one-hole pipe straps or two hole straps, as specified.
- J. Make rigid galvanized steel conduit bends cold with the radius of bend not less than 9 times the conduit diameter. Ensure that no bend flattens the conduit by more than one-tenth of its diameter. Otherwise use manufactured bends.
- K. Cut threads on conduit neatly with the ends square and the inner diameter reamed smooth to remove burrs.
- L. Provide junction or pull boxes where the number of right-angle bends in one run exceeds three.
- M. Cut cover screws for conduit fittings or junction boxes, to length to avoid damage to wires.
- N. Cap open ends of conduit with proper threaded caps immediately after installation. Do not use wooden plugs.
- O. Where indicated on the Drawings, ensure conduits are sized accordingly. Do not exceed the number of wires in any conduit per the requirements of the current edition of the Canadian Electrical Code. Do not pull any group of wires sufficient to damage or distort them and use only an approved silicone base (greaseless) lubricant to facilitate pulling.
- P. Form a continuous metallic path with conduit and fittings in accordance with the latest requirements of the Canadian Electrical Code to the satisfaction of the local inspector.
- Q. For conduit connections to equipment whose position is subject to adjustment or vibration, use flexible galvanized steel conduit with a PVC jacket equal to "Sealtite" for a length not exceeding 500 mm.
- R. Ensure that no conduit or pullboxes are closer than 200 mm to heating equipment.
- S. Where indicated on the Drawings or required, fasten conduit to Unistrut support channels using approved clamps.



- T. Use short lengths of liquid-tight PVC coated flexible steel conduits for connections to motors, except as otherwise indicated on the Drawings or specified.
- U. Install 4.5 kN tensile strength polypropylene or nylon fish cord in empty conduits or conduits provided for telephone and paging systems.
- V. For threaded joints in hazardous areas, ensure that at least 5 threads are fully engaged.
- W. Seal all conduits exiting the chemical area with removeable duct sealing compound.
- X. For threaded joints in chemical areas, ensure that at least 5 threads are fully engaged.
- Y. Where supports are required on structural steel, weld studs to the structure but do not cut or drill beams or structural steel unless written permission from the Engineer is obtained.
- Z. The conduit installations made to panelboards / control panels must maintain the panel's appropriate EEMAC/NEMA rating.

END OF SECTION 16111

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Requirements:

- A. The drawings are not intended to show in detail, the location and size of every wire. Ensure that each and every item of power and control equipment shown on any or all drawings is provided and interconnected by cables of the specified or approved type and size for the intended purpose, as shown by the cable schedules, schematic and distribution diagrams, manufacturer's equipment diagrams, and the Contract Documents.
- B. Identify wiring with wire markers at both ends.
- C. Wire sizes shown have been determined on the basis of ampacity, short circuit availability or voltage drop. Do not reduce wire size without approval from the Engineer.
- D. Colour code single conductors forming part of a multiple conductor cable for phase identification.

#### Lighting and Power

- |    |             |   |       |
|----|-------------|---|-------|
| 1. | Line 1      | - | Red   |
| 2. | Line 2      | - | Black |
| 3. | Line 3      | - | Blue  |
| 4. | Neutral     | - | White |
| 5. | Ground Wire | - | Green |

### E. Phase relationships and terminal requirements:

- |    |        |   |        |   |        |
|----|--------|---|--------|---|--------|
| 1. | Left   | - | Middle | - | Right  |
| 2. | Line 1 | - | Line 2 | - | Line 3 |
| 3. | Red    | - | Black  | - | Blue   |

### 1.03 Quantities:

- A. Refer to 'E' electrical drawings.

## PART 2 - PRODUCTS

### 2.01 Power and Control Wiring:

- A. Conductors: sized as indicated or required, stranded copper for #12 AWG and larger. Stranded copper for motor conductors.

- B. Insulation: 600 volt RW90 insulation for conductors up to size #10 and 1000 volt RW90 insulation for conductors size #8 and larger to CSA C22.2 No. 38 -latest edition. Use RWU-90 in underground conduit and ducts and for hydro service cables.
- C. Minimum conductor size for power and lighting wiring: #12 AWG.
- D. Minimum conductor size for control wiring: #14 AWG, coloured per unit function.
- E. Flexible cable for pendant equipment - Type SEW 600 volt, 4 conductors.
- F. Ground wires - bare copper with green RW 90 insulation when run in duct banks, tray or conduit. Use RWU-90 in underground conduit and ducts and for hydro service cables.
- G. Provide Teck90 cables for power and control for direct buried and unprotected cable trough runs. Teck90 cables to have Hazardous Location Rating (HL) when used in classified area.
- H. Armored VFD Cables: Provide 3/C armored cable with three symmetrical grounding wires with in the interstices of the phase conductors. Armor to also provide EMI shielding performance.

## 2.02 Instrumentation and Signal Wiring:

### A. Analog Signal

- 1. In conduit: 600V CIC, shielded twisted pair or triads (as required), insulated stranded tinned copper, aluminum foil-polyester shield 100%, stranded tinned copper drain wire, PVC jacket, conductor size #16 AWG, Belden Part No. 224xx or Owner approved equivalent.
- 2. In cable trays: 600V ACIC Armored cables, shielded twisted pair or triad (as required), insulated stranded tinned copper, aluminum foil-polyester shield 100%, tinned copper drain wire, PVC jacket, interlocked steel armor, and PVC outer jacket, size #16 AWG, Belden Part No. 255xx or Owner approved equivalent.

### B. DC Power and Digital Signal

- 1. In conduit: 600V CIC multiconductor cable, 6 conductor #14 AWG, insulated stranded copper, PVC jacket, Belden Part No. 22104 or Owner approved equivalent.
- 2. In cabletrough: 600V Teck90 cables, 6 conductor #14 AWG copper, stranded, insulated, PVC inner jacket, PVC jacketed aluminum interlock armour, Belden Part No. C5504 or Owner approved equivalent.

### C. Data Signals:

- 1. Use Cat-6 cables for telephone, Ethernet and communication link wiring unless otherwise noted. Cables to be 24 AWG, twisted pair with flame retardant PVC for non-plenum installations and low smoke flame retardant PVC for all plenum installations. Cables to be colored gray for telephone wiring and blue for data wiring. Provide additional cable colors for other systems as required.

PART 3 - EXECUTION

## 3.01 Installation of Power Wires:

## A. Install wiring as follows:

1. In conduits in accordance with Section 16111.
2. In underground ducts in accordance with Sections 16106 or 16107.
3. Do not pull spliced cables inside ducts or conduit.
4. Do not use splice cables from supply point to load, unless otherwise indicated and approved.
5. Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

## 3.02 Teck90 or Armored Cable:

- A. Install cable in Cable Trays or as shown on the drawings.
- B. When not using cable trays, install the cables in open ended conduits keeping the installation neat and straight.
- C. Secure all cables to tray with recommended clamps. Secure all conductors using nylon wire ties.
- D. Support all single and multi-conductor cables adequately in manholes, using approved metal inserts.
- E. Provide barrier as supplied by the cable tray manufacturer for separation of control and power cables.

## 3.03 Installation of Instrumentation Signal Cables:

- A. Install instrumentation signal cables, in conduits and cable trays.
- B. Ground the cable shields only at one end. Where cables are joined at terminal strips in terminal boxes or panels between the transmitter and receiver for series connections, join the shields, insulate connection, but do not ground.
- C. Provide at least 20% spare cables for the control and instrumentation when wiring is done between local control panels, Motor Control Centers and PLC.
- D. Provide proper barrier from power wires as per OESC.

END OF SECTION 16122

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

## PART 2 - PRODUCTS

### 2.01 Junction and Pull Boxes:

- A. Size and install boxes in accordance with CSA C22.2 No. 40.
- B. Welded steel construction or rigid PVC with screw on flat covers for surface mounting, matching conduit material type.
- C. Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- D. Provide gasketed covers for wet or damp locations.
- E. Provide terminal blocks of suitable size for inter-connection of wires (twist-on or marrette style connections not allowed).
- F. For Class 1 Div 1 (Zone 1) hazardous locations, use boxes only approved for the hazard - Class 1, Division 1, Group D, with coating material similar to PVC coated RGS (Robroy) conduits.
- G. For Class 1 Div 2 (Zone 2) hazardous locations with non-arcing components and connecting devices such as joints, terminal blocks etc, use NEMA-4X boxes with coating material similar to PVC coated RGS (Robroy) conduits. For all other applications use boxes approved for Class 1 Zone 2 locations.
- H. For OESC Category 1 and Category 2 locations, use boxes with coating material similar to PVC coated RGS (Robroy or equivalent) conduits.
- I. For chemical locations, use junction and pull boxes with protective coating suitable for corrosive conditions.

## PART 3 - EXECUTION

### 3.01 Installation of Junction and Pull Boxes:

- A. Install junction and pull boxes in inconspicuous but accessible locations.
- B. For hazardous locations, ensure that conduit entries are threaded with at least 5 full threads engaged as per the OESC.

END OF SECTION 16131

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

## PART 2 - PRODUCTS

### 2.01 Outlet and Conduit Boxes General:

- A. Size boxes in accordance with CSA C22.1, Section 12.
- B. 102 mm square or larger outlet boxes as required for special devices.
- C. Gang boxes where wiring devices are grouped.
- D. Provide blank cover plates for boxes without wiring devices.
- E. Combination with barriers where outlets for more than one system are grouped.
- F. Masonry electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.
- G. Concrete electro-galvanized steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- H. Provide weatherproof fittings, boxes and covers, in below grade areas, in accordance with EEMAC 4 / NEMA 4, unless otherwise noted.
- I. Single Gang or Two Gang ECS type boxes for hazardous locations.
- J. For hazardous locations, only use boxes and fittings approved for the hazard similar to the corresponding conduit material.
- K. For chemical locations, use boxes and fittings with protective coating suitable for corrosive conditions.

### 2.02 Conduit Boxes:

- A. Rigid PVC FS or FD boxes with factory hubs and mounting feet for surface wiring of switches and receptacles.

### 2.03 Fittings General:

- A. Ferrous hot-dip galvanized for rigid galvanized conduit.
- B. Rigid PVC for rigid conduit.
- C. Bushing and connectors with nylon insulated throats.
- D. Knock-out fillers to prevent entry of debris.

- E. Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- F. Double locknuts and insulated bushings on sheet metal boxes.

### PART 3 - EXECUTION

#### 3.01 Installation:

- A. Support boxes independently of connecting conduits.
- B. Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
- C. Provide correct size of openings in boxes for conduit. Reducing washers are not allowed.
- D. Install all outlet boxes in exterior walls with flexible vapour barrier and seal with caulking.
- E. Provide proper seals for hazardous locations (say, Class 1, Division 1, Group D) meeting the requirements of the OESC.

END OF SECTION 16132

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

## 1.02 Warranty and Maintenance:

- A. The Warranty and Guarantee periods commence at Substantial Performance of the entire project, unless otherwise agreed to by the Owner in writing.
- B. Unless otherwise specified, provide a one (1) year warranty for all components of the work.
- C. Promptly correct any defects during the Guarantee Period.
- D. Submit the required guarantee/warranty certificates and/or written documentation as specified.

PART 2 - PRODUCTS

## 2.01 Switches:

- A. 15A, 20A, 120V, single pole switches as indicated or where required, manually operated, brown toggle, specification grade.
- B. Switches of one manufacturer through project where possible.
- C. Acceptable manufacturers:
  - 1. Arrow Hart
  - 2. Bryant
  - 3. Hubbell
  - 4. Smith & Stone
  - 5. Appleton (Hazardous Locations)

## 2.02 Receptacles:

- A. Duplex receptacles, CSA Type 5-15R 125 Volts, 15A, u-ground, brown, (in all areas except finished areas) specification grade.
- B. Receptacles of one manufacturer throughout projects, where possible.
- C. GFCI receptacles for outdoor locations, within 1.5 meter of sinks or shower stalls.
- D. Acceptable manufacturers:
  - 1. Arrow Hart



2. Bryant
3. Hubbell
4. Smith & Stone
5. Appleton (Hazardous Locations)

### 2.03 Coverplates:

- A. Coverplates for wiring devices in finished non hazardous areas: stainless steel, type 302 alloy, 0.035 satin finish.
- B. Coverplates for wiring devices in finished hazardous areas:
  1. Receptables: Malleable iron housing and cover, baked grey epoxy finish (Appleton EFSR-1523C-M) rated for Class 1 Div 1 Grp D.
  2. Switches: Malleable iron housing and cover, front operated tumbler switch (Appleton ECSK to suit switch type) rated for Class 1 Div 1 Grp D.
- C. Coverplates from one manufacturer throughout project, except for hazardous locations.
- D. Coverplates for surface mount wiring devices and blank Scepter PVC type.
- E. Weatherproof duplex receptacle covers: Hubbell Cast Aluminum, Cat. No. 5205 UO.
- F. Rain Tight, while in use type cover for outdoor receptacles.

### 2.04 Wiring Device Schedule:

- A. Schedule for material requirements as follows:

Wiring Device	Rating	Manufacturer's Cat. No.
Single Pole Toggle Switch	15A, 120-277VAC	Hubbel #1201 (ivory) (for finished non hazardous areas) and Hubbel #1201 (brown) (for all other non hazardous areas).
3-way Toggle Switch	15A, 120-277VAC	Hubbel #1203F (ivory) (for finished non hazardous areas) and Hubbel #1203 (brown) (for all other non hazardous areas)
4-way Toggle Switch	15A, 120-277VAC	Hubbel #1204I (ivory) (for finished non hazardous areas) and Hubbel #1204 (brown) (for all other non hazardous areas)
Single Pole Toggle Sw.	20A, 120-277VAC	Hubbel #1221I (ivory) (for finished non hazardous areas) and Hubbel #1221 (brown) (for all other non hazardous areas) Appleton #ECSK-F1 Tumbler Switch (for hazardous areas)

Wiring Device	Rating	Manufacturer's Cat. No.
3-way Toggle Switch	20A, 120-277VAC	Hubbel #1223I (ivory) (for finished non hazardous areas) and Hubbel #1223 (brown) (for all other non hazardous areas) Appleton #ECSK-F3W Tumbler Switch (for hazardous areas)
4-way Toggle Switch	20A, 120-277VAC	Hubbel #1224I (ivory) (for finished non hazardous areas) and Hubbel #1224 (brown) (for all other non hazardous areas) Appleton #ECSK-F4W Tumbler Switch (for hazardous areas)
Duplex Receptacle	15A, 125VAC	Hubbel #5262-I (ivory) (for finished non hazardous areas) and Hubbel #5262 (brown) (for all other non hazardous areas)
Single Receptacle	15A, 125VAC	Hubbel #5261-I (ivory) (for finished non hazardous areas) and Hubbel #5261 (brown) (for all other non hazardous areas) Appleton #EFSR-1523C-M (for hazardous areas)
Range Receptacle c/w cover plate	50A, 125/250VAC 3 pole, 4 wire	Hubbel #9450 (black) (for non hazardous areas)
Flush Floor Duplex Receptacle with flap cover	15A, 125V	Hubbell #S-3925
Deep box for flush Floor Receptacle		Hubbell #B-2527
Clock Hanger Receptacle c/w S.S. coverplate	15A, 125V	Hubbell 5235 (brown)
GFI Receptacles	20A, 125V	Hubbel #GF-5252SC (ivory) (for finished non hazardous areas) and Hubbel #GF-5252C (brown) (for all other non hazardous areas)
While in use covers		Hubbel Extra Duty die-cast metal construction TAYMAC series (MX3200, MX6200 etc.)
Isolated Ground Duplex Receptacle	15A, 125V	Hubbel #IG-5262 (orange) (for all non hazardous areas)

B. 600 Volts Outlets and Plugs:

1. 600 volt outlets shall be supplied for 3 phase 4 wire operation for portable equipment.
2. The current rating shall be 60A minimum.

3. The receptacle shall be the following:
  - a) Non hazardous areas: Appleton #IDSR 6034-NF-C Non fusible disconnect switch with screw cap receptacle
  - b) Hazardous areas: Appleton #EBR 6034 non breakered (Class 1 Div 1 Grp D) disconnect switch with screw cap receptacle.
4. Each receptacle shall be complete with matching plug - Appleton #ACP 6034BC.

### PART 3 - EXECUTION

#### 3.01 Installation:

##### A. Switches:

1. Install single throw switches with handle in "UP" position when switch closed.
2. Install switches in gang type outlet box when more than one switch is required in one location.
3. Install seals as required by the Ontario Hydro Electrical Safety Code (OHESC) for hazardous locations.
4. Mount toggle switches at height specified in Section 16000 or as indicated.

##### B. Receptacles:

1. Install receptacles in gang type outlet box when more than one receptacle is required in one location.
2. Install seals as required by the OHESC for hazardous locations.
3. Mount receptacles at height specified in Section 16000 or as indicated.
4. Rooftop receptacles for maintenance of HVAC equipment as per OESC Rule 26-704.

##### C. Coverplates:

1. Install suitable common coverplates where wiring devices grouped.
2. Do not use coverplates meant for flush outlet boxes on surface mounted boxes.

END OF SECTION 16141

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

## PART 2 - PRODUCTS

### 2.01 Materials:

- A. Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- B. Fixture type splicing connectors: with current carrying parts of coppers sized to fit copper conductors 10 AWG or less.
- C. Bushing stud connectors: to consist of:
  - 1. Connector body and stud clamp for stranded copper conductors.
  - 2. Clamp for stranded copper conductors.
  - 3. Stud clamp bolts.
  - 4. Bolts for copper conductors.
  - 5. Sized for conductors as indicated.
- D. Clamps or connectors for armoured cable, flexible conduit, as required.

## PART 3 - EXECUTION

### 3.01 Installation:

- A. Remove insulation carefully from ends of conductors and:
  - 1. Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness test in accordance with CSA C22.2 No. 65.
  - 2. Install fixture type connectors and tighten. Replace insulating cap.
  - 3. Install bushing stud connectors in accordance with manufacturer's recommendations.
  - 4. Install crimp type connectors with approved compression tool.
  - 5. Install box connectors in an approved manner.

END OF SECTION 16151

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Install fastenings and supports as required for equipment, cables and conduits.

## PART 2 - PRODUCTS

### 2.01 Support Channels:

- A. U shape, size 41 x 41 mm, 2.7 mm thick (12 gauge), surface mounted, suspended or as required set in poured concrete walls and ceilings.
  - 1. Galvanised steel channels for indoor dry areas, galvanized accessories, and plated fasteners
  - 2. Aluminium channels for outdoor and indoor wet areas, stainless accessories, and stainless fasteners
  - 3. PVC coated channels for hazardous, corrosive, OESC category 2 areas, PVC coated accessories, 316 stainless fasteners

## PART 3 - EXECUTION

### 3.01 Installation:

- A. Secure equipment and supports to masonry, tile and plaster surfaces with lead anchors.
- B. Secure equipment and supports to hollow masonry walls or suspended ceilings with toggle bolts.
- C. Secure equipment and supports to interior poured concrete with HILTI expandable inserts.
- D. Secure equipment and supports to exterior poured concrete with HILTI chemical adhesive and 316 stainless anchor-rod.
- E. Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified.
- F. For heavy equipment or devices to be mounted in T-bar ceilings, use support chains rated for the appropriate weights, hung with support hooks mounted in ceiling slab.
- G. Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps, etc., designed as accessories to the support channels. All accessories to come from support channel manufacturer.

- H. Fasten exposed surface mounted conduit and cables to building construction or support system using straps.
  - 1. One-hole straps for conduits and cables 50 mm or smaller.
  - 2. Two-hole straps for conduits and cables larger than 50 mm.
  - 3. Beam clamps to secure conduit to exposed steel work.
  - 4. Provide galvanized straps and clamps for indoor dry location, with stainless steel 316 fasteners, mechanical anchors.
  - 5. Provide Stainless Steel 316 straps and clamps for outdoor and indoor-damp locations with stainless steel 316 fasteners, mechanical anchors.
  - 6. Provide stainless steel 316 straps and clamps for hazardous, corrosive, OESC category 1, and OESC category 2 areas, PVC coated accessories, 316 stainless fasteners, stainless mechanical anchors.
  
- I. Suspended Support Systems.
  - 1. Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - 2. Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
  - 3. Provide galvanized rod and clips for indoor dry locations, stainless steel 316 fasteners, mechanical anchors.
  - 4. Provide Stainless Steel 316 rod and clips for outdoor and indoor-damp locations with stainless steel 316 fasteners, mechanical anchors.
  - 5. Provide Stainless Steel 316 rod and clips for hazardous, corrosive, OESC category 1, and OESC category 2 areas, PVC coated accessories, 316 stainless fasteners, stainless mechanical anchors.
  
- J. For surface mounting of two or more conduits use U-channels at 3 m centres spacing.
  
- K. Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
  
- L. Do not use wire lashing or perforated strap to support or secure raceways or cables.
  
- M. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of the other trade and approval of the Engineer.

END OF SECTION 16191

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

## PART 2 - PRODUCTS

### 2.01 Disconnect Switches:

- A. Fusible or non-fusible disconnect switch as shown on drawings.
- B. Service entrance rated where shown on drawings.
- C. For 120V mechanical equipment, disconnect switch shall be a 20A toggle type switches with stainless steel cover plate unless specified otherwise.
- D. All 600V disconnect switches Short circuit rating to exceed the available fault current as determined by the short circuit study.
- E. All 600V motor disconnect switches shall be HP rated to match the HP rating of the motor.
- F. For 600 V rated HVAC equipment use disconnect switches approved for HVAC applications.

### 2.02 Construction:

- A. Enclosure EEMAC/NEMA 4X stainless steel SS316 for outdoor and indoor wet locations.
- B. Enclosure EEMAC/NEMA 12 for indoor dry locations.
- C. Enclosure to be NEMA 7 for Hazardous Area (Zone 1 or 2 as required) for indoor dry locations
- D. Enclosure to be NEMA 8 (or NEMA 7 combined with NEMA 4X) for Hazardous Area (Class 1, Zone 1 or 2 as required) for outdoors and indoor wet locations
- E. Switch blades and jaws shall be visible and plated copper.
- F. Switches shall have defeatable door interlocks that prevent the door from opening when the handle is in the ON position. Defeater mechanism shall be front accessible.
- G. Switches shall have deionizing arc chutes.
- H. Switch assembly and operating handle shall be an integral part of the enclosure base.
- I. Provide option for padlocking in ON-OFF switch position.
- J. Fuse holders: suitable without adapters, for type and size of fuse indicated.
- K. Switches shall have quick-make, quick-break action.

- L. Provide ON-OFF position indicator on switch enclosure cover.
- M. Auxiliary N/O and N/C contact for interlocking where shown on the control circuits.

### 2.03 Manufacturers:

- A. Acceptable manufacturers:
  - 1. Eaton / Cutler Hammer
  - 2. ABB
  - 3. Schneider Electric
  - 4. Siemens
  - 5. Hubbell
  - 6. Appleton
  - 7. Meltric

## PART 3 - EXECUTION

### 3.01 Installation:

- A. Install seals as required by the OESC for disconnects installed in hazardous areas.
- B. For fused disconnect switches, provide one set of spare fuses stored inside a fuse storage box with ingress protection suitable for the area. Install this storage box in vicinity of the fused disconnect. Provide legible label 'Spare Fuse set'.
- C. Nameplate shall be front mounted indicating switch type, ampere rating, and maximum voltage rating in addition to specified client tagging details.

END OF SECTION 16440



## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Provide grounding systems as shown on the drawings and specified herein.

## PART 2 - PRODUCTS

### 2.01 Materials:

- A. Grounding equipment to conform to: CSA C22.2 No. 41.
- B. Ground Electrodes: manufactured grounding rod copper bonded steel 19mm diameter and 3 meter long.
- C. Clamps for grounding of conductor, size as required to electrically conductive underground water pipe.
- D. Copper conductor at least 20 m long for each concrete encased electrode, bare, stranded, soft annealed, size (as indicated).
- E. System and circuit, equipment, grounding conductors, bare stranded copper soft annealed, size as indicated.
- F. Non-corroding accessories, necessary for grounding system, type, size, material as required, or as indicated, including but not necessarily limited to:
  - 1. Grounding and bonding bushings.
  - 2. Protective type clamps.
  - 3. Bolted type conductor connectors.
  - 4. Bonding jumpers, straps.
  - 5. Pressure wire connectors.
  - 6. Thermit welded type conductor connectors.

## PART 3 - EXECUTION

### 3.01 Installation - General:

- A. Install complete permanent and continuous grounding systems including electrodes, conductors, connectors, accessories to conform to requirements of the Engineer and

authorities having jurisdiction over installation. Where PVC conduit is used, run ground wire in conduit.

- B. Install connectors to manufacturer instructions.
- C. Protect exposed grounding conductors from mechanical injury.
- D. Make buried connections, and connections to conductive water main, electrodes, using copper welding by cadweld process.
- E. Use mechanical connectors for grounding connections to equipment provided with lugs.
- F. Soldered joints not permitted.
- G. Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- H. Connect building structural steel and metal siding to ground as per OESC.
- I. Make grounding connections in radial configuration only, with connections termination at single grounding point. Avoid loop connections.
- J. If an existing ground detection system exists connect the new ground system to it.

### 3.02 Electrodes:

- A. Install ground electrodes and make grounding connections, as indicated.
- B. Make special provision for installing electrodes that will give an acceptable resistance to ground value, where rock or sand terrain prevails.

### 3.03 System and Circuit Grounding:

- A. Install system and circuit grounding connections to neutral of secondary 600/347 Volt and 208/120 Volt system as indicated.

### 3.04 Equipment Grounding:

- A. Install grounding connections to typical equipment included in, but not necessarily limited to, the following list: service equipment, duct systems, starters, control panels, building steel work, distribution panels, pipe and conduit systems.
- B. Install grounding connections to meet the requirements of the OESC.

### 3.05 Cable Sheath Grounding:

- A. Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.
- B. Use No. 6 flexible copper wire soldered, not clamped, to cable sheath.

- C. Connect bonded cables to ground with No. 2/0 AWG copper connector.

3.06 Tests:

- A. Perform test in accordance with Section 16000 – Electrical.
- B. Perform ground continuity and insulation resistance tests using method appropriate to site conditions and to approval of Engineer and authorities having jurisdiction over installation.
- C. Perform test before energizing electrical system.

END OF SECTION 16450.

PART 1 - GENERAL

## 1.01 Reference:

A. Section 16000 applies to and governs the Work of this Section.

## 1.02 Work Included:

A. Provide dry type transformers as shown on the drawings and specified herein.

PART 2 - PRODUCTS

## 2.01 Transformers:

A. Dry type transformers are manufactured and tested in accordance with CSA, ANSI C57.12.91 standard, CSA C22.2-47, CSA C9 standards, NEMA TP-1 and TP-2;

B. Use transformers of one manufacturer throughout project.

## C. Design:

1. Type: ANN

2. 3 phase or single phase with kVA rating as indicated on the drawings. Primary and secondary voltages as indicated on the drawings.

3. Insulation: Temperature Class 220°C

4. Maximum allowed Temperature rise: 150°C at 40°C ambient

5. Impedance: standard.

6. Separate primary and secondary copper windings only with soldered terminals. Aluminum windings is not accepted.

7. Taps: 4-2 1/2%, 2-FCAN and 2-FCBN.

8. Enclosure: NEMA 1 or better, removable metal front panel for indoor installation

9. Enclosure: NEMA 3R, for outdoor installation or indoor wet locations

10. Enclosure shall be provided with separated grounding connector as per standard; with ventilation openings, mounting brackets and lifting devices;

11. Neutral terminal X0 provided with double connector;

12. Efficiency level: Efficiency values as per CSA 802.2 standard;

13. Wall mounting, floor mounted on concrete pad or in MCC as indicated. For wall mounted transformers provide manufacturer supplied bracket.

14. Finish for wall mount: ANSI 61 grey.

2.02 Acceptable Manufacturers:

- A. Marcus Transformers
- B. Siemens
- C. ABB
- D. Delta Transformers
- E. Rex Transformers
- F. Hammond Power Solutions
- G. Schneider Electric

### PART 3 - EXECUTION

3.01 Installation:

- A. Transformer up to 45KVA should be wall mounted unless otherwise indicated. Transformers above 45KVA to be floor mounted.
- B. For wall mounted transformers, provide supporting structure suitable for mounting in the location indicated in the drawing designed and sealed by a Professional Engineer.
- C. Install transformers on a 100mm concrete pad if installed floor mounted.
- D. Ensure adequate clearance is provided around transformer for ventilation. Consult manufacturer's recommendations for further instructions.
- E. Make primary and secondary connections as shown on wiring diagram.
- F. Ground the transformers as per OESC.

END OF SECTION 16461

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide panelboards as shown on the drawings and specified herein.

### 1.03 Related Work

- A. Molded Case Circuit Breakers – Section 16477

### 1.04 Shop Drawings:

- A. Drawings to include main bus voltage and ampacity, enclosure dimensions, and branch circuit breaker (type, quantity, sizes).

## PART 2 - PRODUCTS

### 2.01 Panelboards:

- A. Panelboard to meet to CSA C22.2 No. 29.
- B. Manufacturer's nameplate to show fault current for panel and breakers.
- C. Voltage and phases as shown in drawing, bus and breakers rated for minimum 10KA symmetrical interrupting capacity for up to 240V and 22KA above 240V; or as indicated on the drawings (whichever is higher). Provide fully rated panels, series rated are only acceptable if shown on the drawings.
- D. Sequence phase bussing with odd numbered breakers on the left and even numbered on the right. Permanently identify each breaker with circuit number.
- E. Panelboard door: lockable with concealed hinges and positive latching.
- F. Provide factory installed padlocking devices for each 600V breaker (for below 600V where shown on drawings)
- G. Tin plated copper bus with full size neutral.
- H. Mains suitable for bolt-on breakers. All 600V breakers (main/branch) to be bolt-on type.
- I. Surface or flush mounting or in MCC as indicated.
- J. Provide NEMA12 enclosure for indoor installation; NEMA4X for outdoor installation.
- K. Provide panelboard rated to area classification category.

- L. For chemical areas, install inside a NEMA4X fiber glass enclosure. Provide conduit seals to prevent ingress of chemical vapors inside the panelboard.

#### 2.02 Breakers:

- A. Provide breakers per Section 16477.
- B. Install circuit breakers in panelboards before shipment.
- C. Breakers shall have lock on devices with each panel.

#### 2.03 Identification:

- A. Nameplate: provide engraved lamacoid nameplate screw fastened to door exterior.
- B. Directory: provide a type-written complete circuit directory, protected under transparent plastic, showing location and load of each circuit. Update directories of existing panelboards.

#### 2.04 Acceptable Manufacturers:

- A. Schneider Electric,
- B. Eaton,
- C. Siemens,
- D. Allen Bradley,
- E. ABB

### PART 3 - EXECUTION

#### 3.01 Installation:

- A. Locate panelboard as indicated and mount securely, plumb true and square, using unistrut construction or as per detail on drawing. Unistrut to be fixed in position prior to pouring cement for floor slab. Supply panelboards in MCC where shown.
- B. Mount panelboards to the heights indicated in Section 16000. Where floor mounted provide a 100m high concrete maintenance pad.
- C. Assign the circuits to balance the load so that each phase is loaded equally. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within [20%] of each other.
- D. Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION 16471

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

### 1.02 Definitions:

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
  - 1. MCCB: Molded Case Circuit Breaker
  - 2. LSIG or combination of these letters: type of protection and available adjustments on certain trip units.
    - a) L: Long Time (overload protection, analogous to the inverse-time thermal trip of a thermal/magnetic breaker)
    - b) S: Short Time (short circuit protection of low level faults)
    - c) I: Instantaneous (short current protection of high level faults, analogous to the instantaneous magnetic trip of a thermal/magnetic breaker)
    - d) G: Ground Fault (equipment ground fault protection)
    - e) Therefore, LSIG = Long-time + Short-time + Instantaneous + Equipment Ground-fault Protection
  - 3. ETD = Electronic Trip Device (adjustable)

### 1.03 Work Included:

- A. Provide molded case circuit breakers as shown on the drawings and specified herein.

## PART 2 - PRODUCTS

### 2.01 Breakers General:

- A. Provide Moulded case circuit breakers certified to CSA C22.2 No. 5.
- B. Bolt-on thermal magnetic moulded case circuit breaker, quick make, quick break type, for manual operation.
- C. Common-trip breakers with single handle for multi-pole applications. No handle ties allowed.



- D. Individual moulded case circuit breakers to be in NEMA 1 enclosures for indoor climatically controlled area installation (electrical room etc.) and NEMA-4X for indoor damp / non-climatically controlled locations (pump rooms etc.) and outdoor installation, unless otherwise noted. Provide enclosure rated for Hazardous Area Class/Zone when installed inside classified area.
- E. Symmetrical interrupting capacity:
  - 1. Up to and including 250-volt: 10kA
  - 2. Above 250-volt and below 600-volt: 22kA.
  - 3. 600-volt: match the Interruption capacity of the panel board / MCC in which the breaker is being installed. Breaker must be fully rated. Series rating acceptable only when specifically mentioned on drawings.
- F. Provide spare NC and NO contacts where shown.
- G. Main breakers to be 100% current rated.
- H. Breakers with adjustable ampere rating (that can be changed without removing the trip unit) are to be provided with a method of adjustment that does not require opening the panel.
- I. Breaker 1000A or above to be provided with Ground Fault Protection as per OESC rule 14-102.
- J. Breakers for utility service entrance must be CSA approved for Service Entrance application.

#### 2.02 Thermal Magnetic Breakers:

- A. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection, with interchangeable magnetic trip units.

#### 2.03 Electronic Trip Breakers:

- A. Moulded case circuit breaker to operate automatically by means of adjustable electronic tripping devices to provide inverse time current tripping under overload conditions and instantaneous tripping for short circuit protection.
- B. Breaker above 400A should be provided with adjustable electronic trip.

#### 2.04 Magnetic Breakers:

- A. Moulded case circuit breaker (motor circuit interrupter) to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for each circuit protection. Use for combination starters.

2.05 Acceptable Manufacturers:

- A. First Named: Eaton / Cutler-Hammer
- B. Acceptable alternates: Siemens, Schneider Electric, ABB, GE

**PART 3 - EXECUTION**

- A. Install breakers in the panelboards / switchboards / MCC as per manufacturer's instructions.
- B. Adjust the breaker settings as per the recommendation of Selective Protection Coordination Study.

END OF SECTION 16477

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

## 1.02 Work Included:

- A. Provide contactors as shown on the drawings and specified herein.

PART 2 - PRODUCTS

## 2.01 Contactors:

- A. Contactors to match NEMA rating of panel.
- B. Provide a NEMA-1 enclosure for indoor dry locations, unless otherwise indicated.
- C. Provide a NEMA-4X enclosure for indoor damp / non-climatically controlled locations (pump rooms etc.) and outdoor installation, unless otherwise noted.
- D. Provide enclosure rated for Hazardous Area Class/Zone when installed inside classified area.
- E. Electrically held, controlled by pilot devices as indicated and rated for type of load controlled.
- F. Provide minimum 2 normally open and 2 normally closed spare auxiliary contacts.
- G. Provide surge suppressor for contactor coil.

## 2.02 Acceptable Manufacturers:

- A. First named: Siemens, Schneider Electric, Eaton, Allen Bradley, GE, ABB

PART 3 - EXECUTION

- A. There are no instructions in this part.

END OF SECTION 16485

**PART 1 - GENERAL****1.01 Reference:**

- A. Section 16000 applies to and governs the Work of this Section.

**1.02 Work Included:**

- A. Provide Lighting equipment as shown on the drawings and specified herein.

**1.03 Related Work**

- A. Conduit, Conduit Fastenings - Section 16111

**1.04 Codes and standards:**

- A. HID lamps to: ANSI C78-1972.
- B. Fluorescent lamps to: ANSI C78 – Fluorescent Lamps 1972.
- C. Provide equipment certified to the electrical classification of the area where the equipment is installed.

**1.05 Submittals:**

- A. Include luminaire colour temperature.
- B. Contractor to coordinate and assist owner and provide the information listed below at least or any information requested by the owner to submit an application for Save-on-Energy Incentives.
  - 1. Existing Fixtures:
    - a) Type
    - b) Lamp wattage
    - c) Lamps/fixture quantity
  - 2. Photos of fixture being removed:
    - a) Photo of the typical room for each type of fixture.
    - b) Photo of the typical fixture being removed, (for each type of fixture)
    - c) Closeup photo of the nameplate showing the wattage, (either of the lamp installed or the box replacement lamps if actual lamp is not accessible).
    - d) All photos must show the time stamp indicating the date it was taken.
  - 3. Photos of new fixtures being installed:
    - a) Photo of the typical room for each type of fixture.

- b) Photo of the typical fixture being installed, (for each type of fixture)  
Closeup photo of the nameplate showing the model number, wattage etc.
  - c) All photos must show the time stamp indicating the date it was taken.
4. Documentation for waste disposal:
- a) A receipt, certificate or invoice from the waste disposal company indicating the number of lamps and type of lamps disposed off.

## **PART 2 - PRODUCTS**

### **2.01 Lamps:**

#### **A. Exit Lights:**

1. Exit lights shall be suitable for wall and/or ceiling mounting. The housing and faceplate shall be constructed of one-piece extruded aluminum. Finish shall be polar white in finished areas.
2. The exit sign face shall be ISO 3864-1 and ISO 7010 green & white "running man" graphical symbol. Running man sign shall be internally illuminated with white LEDs and be certified CSA 22.2 No.141-10. It shall operate with 2-wire AC input voltage of 120 to 347Vac at less than 2 Watts and 2-wire DC input voltage from 6 to 24Vdc at less than 1.5 Watts. Externally illuminated ULC S572 Photoluminescent or "Power Free" Radioluminescent signs are not acceptable.
3. Single directional arrow where indicated on drawings for single and double face signs. If both arrow left & arrow right are required for T intersection, contractor shall supply & install 2 separate running man signs, 1 arrow left & 1 arrow right.

#### **B. LED Lighting:**

1. CSA approved, ULC listed and labeled.
2. Operating temperature:
  - a) Luminaires in non-climate-controlled areas shall be rated for -30 C to 60 C.
  - b) Luminaires in climate-controlled areas shall be rated for -20 C to 50 C.
3. Specifications standards to comply with IES LM-79 and LM-80.
4. Light emitting diodes (LEDs) features to include:
  - a) Generally, color temperature to be in the range from 3500K-4500K, refer to schedule of Luminaires for specific requirement.
  - b) Minimum CRI of 80, refer to Schedule of Luminaires for specific requirements.

- c) Rated life (based on 70% lumen depreciation level) from 50,000 to 70,000 hours.
- 5. LED luminaires and LED drivers to include 5 years parts and labour warranty.
- 6. Confirm exact color temperature of lamp with consultant, prior to ordering.

**2.02 Ballasts:****A. Materials:**

- 1. Ballasts to the following:
  - a) CSA C22.2 No. 74-1969.
  - b) Certified Ballast Manufacturers Association and ANSI Specifications, FCC Rules and Regulations, and the latest Electrical Testing Laboratories specifications and requirements.

**B. LED Driver (ballast):**

- 1. Operate from 60Hz input source of 120 VAC with sustained variation of  $\pm 10\%$  (voltage and frequency) with no damage to driver.
- 2. Output regulated to  $\pm 5\%$  across load range.
- 3. To operate at power factor greater than 0.9.
- 4. Total harmonic distortion less than 20%.
- 5. Class A sound rating.
- 6. Comply with ANSI C62.41 category A for transient protection.

**2.03 Acceptable Manufacturer:**

- A. First named: Eaton/Cooper Crouse-Hinds, Cooper lighting, Hubbell Lighting, Emergi-Lite, AimLite, Lithuania / AcuityBrands.

**PART 3 - EXECUTION****3.01 Installation:**

- A. All wiring (120V and 24V) shall be installed in conduit as per Section 16111.
- B. Mount all fixtures securely and accurately in line and level.
- C. Furnish fixtures with suitable plaster ring, fitter or other device to suit the area in which they are installed. Examine the room finish schedule and supply fixtures, which are suitable for the ceiling specified. Leave lighting fixtures with all glassware, lamps, etc., thoroughly cleaned and hangers and metal parts brightly polished, where applicable.

- D. Where pendant mounted fixtures are required, use rod type hangers in conjunction with ball aligners. Provide corrosion resistant hangers and fasteners.
- E. The lighting plan is a general guide for placement. Any fixture in conflict with equipment to be shifted to avoid conflict. Fixtures to be accessible for maintenance.
- F. Photo Cell Systems:
  - 1. Point Photo cells to north, when practical.
  - 2. Provide a switch to “by-pass” the photo sensor so that the lighting will remain on continuously as required for maintenance. Provide Lamacoid nameplate for each “by-pass” switch.
- G. Occupancy systems:
  - 1. Provide a switch to “by-pass” the occupancy/motion sensor so that the lighting will remain on continuously as required for maintenance. Provide Lamacoid nameplate for each “by-pass” switch.
  - 2. Provide a letter of guaranty from the manufacturer’s representative indicating the occupancy/motion system components have been installed to meet their requirements and the product is warranted for the specified time limit of five (5) years.
- H. Install the required lamps in all fixtures. Replace any burnt out lamps on the construction completion date.

END OF SECTION 16505

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide Emergency Lighting Equipment as shown on the drawings and specified herein.

### 1.03 Related Work:

- A. Conduits, Conduit Fastenings- Section 16111
- B. Wire and Cables - Section 16122

### 1.04 Submittals:

- A. Submittals to include system components, mounting method, source of power and special attachments.

### 1.05 Codes and Standards:

- A. Emergency Lighting Equipment to be certified to CSA 22.2 No.141.

### 1.06 Guarantee:

- A. Provide a written guarantee stating that the emergency lighting battery is fully guaranteed against defects in material and workmanship for a period of 10 years from date of the Final Certificate of Completion. The guarantee to provide no-charge replacement any time in the first five years and a pro-rated replacement charge for the remaining five years.

## PART 2 - PRODUCTS

### 2.01 Equipment:

- A. Supply Voltage: 120 Volts A.C, fed from a dedicated emergency lighting circuit.
- B. Output Voltage: 12 Volts D.C.
- C. Operating Time: 30 minutes.
- D. Battery: long life, sealed, maintenance free, sized to match the minimum backup time requirement for the main unit and the connected remote unit as per Building Code requirements.
- E. Charger: Solid State, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected, modular construction.



- F. Transfer system: Solid State
- G. Low voltage disconnect: Solid State, modular, operate at 80% battery voltage.
- H. Signal lights: Solid State, life expectancy 100,000 hours minimum - "AC Power On" and "High Charge".
- I. Push to test switch, AC 'on' pilot light.
- J. Lamp Heads: two integral with battery unit and remote units as shown complete with LED lamps.
- K. Auto Test: Model/AT circuitry shall include functions required for operation, testing and self-diagnosis of emergency lighting systems. Unit shall feature automatic test cycle, which will place the unit on a fifteen (15) minute diagnostic test on a monthly basis and a half (1/2) hour test on an annual basis. An externally mounted test switch shall be provided, which when triggered manually or with the "Tele-Test" controller, will initiate a five (5) minute discharge test on the complete system. The unit shall be complete with display and alarm functions.

Tele-Test feature shall include, solid-state circuitry and allow remote testing of all emergency light battery units.

- L. Cabinet: Provide cabinet complete with mounting brackets and fixing accessories, unless otherwise noted. NEMA-1 enclosures for indoor climatically controlled area installation (electrical room etc.) and NEMA-4X for indoor damp / non-climatically controlled locations (pump rooms etc.) and outdoor installation, unless otherwise noted. Provide enclosure rated for Hazardous Area Class/Zone when installed inside classified area.

#### 2.02 Wiring of Remote Heads:

- A. Conduit: To Section 16111.
- B. Conductors: To Section 16122, sized to manufacturer's recommendation.

#### 2.03 Acceptable Manufacturers:

- A. First named: Eaton/Cooper Crouse-Hinds, Cooper lighting, Hubbell Lighting, Emergi-Lite, AimLite, Lithuania / AcuityBrands

### PART 3 - EXECUTION

#### 3.01 General:

- A. Install unit equipment lighting in accordance with CSA C22.2 No. 141.
- B. Direct heads for optimum coverage.

- C. All wiring shall be minimum #10 AWG. Size all conductors to meet the manufacturer's recommendations for voltage drop.

END OF SECTION 16536

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

### 1.02 Work Included:

- A. Provide motor starters as shown on the drawings and specified herein.

### 1.03 Related Work:

- A. Contactors – Section 16485

### 1.04 Codes and Standards:

- A. Provide starters certified to EEMAC E14-1.
  - 1. Half size starters not acceptable.

### 1.05 Submittals:

- A. Provide wiring diagrams that include all interconnecting field equipment wiring along with wiring tags and terminal numbers on the field equipment.

## PART 2 - PRODUCTS

### 2.01 Combination Starters:

- A. To be part of the MCC or in an individual enclosure as shown in drawings. Voltage rating and short circuit rating as shown in drawings (if not shown on drawings then provide matching with the feeder panel)
- B. Combination type starter to include motor circuit interrupter (MCI) with operating lever on outside of enclosure to control the MCI, and provision for:
  - 1. Locking in "OFF" position with up to 3 padlocks.
  - 2. Locking in "ON" position.
  - 3. Independent locking of enclosure door.
- C. Motor overload protective device in each phase, manually reset from outside enclosure; or automatically reset type which latching relay and reset button if shown on drawings.
- D. Power and control terminals.
- E. Wiring and schematic diagram inside starter enclosure in visible location.
- F. Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

- G. Full voltage magnetic starters of size, type, rating and enclosure type as required with components as follows:
1. Contactor solenoid operated, rapid action type as per Section 16485 – Contactors.
- H. Accessories:
1. H-O-A Mode Selector switches (or L-O-R switches with start/stop pushbuttons, depending on application): heavy duty, oil tight, labeled to indicate function, mounted on door. Make before break contacts.
  2. Indicating lights: heavy duty oil tight type. Push to test.
  3. One (1) – N/O and one (1) N/C spare auxiliary contacts for Run/Stop state unless otherwise indicated.
  4. One (1) – N/O and one (1) N/C spare auxiliary contacts for overload trip unless otherwise noted.
  5. PTC monitoring relay for motors up to 50HP, RTD monitoring relay for motors above 50HP complete with external reset and 2 form C contacts; unless different monitoring relays are shown on control schematics
  6. Control Transformer (for motor voltages greater than 120V):
    - a) Single phase, dry type, control transformer with primary rated at motor voltage and 120V secondary, complete with primary and secondary fuses, installed in with starter as indicated.
    - b) Size control transformer for control circuit load plus 20% spare capacity.
  7. In case of power failure, the starter should be able to automatically reset itself when the power resumes and be ready to start on receipt of start command; no manual resetting should be required. Provide necessary wiring to meet this requirement.

#### 2.02 Equipment Identification:

- A. Lamicoid starter designation plates, secured by screws / rivets to the panel door, white plate with engraved black letters to match section 16000, as indicated.

#### 2.03 Acceptable Manufacturers:

- A. First named: Eaton, Siemens, Allen Bradley, Schneider, ABB, Benschaw

### PART 3 - EXECUTION

#### 3.01 Operations and Maintenance Training:

- A. Provide the services of an experienced manufacturer service representative to instruct the Owners staff on operations and maintenance. Training sessions to consist of two person-days and two site trips. Provide an electronic copy of the training session. Training days are

in addition to any other commissioning time required. Training to be complete prior to commissioning.

3.01 Commissioning:

- A. Provide the services of an experienced manufacturer service representative for testing, commissioning and start-up as follows:
  - 1. Two person-days, two trips for installation assistance and inspection.
  - 2. Two person-days, two trips for commissioning and completion of a certified installation report.
- B. Provide a report from the service representative certifying the following:
  - 1. Proper installation procedures are being followed.
  - 2. Completeness of installation.
  - 3. All switches and contactors are functioning correctly.
  - 4. Starting and stopping sequences for contactors and relays have been tested and are working correctly.
  - 5. Overload features, alarm settings and safety device settings are set correctly.

END OF SECTION 16811

PART 1 - GENERAL

## 1.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

## 1.02 Work Included:

- A. Provide AC Variable Frequency Drives as shown on the drawings and specified herein.

## 1.03 Related Work:

- A. Electric Motors – Section 11005

## 1.04 Submittals:

- A. Provide shop drawings complete with:

1. Written certificates that the proposed AC Adjustable Frequency Drives will properly match and suitable for the selected motors and the standby power generator.
2. Provide list of factory set points
3. Complete converter/inverter technical data.
4. Harmonic current contents for the first 12 n order harmonics, in percent, with the drive running at 100% of full load.
5. Line and load reactors ratings
6. Enclosure heat rejection data showing that the VFD enclosure cooling system is designed such that the temperature inside the enclosure does not rise above 40oC at all operating conditions.

PART 2 - PRODUCTS

## 2.01 General:

- A. Review the shop drawings of the pump and motor suppliers for complete co-ordination and proper acceptable matching of components.
- B. The complete assembly to be CSA / cUL approved.
- C. The complete assembly should have a short circuit current rating (SCCR) matching SCCR of the feeder MCC / panel board – 42 KAIC.

## 2.02 Equipment Description:

- A. Voltage source type drive using a Pulse Width Modulated output inverter section and shall be suitable for use with standard or high efficiency EEMAC design B, 575 V, squirrel-cage induction motor.
- B. Design drive system against:
  - 1. Premature breakdown of motor insulation.
  - 2. Higher than rated motor temperature rise, as dictated by motor manufacturer under intended operating speed and load range.
- C. Environmental conditions: Ambient operating temperature range 0°C to 40°C, humidity range 20% to 90% RH non-condensing, altitude 1000 m maximum above sea level.
- D. Rated and designed for continuous operation at 100% load.
- E. Robust design, incorporating Diodes, SCR's, Transistors and/or GTO's. PRV values of the input stage to be 1700 V or higher. In the inverter stage, keep maximum margins for these devices.
- F. Designed to operate the motors under supply disturbances, transient load fluctuations and various operating deviations.
- G. The invert DC filter sized to enable load transients, as well as continuous current in the input.
- H. Front access with all power components accessible without removal of any items.
- I. Designed to allow set-up and testing while the system is operating as well as without load.
- J. Provide fast acting input line fuses to protect the drive from major faults. All control circuiting shall be electrically isolated from the power circuitry.
- K. Provide an Incoming Disconnect Switch with a door interlock mechanism and ability for padlocking.
- L. The design shall be based upon total environmental immunity, especially in the area of transients (electrical), whether in the power circuit or in the logic control.

- M. The Drive shall be designed to accept the opening and closing of a Remote Motor Disconnect Switch while running, without causing damage to the drive.
- N. Provide three (3) frequencies reject points to prevent the motor from operating at a resonant speed. Both the frequency and band-width shall be adjustable.
- O. The drive shall be equipped with line reactor on the input and dv/dt filter on the output (to be supplied and installed by the VFD supplier) to reduce the output voltage change rate to no more than 100 V/microsec and the output voltage peak to no more than 1500 V.
- P. Transient suppression of input and output (Inverter) devices of robust design.
- Q. Harmonic suppression as required by Harmonic Study of the system. Vendor shall be responsible for appropriate size harmonic filters selection to limit the total harmonic distortion (voltage and current) in the acceptable limits as described in IEEE 519-2014).
- R. Provide thermostatically controlled cooling fan for the enclosure. The cooling fan to be selected such as to maintain the rating of the enclosure.

### 2.03 Operating Conditions and Ratings:

- A. Rate the AC Variable Frequency Drives to operate reliably under the following operating conditions.
  - 1. Input Voltage - 600V  $\pm$  10%, 3 phase
  - 2. Input Frequency - 60 Hz  $\pm$  5%
  - 3. Ambient Temperature - 0 to 40oC
  - 4. Humidity - 95% non-condensing
  - 5. Input Power Factor - 0.95 at all loads
  - 6. Input Harmonics - less than 5% RMS increase in current
  - 7. Output Voltage - 600V pulse width modulated wave form
  - 8. Output Frequency - 6 to 63 Hertz
  - 9. Output Current - 150% FLC x 60 seconds
  - 10. Induced THD - max. 5% for entire system



- B. In case of power failure, the VFD should be able to automatically reset itself when the power resumes and be ready to start on receipt of start command. Provide necessary wiring to meet this requirement.

2.04 Controls and Indication:

A. The minimum controls requirement:

1. Control Method - Pulse Width Modulated
2. Frequency Control Range - 20:1
3. Adjustable Maximum Speed - 105.0% - 50.0%
4. Adjustable Minimum Speed - 80% - 10.0%
5. Frequency Accuracy - 0.5%
6. Frequency Resolution - 0.01%
7. Overload Capacity - 150% FLC for 60 seconds
8. Frequency Setting Signal - 0 – 5 V DC or 4 – 20 mA DC
9. Acceleration/deceleration - Adjustable 10-180 seconds each independent  
Decel controlled or coast-stop)
10. Efficiency - above 96%
11. Breaking Torque - 10% inherent
12. Variable Frequency Patterns - (1) Constant torque  
(preset at factory to match load - (2) Variable torque  
Characteristics)

B. As a minimum, the unit shall be capable of receiving the following inputs:

1. dry contact run/stop (maintained)
2. dry contact start (momentary)
3. dry contact stop (momentary)
4. 4-20 mA input signal for speed control
5. dry contacts for two external interlocks

C. As a minimum, provide the following output interface:

1. dry contact control mode indication
2. dry contact common failure alarm
3. dry contact(s) to indicate "running" status
4. 4-20 mA output proportional to 0% - 100% motor speed

- D. As a minimum, provide the following panel controls and indication on the door panel:
1. 600 V rated disconnect switch
  2. LOCAL/OFF/REMOTE control mode switch
  3. manual speed control which controls the speed in the local mode. Adjustable range shall be 0% to 100%.
  4. running L.E.D.
  5. individual L.E.D. for each protection failure
  6. start/stop push buttons
  7. reset pushbutton
  8. Door mounted LCD display for measurement and parameterization. The display should, as a minimum, comprise of 2 x 40 character LCD alphanumeric to indicate values and unit of the programmed/measured parameters and should be capable to display the value and meaning of the parameters.
- E. Communication:
1. VFD must be capable for communication via **Ethernet/IP** to a central master controller and provide motor current (in percent of the motor full load amps) input and output data, status messages ON, OFF, under and over current warning and trip) on a continuous cyclical basis.
  2. In addition, the user must have the ability to remotely monitor and program all programmable parameters, diagnostic data and operating data.
  3. In the event of a communication network failure or PLC failure, the device must have the ability to operate as a stand-alone device. Upon restoration of the network, the device must resume communication with the network.

#### 2.05 Protection Features:

- A. The following protective features shall be provided:
1. Input fuses.
  2. Input transient protection.
  3. Input phase loss.
  4. DC bus under-voltage.
  5. DC bus over-voltage.
  6. Short circuit.

7. Commutation error.
8. Semi-conductor over-temperature.
9. Phase unbalance protection.
10. Line filters.
11. Phase to phase and phase to ground fault protection - adjustable trip level.
12. Over-temperature protection – connected to remote motor winding sensor via permissive start and interlock circuiting.
13. Instantaneous over-current – 125% - 150% rated current.
14. Overload – inverse time to trip (150% trip at 60 seconds).
15. AC Over-voltage – 1.1 x rated (fixed at factory).
16. AC Under-voltage – 0.8 x rated (adjustable).
17. Momentary power failure – coast to stop with automatic restart after time delay in the automatic mode – 0 to 150 seconds adjustable.
18. Overheat (heatsink) – fault trip at 90°C.
19. Stall protection – frequency foldback @ current & O/L trip.
20. Inrush current characteristics – less or equal to motor full load current during start-up conditions regardless of speed signal input level.

#### 2.06 Construction:

- A. Panel mounted or as part of MCC as shown. Provide NEMA 12 enclosures with factory finish for panel mounted unit. For NEMA 12 enclosure provide VFD with Flange mounting kit to install the heat sink outside the third-party enclosure.
- B. Coat circuit boards to prevent contamination.
- C. Provide terminal strips in the controller cabinet for the termination of all field control wiring. Identify all control wiring with wrap-around self-adhering wire number markers. Contractor to field determine cable entry – top/bottom.
- D. Provide sufficient room within the cabinet for routing all fields wiring to the terminal strip without obstruction from components or contact with the power or control devices.

#### 2.07 System Operation:

- A. If the control mode selector switch is in the "Remote" position, the drive/motor is started/stopped and the speed is controlled by the next higher level of control.

- B. If the selector switch is in the “Local” position, it is controlled using the start, stop and speed controls on the panel. Provide “Bump-less” transfer.
- C. In the event of an inverter fault trip the drive shall attempt to restart automatically up to a maximum of 3 attempts. If, after 3 attempts, restart does not occur, the drive shall lock out.
- D. The lower level of control will take precedence over the higher level. Lower level means closer to the motor.

#### 2.08 Tests:

- A. Carry out standard factory tests in accordance with these specifications and provide test schedule and procedures two (2) weeks in advance to the engineer.
- B. Test the power semi-conductors for proper electrical characteristics. All chips shall be given a 100% burn-in with applied voltage.
- C. Test and compare all printed circuit boards. Burn-in all cards for a minimum of 20 hours while undergoing heat cycling and continuous testing.
- D. Test the main frequency converter section with a worst case load for 12 hours then run a motor of nominal load and cycle it automatically for an additional 6 hours.
- E. Complete a site test and confirm in writing that the electrical system conforms to the requirements of the manufacturer’s equipment. All potential problems shall be submitted in writing. Refer to Section 11005 for motor specifications.

#### 2.09 Documentation:

- A. Include, for each controller, a total documentation package that will enable complete maintenance and repair, including in the parts list types of main devices along with a second source manufacturer capable of supplying equivalent devices. Show in the final documents the actual manufacturer’s part number and second source part number.
- B. Provide a complete extensive itemized spare parts list for the drives. Include touch-up spray paint for each of the colours.
- C. In wiring diagrams, include all interconnecting field equipment wiring along with wiring tags and terminal numbers on the field equipment.
- D. Provide the parameterization list indicating site adjusted values.

#### 2.10 Approved Manufacturers:

- A. Eaton / Cutler Hammer
- B. Allen Bradley
- C. Toshiba
- D. Siemens

- E. Benshaw
- F. Schneider
- G. Yaskawa
- H. ABB

### **PART 3 - EXECUTION**

#### 3.01 Installation:

- A. Provide on-site commissioning (start-up) of the adjustable frequency drives by a qualified technician. Coordinate with Process Team and satisfy Engineer/Owner that the VFDs are operating the pumps as intended described in Process Control Narrative.
- B. Upon completion of the installation, provide to the Owner one complete electronic copy of the service and maintenance manuals including wiring and connection diagrams in addition to operation and maintenance manuals required under Division 1.
- C. Affix list of all set points on internal door of the VFD for quick reference.

#### 3.02 Training

- A. Provide one day training to owner's staff for operations and maintenance of the VFDs. Provide hard and soft copies of the training manuals one week in advance to Engineer/Owner for review and approval.

END OF SECTION 16816

PART 1 -PART 2 - GENERAL

## 2.01 Reference:

- A. Section 16000 applies to and governs the Work of this Section.

## 2.02 Work Included:

- A. Provide control devices as shown on the drawings and specified herein.

PART 3 - PRODUCTS

## 3.01 Operator Control Stations:

- A. Enclosure: EEMAC 4, 4x, 7 or 8 to satisfy the location.

## 3.02 Pushbuttons:

- A. Heavy duty. Operator recessed type, with 1-NO and 1-NC contacts rated at 5 A, or as indicated. Stop pushbuttons coloured red, start pushbuttons - green, Reset pushbuttons – black, Emergency Stop – mushroom self-latching twist-to-reset type Red with yellow base, labels as indicated.

## 3.03 Selector Switches:

- A. 2 or 3 position labelled as indicated, heavy duty, four contacts rated 120V, 5A, AC. For Mode Selectors use make before break contacts. See drawings for the N.O. or N.C. contacts requirements.
- B. Provide HP rated selector switches when used in line with motors.

## 3.04 Indicating Lights:

- A. LED, Heavy duty, full voltage, push-to-test, lens colour: as indicated, supply voltage: nominally 120 V unless indicated otherwise, lamp voltage: nominally 120V unless indicated otherwise, labels as indicated.

## 3.05 Acceptable Manufacturers:

- A. Allen Bradley
- B. Eaton
- C. Allen Bradley
- D. Schneider Electric
- E. ABB

F. Siemens

PART 4 - EXECUTION

4.01 Field Quality Control:

- A. Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of each section.
- B. Upon completion of sectional test, undertake group testing.
- C. Check out complete system for operational sequencing.
- D. Submit a certified copy of test results.

END OF SECTION 16825

## PART 1 - GENERAL

### 1.01 Reference:

- A. Section 16000 applies to and governs the work of this Section.

### 1.02 Work Included:

- A. Provide heat tracing systems as shown on the Drawings and specified herein.

### 1.03 Submittals:

- A. Provide shop drawings indicating:
  - 1. The location of thermostats/controllers and interphasing with electric power supply.
  - 2. Provide calculations for heat tracing heaters sizing.
- B. Provide complete manufacture's data of the electric heating cables and thermostats /controllers.

## PART 2 - PRODUCTS

### 2.01 General:

- A. Design, furnish and install a complete system of heaters and components approved by the Canadian Standards Association (CSA) specifically for pipe freeze protection heat tracing applications. The heating tracing system shall conform to of the applicable requirements of following codes and standards:
  - 1. Canada Electrical Code (CEC)
  - 2. National Fire Protection Association (NFPA)
  - 3. Occupational Health and Safety Act (OHSA)
  - 4. National Electrical Manufacturers Association (NEMA)
  - 5. American National Standards Institute (ANSI)
  - 6. Institute of Electrical and Electronics Engineers (IEEE)
  - 7. All applicable local codes and standards
- B. All pipes, valves, equipment and appurtenances shall be provided with heat tracing where shown; or, where not shown, heat tracing shall be provided in all locations where such items could be endangered by freezing. Such heat tracing shall consist of wrapping with electrical heating cables as recommended by manufacturer and subsequent insulation with fiber glass sections, sealed and weatherproofed. The heating cables shall be controlled from thermostats installed in representative locations and accessible for



adjustment. The heat tracing systems shall be installed complete, including heating elements, power connections, end seals, warning labels and controlling thermostats.

#### 2.02 Basic Materials:

- A. Heating Cable: The electrical heat tracing system shall consist of a flat, flexible, low heat density, electrical heating strip of parallel construction, consist of a continuous inner core of conductive material between two parallel copper bus strips. The heating cables shall be self-regulating in nature and vary their output in response to temperature variations along the length of traced pipe.
- B. Temperature Controller: A controller with a range of 5 degrees to 60 degrees C shall be provided for each heated pipe. The RTD sensing element shall be mounted on the pipe under the insulation. Controller shall have ground fault protection, current failure alarm, RTD failure alarm, low and high temperature alarm, dry contacts for remote monitoring (120VAC dry contacts for 'run' and for 'alarm'). LED display should be provided for the temperature measurement and on-site parameterization / adjustment of settings.
- C. Provide Non-Volatile memory to retain all programmed parameters in the event of power outage.
- D. Provide a GFI breaker at the main power feed supply of the controller.
- E. For hazardous areas, provide classified area rated accessories for heat tracing as shown on drawings.

#### 2.03 Acceptable Manufacturers:

- a) Britech Canada
- b) Chromalox Canada.
- c) Thermon Manufacturing Company, Thermon Canada Inc
- d) 3M Canada;
- e) Urecon Canada

### PART 3 - EXECUTION

#### 3.01 Installation:

- A. All heating strips shall be cut in the field and wrapped on the equipment as required.
- B. The heat trace receptacle locations shown on the drawings are for guidance only. The contractor is to coordinate the final locations to suit the heat trace design. Provide additional receptacles if required by the heat trace design.

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3.02 Commissioning:

- A. Provide the services of an experienced manufacturer service representative for testing, commissioning and start-up as follows:
  - 1. one person-day, one trip for installation assistance and inspection.
- B. Perform tests in accordance with Section 16000 – Electrical.
- C. Each system shall be tested for proper operation and thermostats shall be set.
- D. Provide a certified commissioning report from the manufacturer's representative.

END OF SECTION 16850