



**THE CITY OF WINNIPEG**

# **BID OPPORTUNITY**

**BID OPPORTUNITY NO. 709-2009**

**SOUTH END WATER POLLUTION CONTROL CENTRE  
INSTALLATION OF OUTFALL PIPE, EFFLUENT SAMPLING FACILITY AND  
ASSOCIATED WORKS  
CONTRACT NO. 2**

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## **PART B - BIDDING PROCEDURES**

### **B1. CONTRACT TITLE**

- B1.1 SOUTH END WATER POLLUTION CONOTRL CENTRE  
INSTALLATION OF OUTFALL PIPE, EFFLUENT SAMPLING FACILITY AND ASSOCIATED  
WORKS, CONTRACT NO. 2

### **B2. SUBMISSION DEADLINE**

- B2.1 The Submission Deadline is 12:00 noon Winnipeg time, October 28, 2009.
- B2.2 Bids determined by the Manager of Materials to have been received later than the Submission Deadline will not be accepted and will be returned upon request.
- B2.3 The Contract Administrator or the Manager of Materials may extend the Submission Deadline by issuing an addendum at any time prior to the time and date specified in B2.1.

### **B3. SITE INVESTIGATION**

- B3.1 Further to C3.1, the Bidder may view the Site without making an appointment.
- B3.2 The Bidder is advised that this project is located within a field that is currently used for agriculture purposes. The Contractor will be responsible for any damage to any crops while visiting the site.

### **B4. ENQUIRIES**

- B4.1 All enquiries shall be directed to the Contract Administrator identified in D4.1.
- B4.2 If the Bidder finds errors, discrepancies or omissions in the Bid Opportunity, or is unsure of the meaning or intent of any provision therein, the Bidder shall notify the Contract Administrator of the error, discrepancy or omission, or request a clarification as to the meaning or intent of the provision at least five (5) Business Days prior to the Submission Deadline.
- B4.3 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator to all Bidders by issuing an addendum.
- B4.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator only to the Bidder who made the enquiry.
- B4.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B4 unless that response or interpretation is provided by the Contract Administrator in writing.

### **B5. ADDENDA**

- B5.1 The Contract Administrator may, at any time prior to the Submission Deadline, issue addenda correcting errors, discrepancies or omissions in the Bid Opportunity, or clarifying the meaning or intent of any provision therein.
- B5.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.
- B5.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/bidopp.asp>

B5.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Division website for addenda regularly and shortly before the Submission Deadline, as may be amended by addendum.

B5.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 10 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

## **B6. SUBSTITUTES**

B6.1 The Work is based on the Plant, Materials and methods specified in the Bid Opportunity.

B6.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.

B6.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least five (5) Business Days prior to the Submission Deadline.

B6.4 The Bidder shall ensure that any and all requests for approval of a substitute:

- (a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the Plant, Material or method as either an approved equal or alternative;
- (b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;
- (c) identify any anticipated cost or time savings that may be associated with the substitute;
- (d) certify that, in the case of a request for approval as an approved equal, the substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance;
- (e) certify that, in the case of a request for approval as an approved alternative, the substitute will adequately perform the functions called for by the general design, be similar in substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance.

B6.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his sole discretion grant approval for the use of a substitute as an "approved equal" or as an "approved alternative", or may refuse to grant approval of the substitute.

B6.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, only to the Bidder who requested approval of the substitute.

B6.6.1 The Bidder requesting and obtaining the approval of a substitute shall be entirely responsible for disseminating information regarding the approval to any person or persons he wishes to inform.

B6.7 If the Contract Administrator approves a substitute as an "approved equal", any Bidder may use the approved equal in place of the specified item.

B6.8 If the Contract Administrator approves a substitute as an "approved alternative", any Bidder bidding that approved alternative may base his Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B15.

- B6.9 No later claim by the Contractor for an addition to the Total Bid Price because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.
- B6.10 Notwithstanding B6.2 to B6.9, and in accordance with B7.6 deviations inconsistent with the Bid Opportunity document shall be evaluated in accordance with B15.1(a).

## **B7. BID COMPONENTS**

- B7.1 The Bid shall consist of the following components:
- (a) Form A: Bid;
  - (b) Form B: Prices;
  - (c) Bid Security
    - (i) Form G1: Bid Bond and Agreement to Bond, or Form G2: Irrevocable Standby Letter of Credit and Undertaking, or a certified cheque or draft;
- B7.2 Further to B7.1, the Bidder should include the written correspondence from the Contract Administrator approving a substitute in accordance with B6.
- B7.3 All components of the Bid shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely, to constitute a responsive Bid.
- B7.4 The Bid shall be submitted enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address.
- B7.4.1 Samples or other components of the Bid which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder's Bid.
- B7.5 Bidders are advised not to include any information/literature except as requested in accordance with B7.1.
- B7.6 Bidders are advised that inclusion of terms and conditions inconsistent with the Bid Opportunity document, including the General Conditions, will be evaluated in accordance with B15.1(a).
- B7.7 Bids submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.
- B7.8 Bids shall be submitted to:
- The City of Winnipeg  
Corporate Finance Department  
Materials Management Division  
185 King Street, Main Floor  
Winnipeg MB R3B 1J1

## **B8. BID**

- B8.1 The Bidder shall complete Form A: Bid, making all required entries.
- B8.2 Paragraph 2 of Form A: Bid shall be completed in accordance with the following requirements:
- (a) if the Bidder is a sole proprietor carrying on business in his own name, his name shall be inserted.
  - (b) if the Bidder is a partnership, the full name of the partnership shall be inserted.
  - (c) if the Bidder is a corporation, the full name of the corporation shall be inserted.

- (d) if the Bidder is carrying on business under a name other than his own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

B8.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B8.2.

B8.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.

B8.4 Paragraph 12 of Form A: Bid shall be signed in accordance with the following requirements:

- (a) if the Bidder is a sole proprietor carrying on business in his own name, it shall be signed by the Bidder;
- (b) if the Bidder is a partnership, it shall be signed by the partner or partners who have authority to sign for the partnership;
- (c) if the Bidder is a corporation, it shall be signed by its duly authorized officer or officers and the corporate seal, if the corporation has one, should be affixed;
- (d) if the Bidder is carrying on business under a name other than his own, it shall be signed by the registered owner of the business name, or by the registered owner's authorized officials if the owner is a partnership or a corporation.

B8.4.1 The name and official capacity of all individuals signing Form A: Bid should be printed below such signatures.

B8.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid and the Contract, when awarded, shall be both joint and several.

## **B9. PRICES**

B9.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.

B9.2 The quantities listed on Form B: Prices are to be considered approximate only. The City will use said quantities for the purpose of comparing Bids.

B9.3 The quantities for which payment will be made to the Contractor are to be determined by the Work actually performed and completed by the Contractor, to be measured as specified in the applicable Specifications.

B9.4 Prices from Non-Resident Bidders are subject to a Non-Resident Withholding Tax pursuant to the Income Tax Act (Canada).

## **B10. QUALIFICATION**

B10.1 The Bidder shall:

- (a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba; and
- (b) be financially capable of carrying out the terms of the Contract; and
- (c) have all the necessary experience, capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract.

B10.2 The Bidder and any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

- (a) be responsible and not be suspended, debarred or in default of any obligations to the City. A list of suspended or debarred individuals and companies is available on the Information



Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/debar.stm>

- B10.3 The Bidder and/or any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:
- (a) have successfully carried out work similar in nature, scope and value to the Work; and
  - (b) be fully capable of performing the Work required to be in strict accordance with the terms and provisions of the Contract; and
  - (c) have a written workplace safety and health program if required pursuant to The Workplace Safety and Health Act (Manitoba);
- B10.4 Further to B10.3(c), the Bidder shall, within five (5) Business Days of a request by the Contract Administrator, provide proof satisfactory to the Contract Administrator that the Bidder/Subcontractor has a workplace safety and health program meeting the requirements of The Workplace Safety and Health Act (Manitoba), by providing:
- (a) a valid COR certification number under the Certificate of Recognition (COR) Program administered by the Manitoba Construction Safety Association or by the Manitoba Heavy Construction Association's Safety, Health and Environment Program; or
  - (b) a report or letter to that effect from an independent reviewer acceptable to the City. (A list of acceptable reviewers and the review template are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>)
- B10.5 The Bidder shall submit, within three (3) Business Days of a request by the Contract Administrator, proof satisfactory to the Contract Administrator of the qualifications of the Bidder and of any proposed Subcontractor.
- B10.6 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

## **B11. BID SECURITY**

- B11.1 The Bidder shall provide bid security in the form of:
- (a) a bid bond, in the amount of at least ten percent (10%) of the Total Bid Price, and agreement to bond of a company registered to conduct the business of a surety in Manitoba, in the form included in the Bid Submission (Form G1: Bid Bond and Agreement to Bond); or
  - (b) an irrevocable standby letter of credit, in the amount of at least ten percent (10%) of the Total Bid Price, and undertaking issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form included in the Bid Submission (Form G2: Irrevocable Standby Letter of Credit and Undertaking); or
  - (c) a certified cheque or draft payable to "The City of Winnipeg", in the amount of at least fifty percent (50%) of the Total Bid Price, drawn on a bank or other financial institution registered to conduct business in Manitoba.
- B11.1.1 If the Bidder submits alternative bids, the bid security shall be in the amount of the specified percentage of the highest Total Bid Price submitted.
- B11.1.2 All signatures on bid securities shall be original.
- B11.1.3 The Bidder shall sign the Bid Bond.
- B11.1.4 The Surety shall sign and affix its corporate seal on the Bid Bond and the Agreement to Bond.

B11.2 The bid security of the successful Bidder and the next two lowest evaluated responsive and responsible Bidders will be released by the City when a Contract for the Work has been duly executed by the successful Bidder and the performance security furnished as provided herein. The bid securities of all other Bidders will be released when a Contract is awarded.

B11.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B11.1(c), it will be deposited and retained by the City as the performance security and no further submission is required.

B11.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.

B11.3 The bid securities of all Bidders will be released by the City as soon as practicable following notification by the Contract Administrator to the Bidders that no award of Contract will be made pursuant to the Bid Opportunity.

## **B12. OPENING OF BIDS AND RELEASE OF INFORMATION**

B12.1 Bids will be opened publicly, after the Submission Deadline has elapsed, in the office of the Corporate Finance Department, Materials Management Division, or in such other office as may be designated by the Manager of Materials.

B12.1.1 Bidders or their representatives may attend.

B12.1.2 Bids determined by the Manager of Materials, or his designate, to not include the bid security specified in B11 will not be read out.

B12.2 Following the submission deadline, the names of the Bidders and their Total Bid Prices (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>

B12.3 After award of Contract, the name(s) of the successful Bidder(s) and the Contract Amount(s) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>

B12.4 The Bidder is advised that any information contained in any Bid may be released if required by City policy or procedures, by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law.

## **B13. IRREVOCABLE BID**

B13.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 11 of Form A: Bid.

B13.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work until a Contract for the Work has been duly executed and the performance security furnished as herein provided, but any Bid shall be deemed to have lapsed unless accepted within the time period specified in Paragraph 11 of Form A: Bid.

## **B14. WITHDRAWAL OF BIDS**

B14.1 A Bidder may withdraw his Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.

B14.1.1 Notwithstanding C23.3, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.

B14.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid, and only such person, has authority to give notice of withdrawal.

B14.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:

Retain the Bid until after the Submission Deadline has elapsed;

Open the Bid to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid; and

If the notice has been given by any one of the persons specified in 0, declare the Bid withdrawn.

B14.2 A Bidder who withdraws his Bid after the Submission Deadline but before his Bid has been released or has lapsed as provided for in B13.2 shall be liable for such damages as are imposed upon the Bidder by law and subject to such sanctions as the Chief Administrative Officer considers appropriate in the circumstances. The City, in such event, shall be entitled to all rights and remedies available to it at law, including the right to retain the Bidder's bid security.

## **B15. EVALUATION OF BIDS**

B15.1 Award of the Contract shall be based on the following bid evaluation criteria:

- (a) Compliance by the Bidder with the requirements of the Bid Opportunity, or acceptable deviation there from (pass/fail);
- (b) Qualifications of the Bidder and the Subcontractors, if any, pursuant to B10 (pass/fail);
- (c) Total Bid Price;
- (d) Economic analysis of any approved alternative pursuant to B6.

B15.2 Further to B15.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid is incomplete, obscure or conditional, or contains additions, deletions, alterations or other irregularities. The Award Authority may reject all or any part of any Bid, or waive technical requirements or minor informalities or irregularities, if the interests of the City so require.

B15.3 Further to B15.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his Bid or in other information required to be submitted, that he is responsible and qualified.

B15.4 Further to B15.1(c), the Total Bid Price shall be the sum of the quantities multiplied by the unit prices for each item shown on Form B: Prices adjusted, if necessary, as follows:

- (a) If the lowest evaluated responsive Bid submitted by a responsible and qualified Bidder is within the budgetary provision for the Work, no adjustment will be made to the Total Bid Price; or
- (b) If the lowest evaluated responsive Bid submitted by a responsible and qualified Bidder exceeds the budgetary provision for the Work, the Total Bid Prices of all responsive Bids submitted by responsible and qualified Bidders will be adjusted by progressively deducting items A.3, A.4 b ii, A.9 b, and A15 until a Total Bid Price within the budgetary provision is achieved.

B15.4.1 If there is any discrepancy between the Total Bid Price written in figures, the Total Bid Price written in words and the sum of the quantities multiplied by the unit prices for each item, the sum of the quantities multiplied by the unit prices for each item shall take precedence.

B15.4.2 Further to B15.1(a), in the event that a unit price is not provided on Form B: Prices, the City will determine the unit price by dividing the Amount (extended price) by the approximate quantity, for the purposes of evaluation and payment.

**B16. AWARD OF CONTRACT**

- B16.1 The City will give notice of the award of the Contract or will give notice that no award will be made.
- B16.2 The City will have no obligation to award a Contract to a Bidder, even though one or all of the Bidders are determined to be responsible and qualified, and the Bids are determined to be responsive.
- B16.2.1 Without limiting the generality of B16.2, the City will have no obligation to award a Contract where:
- (a) the prices exceed the available City funds for the Work;
  - (b) the prices are materially in excess of the prices received for similar work in the past;
  - (c) the prices are materially in excess of the City's cost to perform the Work, or a significant portion thereof, with its own forces;
  - (d) only one Bid is received; or
  - (e) in the judgment of the Award Authority, the interests of the City would best be served by not awarding a Contract.
- B16.3 Where an award of Contract is made by the City, the award shall be made to the responsible and qualified Bidder submitting the lowest evaluated responsive Bid, in accordance with B15.
- B16.3.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his Bid upon written request to the Contract Administrator.

## **PART C - GENERAL CONDITIONS**

### **C0. GENERAL CONDITIONS**

- C0.1 The *General Conditions for Construction* (Revision 2006 12 15) are applicable to the Work of the Contract.
- C0.1.1 The *General Conditions for Construction* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at [http://www.winnipeg.ca/matmgt/gen\\_cond.stm](http://www.winnipeg.ca/matmgt/gen_cond.stm)
- C0.2 A reference in the Bid Opportunity to a section, clause or subclause with the prefix “**C**” designates a section, clause or subclause in the *General Conditions for Construction*.

## **PART D - SUPPLEMENTAL CONDITIONS**

### **GENERAL**

#### **D1. GENERAL CONDITIONS**

D1.1 In addition to the *General Conditions for Construction*, these Supplemental Conditions are applicable to the Work of the Contract.

#### **D2. SCOPE OF WORK**

D2.1 The Work to be done under the Contract shall consist of the supply and installation of a 2400 mm diameter reinforced concrete outfall including manholes and chambers, construction of an effluent sampling facility, and all associated works.

D2.2 The major components of the Work are as follows:

- (a) Submission of shop drawings;
- (b) Supply and installation of approximately 650 metres of 2400 mm diameter reinforced concrete outfall pipe;
- (c) Construction of cast in place chambers complete with stop logs;
- (d) Connections to the existing 1800 mm diameter reinforced concrete outfall;
- (e) Construction of an effluent sampling facility over the 2400 mm diameter concrete outfall;
- (f) Installation of all mechanical, electrical, and architectural components of the effluent sampling facility;
- (g) Construction of the Effluent Sampling Facility Access Road; and
- (h) Site restorations.

#### **D3. DEFINITIONS**

D3.1 When used in this Bid Opportunity:

- (a) "SEWPCC" means South End Water Pollution Control Centre;
- (b) "ASTM" means American Society for Testing Materials;
- (c) "ASCE" means American Society of Civil Engineers;

#### **D4. CONTRACT ADMINISTRATOR**

D4.1 The Contract Administrator is Stantec Consulting Ltd., represented by:

Hartley Katz, C.E.T., P. Eng.  
Senior Project Manager  
905 Waverley Street

Telephone No. (204) 489-5900

Facsimile No. (204) 453-9012

D4.2 At the pre-construction meeting, Hartley Katz will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

#### **D5. CONTRACTOR'S SUPERVISOR**

D5.1 At the pre-construction meeting, the Contractor shall identify his designated supervisor and any additional personnel representing the Contractor and their respective roles and responsibilities for the Work.

- D5.2 The Contractor's Supervisor shall have a minimum of five (5) years experience supervising the installation of large diameter sewer.

## **D6. NOTICES**

- D6.1 Except as provided for in C23.2.2, all notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the Contractor shall be sent to the address or facsimile number identified by the Contractor in Paragraph 2 of Form A: Bid.
- D6.2 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D6.3, D6.4 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator at the address or facsimile number identified in D4.1.
- D6.3 Notwithstanding C21, all notices of appeal to the Chief Administrative Officer shall be sent to the attention of the Chief Financial Officer at the following address or facsimile number:

The City of Winnipeg  
Chief Financial Officer  
Administration Building, 3rd Floor  
510 Main Street  
Winnipeg MB R3B 1B9  
Facsimile No.: (204) 949-1174

- D6.4 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications required to be submitted or returned to the City Solicitor shall be sent to the following address or facsimile number:

The City of Winnipeg  
Internal Services Department  
Legal Services Division  
Attn: City Solicitor  
185 King Street, 3rd Floor  
Winnipeg MB R3B 1J1  
Facsimile No.: (204) 947-9155

## **D7. FURNISHING OF DOCUMENTS**

- D7.1 Upon award of the Contract, the Contractor will be provided with five (5) complete sets of the Bid Opportunity. If the Contractor requires additional sets of the Bid Opportunity, they will be supplied to him at cost.

## **SUBMISSIONS**

### **D8. AUTHORITY TO CARRY ON BUSINESS**

- D8.1 The Contractor shall be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Contractor does not carry on business in Manitoba, in the jurisdiction where the Contractor does carry on business, throughout the term of the Contract, and shall provide the Contract Administrator with evidence thereof upon request.

### **D9. SAFE WORK PLAN**

- D9.1 The Contractor shall provide the Contract Administrator with a Safe Work Plan at least five (5) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract.

D9.2 The Safe Work Plan should be prepared and submitted in the format shown in the City's template which is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/Safety/default.stm>

## **D10. INSURANCE**

D10.1 The Contractor shall provide and maintain the following insurance coverage:

- (a) commercial general liability insurance, in the amount of at least five million dollars (\$5,000,000.00) inclusive, with The City of Winnipeg added as an additional insured; such liability policy to also contain a cross-liability clause, contractual liability, unlicensed motor vehicle liability, broad form property damage cover, sudden and accidental pollution cover (IBC Form #2313 or equivalent) and products and completed operations, to remain in place at all times during the performance of the Work and throughout the warranty period;
- (b) automobile liability insurance for owned and non-owned automobiles used for or in connection with the Work in the amount of at least two million dollars (\$2,000,000.00); automobile insurance with stated limits to be retained at all times during the performance of the Work; such insurance may be met through the commercial general liability cover where applicable;
- (c) an all risks Installation Floater carrying adequate limits to cover all machinery, equipment, supplies and/or materials intended to enter into and form part of any installation.

D10.2 Deductibles shall be borne by the Contractor.

D10.3 The Contractor shall provide the City Solicitor with a certificate(s) of insurance, in a form satisfactory to the City Solicitor, at least two (2) Business Days prior to the commencement of any Work but in no event later than the date specified in C4.1 for the return of the executed Contract.

D10.4 The Contractor shall not cancel, materially alter, or cause each policy to lapse without providing at least thirty (30) Calendar Days prior written notice to the Contract Administrator.

## **D11. PERFORMANCE SECURITY**

D11.1 The Contractor shall provide and maintain performance security until the expiration of the warranty period in the form of:

- (a) a performance bond of a company registered to conduct the business of a surety in Manitoba, in the form attached to these Supplemental Conditions (Form H1: Performance Bond), in the amount of fifty percent (50%) of the Contract Price; or
- (b) an irrevocable standby letter of credit issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form attached to these Supplemental Conditions (Form H2: Irrevocable Standby Letter of Credit), in the amount of fifty percent (50%) of the Contract Price; or
- (c) a certified cheque or draft payable to "The City of Winnipeg", drawn on a bank or other financial institution registered to conduct business in Manitoba, in the amount of fifty percent (50%) of the Contract Price.

D11.1.1 Where the performance security is in the form of a certified cheque or draft, it will be deposited by the City. The City will not pay any interest on certified cheques or drafts furnished as performance security.

D11.2 If the bid security provided in his Bid was not a certified cheque or draft pursuant to B11.1(c), the Contractor shall provide the City Solicitor with the required performance security within seven (7) Calendar Days of notification of the award of the Contract by way of letter of intent and prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract.



## **D12. SUBCONTRACTOR LIST**

D12.1 The Contractor shall provide the Contract Administrator with a complete list of the Subcontractors whom the Contractor proposes to engage (Form J: Subcontractor List) at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.

## **D13. DETAILED WORK SCHEDULE**

D13.1 The Contractor shall provide the Contract Administrator with a detailed work schedule at the Pre-Construction Meeting.

D13.2 The detailed work schedule shall include dates for all shop drawing submissions. The work schedule shall take into account a period of five (5) Working Days for shop drawing review.

## **D14. SECURITY CLEARANCE**

D14.1 Each individual proposed to perform the following portions of the Work:

(a) any Work that may be required within the SEWPCC or other City facilities other than:

- (i) An underground structure such as a manhole.
- (ii) In areas and at times normally open to the public.

shall be required to obtain a Criminal Record Search Certificate from the police service having jurisdiction at his place of residence.

D14.2 Prior to the commencement of any Work specified in D14.1, and during the term of the Contract if additional or replacement individuals are proposed to perform Work, the Contractor shall supply the Contract Administrator with a Criminal Record Search Certificate obtained not earlier than one (1) year prior to the Submission Deadline, or a certified true copy thereof, for each individual proposed to perform such Work.

D14.3 Any individual for whom a Criminal Record Search Certificate is not provided, or for whom a Criminal Record Search Certificate indicates any convictions or pending charges related to property offences or crimes against another person, will not be permitted to perform any Work specified in D14.1.

D14.4 Any Criminal Record Search Certificate obtained thereby will be deemed valid for the duration of the Contract subject to a repeated records search as hereinafter specified.

D14.5 Notwithstanding the foregoing, at any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require an updated criminal records search. Any individual who fails to provide a satisfactory Criminal Record Search Certificate as a result of a repeated criminal records search will not be permitted to continue to perform any Work specified in D14.1.

## **SCHEDULE OF WORK**

### **D15. COMMENCEMENT**

D15.1 The Contractor shall not commence any Work until he is in receipt of a letter of intent from the Award Authority authorizing the commencement of the Work.

D15.2 The Contractor shall not commence any Work on the Site until:

- (a) the Contract Administrator has confirmed receipt and approval of:
- (i) Evidence of authority to carry on business specified in D8.
  - (ii) Evidence of the workers compensation coverage specified in C6.15.
  - (iii) The Safe Work Plan specified in D9.

- (iv) Evidence of the insurance specified in D10.
  - (v) The performance security specified in D11.
  - (vi) The Subcontractor list specified in D12.
  - (vii) The detailed work schedule specified in D13.
  - (viii) The security clearances specified in D14.
- (b) The Contractor has attended a pre-construction meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a pre-construction meeting.
- D15.3 The Contractor shall commence the Work on the Site within seven (7) Working Days of receipt of the letter of intent.

#### **D16. SUBSTANTIAL PERFORMANCE**

- D16.1 The Contractor shall achieve Substantial Performance within 175 (One hundred seventy five) consecutive Working Days of the commencement of the Work as specified in D15.
- (a) The Work will be considered Substantially Performed once the following have been completed:
- (i) Commissioning of all required components of the Work; and
  - (ii) Submission all Operation and Maintenance Manuals to the Contract Administrator.
- D16.2 When the Contractor considers the Work to be substantially performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Substantial Performance. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be reinspected.
- D16.3 The date on which the Work has been certified by the Contract Administrator as being substantially performed to the requirements of the Contract through the issue of a certificate of Substantial Performance is the date on which Substantial Performance has been achieved.

#### **D17. TOTAL PERFORMANCE**

- D17.1 The Contractor shall achieve Total Performance within 185 (One hundred eighty five) consecutive Working Days of the commencement of the Work as specified in D15.
- D17.2 When the Contractor or the Contract Administrator considers the Work to be totally performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Total Performance. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be reinspected.
- D17.3 The date on which the Work has been certified by the Contract Administrator as being totally performed to the requirements of the Contract through the issue of a certificate of Total Performance is the date on which Total Performance has been achieved.

#### **D18. LIQUIDATED DAMAGES**

- D18.1 If the Contractor fails to achieve Substantial Performance or Total Performance in accordance with the Contract by the days fixed herein for Substantial Performance or Total Performance, the Contractor shall pay the City the following amount per Working Day for each and every Working Day following the day fixed herein for Substantial Performance or Total Performance during which such failure continues.

- |                             |   |
|-----------------------------|---|
| (a) Substantial Performance | One thousand seven hundred dollars (\$1,700.00) |
| (b) Total Performance       | One thousand seven hundred dollars (\$1,700.00) |

D18.2 The amount specified for liquidated damages in D18.1 is based on a genuine pre-estimate of the City's damages in the event that the Contractor does not achieve Substantial Performance by the day fixed herein for same.

D18.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

## **CONTROL OF WORK**

### **D19. JOB MEETINGS**

D19.1 Regular weekly job meetings will be held at the Site. These meetings shall be attended by a minimum of one representative of the Contract Administrator, one representative of the City and one representative of the Contractor and each sub-contractor as required. Each representative shall be a responsible person capable of expressing the position of the Contract Administrator, the City and the Contractor respectively on any matter discussed at the meeting including the Work schedule and the need to make any revisions to the Work schedule. The progress of the Work will be reviewed at each of these meetings.

D19.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he deems it necessary.

### **D20. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)**

D20.1 Further to C6.24, the Contractor shall be the Prime Contractor and shall serve as, and have the duties of the Prime Contractor in accordance with The Workplace Safety and Health Act (Manitoba).

## **MEASUREMENT AND PAYMENT**

### **D21. PAYMENT**

D21.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.

## **WARRANTY**

### **D22. WARRANTY**

D22.1 Warranty is as stated in C13.

**FORM H1: PERFORMANCE BOND**  
(See D11)

KNOW ALL MEN BY THESE PRESENTS THAT

\_\_\_\_\_ ,  
(hereinafter called the "Principal"), and

\_\_\_\_\_ ,  
(hereinafter called the "Surety"), are held and firmly bound unto **THE CITY OF WINNIPEG** (hereinafter called the "Obligee"), in the sum of

\_\_\_\_\_ dollars (\$\_\_\_\_\_)

of lawful money of Canada to be paid to the Obligee, or its successors or assigns, for the payment of which sum the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS the Principal has entered into a written contract with the Obligee for

BID OPPORTUNITY NO. 709-2009

SOUTH END WATER POLLUTION CONTROL CENTRE  
INSTALLATION OF OUTFALL PIPE, EFLUENT SAMPLING FACILITY AND ASSOCIATED WORKS,  
CONTRACT NO. 2

which is by reference made part hereof and is hereinafter referred to as the "Contract".

NOW THEREFORE the condition of the above obligation is such that if the Principal shall:

- (a) carry out and perform the Contract and every part thereof in the manner and within the times set forth in the Contract and in accordance with the terms and conditions specified in the Contract;
- (b) perform the Work in a good, proper, workmanlike manner;
- (c) make all the payments whether to the Obligee or to others as therein provided;
- (d) in every other respect comply with the conditions and perform the covenants contained in the Contract; and
- (e) indemnify and save harmless the Obligee against and from all loss, costs, damages, claims, and demands of every description as set forth in the Contract, and from all penalties, assessments, claims, actions for loss, damages or compensation whether arising under "The Workers Compensation Act", or any other Act or otherwise arising out of or in any way connected with the performance or non-performance of the Contract or any part thereof during the term of the Contract and the warranty period provided for therein.

THEN THIS OBLIGATION SHALL BE VOID, but otherwise shall remain in full force and effect. The Surety shall not, however, be liable for a greater sum than the sum specified above.

AND IT IS HEREBY DECLARED AND AGREED that the Surety shall be liable as Principal, and that nothing of any kind or matter whatsoever that will not discharge the Principal shall operate as a discharge or release of liability of the Surety, any law or usage relating to the liability of Sureties to the contrary notwithstanding.

IN WITNESS WHEREOF the Principal and Surety have signed and sealed this bond the

\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ .

SIGNED AND SEALED  
in the presence of:

\_\_\_\_\_  
(Witness as to Principal if no seal)

\_\_\_\_\_  
(Name of Principal)

Per: \_\_\_\_\_ (Seal)

Per: \_\_\_\_\_

\_\_\_\_\_  
(Name of Surety)

By: \_\_\_\_\_ (Seal)  
(Attorney-in-Fact)

**FORM H2: IRREVOCABLE STANDBY LETTER OF CREDIT  
(PERFORMANCE SECURITY)**  
(See D11)

\_\_\_\_\_  
(Date)

The City of Winnipeg  
Internal Services Department  
Legal Services Division  
185 King Street, 3rd Floor  
Winnipeg MB R3B 1J1

RE: PERFORMANCE SECURITY - BID OPPORTUNITY NO. 709-2009

SOUTH END WATER POLLUTION CONTROL CENTRE  
INSTALLATION OF OUTFALL PIPE, EFLFUENT SAMPLING FACILITY AND ASSOCIATED  
WORKS, CONTRACT NO. 2

Pursuant to the request of and for the account of our customer,

\_\_\_\_\_  
(Name of Contractor)

\_\_\_\_\_  
(Address of Contractor)

WE HEREBY ESTABLISH in your favour our irrevocable Standby Letter of Credit for a sum not exceeding  
in the aggregate

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ Canadian dollars.

This Standby Letter of Credit may be drawn on by you at any time and from time to time upon written demand for payment made upon us by you. It is understood that we are obligated under this Standby Letter of Credit for the payment of monies only and we hereby agree that we shall honour your demand for payment without inquiring whether you have a right as between yourself and our customer to make such demand and without recognizing any claim of our customer or objection by the customer to payment by us.

The amount of this Standby Letter of Credit may be reduced from time to time only by amounts drawn upon it by you or by formal notice in writing given to us by you if you desire such reduction or are willing that it be made.

Partial drawings are permitted.

We engage with you that all demands for payment made within the terms and currency of this Standby Letter of Credit will be duly honoured if presented to us at:

\_\_\_\_\_  
(Address)

and we confirm and hereby undertake to ensure that all demands for payment will be duly honoured by us.

All demands for payment shall specifically state that they are drawn under this Standby Letter of Credit.

Subject to the condition hereinafter set forth, this Standby Letter of Credit will expire on

\_\_\_\_\_  
(Date)

It is a condition of this Standby Letter of Credit that it shall be deemed to be automatically extended from year to year without amendment from the present or any future expiry date, unless at least 30 days prior to the present or any future expiry date, we notify you in writing that we elect not to consider this Standby Letter of Credit to be renewable for any additional period.

This Standby Letter of Credit may not be revoked or amended without your prior written approval.

This credit is subject to the Uniform Customs and Practice for Documentary Credit (1993 Revision), International Chamber of Commerce Publication Number 500.

\_\_\_\_\_  
(Name of bank or financial institution)

Per: \_\_\_\_\_  
(Authorized Signing Officer)

Per: \_\_\_\_\_  
(Authorized Signing Officer)





## PART E - SPECIFICATIONS

### GENERAL

#### E1. APPLICABLE SPECIFICATIONS AND DRAWINGS

- E1.1 These Specifications shall apply to the Work.
- E1.2 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.
- E1.2.1 *The City of Winnipeg Standard Construction Specifications* is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/Spec/Default.stm>
- E1.2.2 The version in effect three (3) Business Days before the Submission Deadline shall apply.
- E1.2.3 Further to C2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.
- E1.3 The following are applicable to the Work:

<u>Drawing No.</u>	<u>Drawing Name/Title</u>
1-0102A-D0002-001	Cover Sheet and Drawing List Civil
1-0102A-C0001-001	Overall Site Plan and Work Limits
1-0102A-C0002-001	2400 Outfall Pipe – STA 9+00 to STA 11+50
1-0102A-C0003-001	2400 Outfall Pipe – STA 11+50 to STA 14+00
1-0102A-C0004-001	2400 Outfall Pipe – STA 14+00 to STA 16+75
1-0102A-C0005-005-001	Sample Water Pump Suction System Details Manhole and Trench Details Structural
1-0102A-S0001-001	General Notes and Schedules
1-0102A-S0002-001	Concrete Sections and Typical Details
1-0102A-S0003-001	Chamber No. 1 Plan and Section
1-0102A-S0004-001	Chamber No. 2 Plan and Section
1-0102A-S0005-001	Chamber No. 3 Plan and Section
1-0102A-S0006-001	Chamber No. 4 Plan and Section
1-0102A-S0007-001	Chamber No. 5 Plan and Section
1-0102A-S0008-001	Chamber No. 6 Plan and Section
1-0102A-S0009-001	Foundation/Roof Framing Plans and Miscellaneous Details Architectural
1-0102A-A0013-001	Floor and Roof Plan, Building Elevation and Sections
1-0102A-A0014-001	Sections and Details
1-0102A-A0015-001	Miscellaneous Metal Details Mechanical
1-0102A--D-M0001-001	Building Ventilation and Sampling Monitoring Plans
1-0102A-M0002-002	Sample Water Pump Suction System Details Electrical
1-0102A-E0011-001	Site Plan, Floor Plan, Trench Details
1-0102A-E0012-001	Motor Schedule, Panels Schedule, Motor Wiring Diagram, Panel Layout
1-0102A-E0013-001	Miscellaneous Control Wiring, SCADA System Architecture

#### E2. SOILS INVESTIGATION REPORT

- E2.1 Further to C3.1 of the General Conditions, a geotechnical investigation has been done in the vicinity of the proposed works to determine the character of the subsurface soil to facilitate the design of the Work. The information is considered accurate at the locations indicated and at the time of the investigation. However, considerable variations in the soil conditions may exist between the test holes and fluctuations in the ground water levels can be expected seasonally.

Test hole logs are included with the investigation reports. The following soils investigation reports are found in Appendix A:

- (a) Geotechnical Report  
South End Water Pollution Control Centre – Proposed Expansion  
By Dyregrov Consultants dated February 25, 2008
- (b) Report on Subsoil Investigation  
Proposed South End Pollution Control Centre  
By Ripley, Klohn, and Lenoff International Ltd dated March 8, 1971
- (c) Geotechnical Engineering Report  
South End Water Pollution Control Centre  
By Dyregrov & Burgess dated April 15, 1988

E2.2 Bidders are responsible for any interpretation they place on the supplied information and are expected to make such additional investigation

## **GENERAL REQUIREMENTS**

### **E3. OFFICE FACILITIES**

E3.1 The Contractor shall supply office facilities meeting the following requirements:

- (a) The field office shall be for the exclusive use of the Contract Administrator.
- (b) The building shall be conveniently located near the site of the Work at a location determined by the Contract Administrator.
- (c) The building shall have a minimum floor area of 20 square metres, a height of 2.4m with a window and a door entrance with a suitable lock. The Contractor shall supply two keys for the lock.
- (d) The building shall be suitable for all weather use. It shall be equipped with an electric heater and air conditioner so that the room temperature can be maintained between either 16-18°C or 24-25°C.
- (e) The building shall be adequately lighted with fluorescent fixtures and have a minimum of three wall outlets.
- (f) The building shall be furnished with a table 3m X 1.2m, and a minimum of eight (8) chairs.
- (g) A portable toilet shall be located near the field office building. The toilet shall have a locking door and be for the exclusive use of the Contract Administrator and other personnel from the City.
- (h) The field office building and the portable toilet shall be cleaned on a weekly basis immediately prior to each site meeting. The Contract Administrator may request additional cleaning when it is deemed necessary.

E3.2 The Contractor shall be responsible for all installation and removal costs, all operating costs, and the general maintenance of the office facilities.

E3.3 The office facilities will be provided from the date of the commencement of the Work to the date of Total Performance.

### **E4. SHOP DRAWINGS**

E4.1 Description

- (a) This Specification shall revise, amend and supplement the requirements of CW 1100.
  - (i) The term 'shop drawings' means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data, including site erection drawings

- which are to be provided by the Contractor to illustrate details of a portion of the work.
- (ii) The Contractor shall submit specified shop drawings to the Contract Administrator for review. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be show on all submissions for review.
- (b) Shop Drawings
- (i) Original drawings are to be prepared by Contractor, Subcontractor, Supplier, Distributor, or Manufacturer, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.
  - (ii) Shop drawings for the following structural components shall bear the seal of a Registered Professional Engineer of Manitoba.
    - (a) Shoring;
    - (b) Reinforcing steel;
    - (c) Metal Fabrications.
- (c) Contractor's Responsibilities
- (i) Review shop drawings, product data and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements.
  - (ii) Verify:
    - (a) Field measurements
    - (b) Field construction criteria
    - (c) Catalogue numbers and similar data
  - (iii) Coordinate each submission with requirements of work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available.
  - (iv) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.
  - (v) Responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator's review of submission, unless Contract Administrator gives written acceptance of specified deviations.
  - (vi) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
  - (vii) The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Shop Drawings. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.
  - (viii) After Contract Administrator's review and return of copies, distribute copies to sub-trades as appropriate.
  - (ix) Maintain one (1) complete set of reviewed shop drawings, filed by Specification Section Number, at the site of the work for use and reference of the Contract Administrator and Subcontractors.
- (d) Submission Requirements
- (i) Schedule submissions at least 14 Calendar days before dates reviewed submissions will be needed, and allow for a 14 Calendar day period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents.
  - (ii) Submit five (5) paper prints of shop drawings. The Contractor is advised that the Contract Administrator will retain three (3) copies of all submittals and return two (2) copies to the Contractor.
  - (iii) Accompany submissions with transmittal letter, containing:
    - (a) Date
    - (b) Project title and Bid Opportunity number

- (c) Contractor's name and address
  - (d) Number of each shop drawing, product data and sample submitted
  - (e) Specification Section, Title, Number and Clause
  - (f) Drawing Number and Detail/Section Number
  - (g) Other pertinent data
- (iv) Submissions shall include:
- (a) Date and revision dates.
  - (b) Project title and Bid Opportunity number.
  - (c) Name of:
    - (i) Contractor
    - (ii) Subcontractor
    - (iii) Supplier
    - (iv) Manufacturer
    - (v) Separate detailer when pertinent
  - (d) Identification of product of material.
  - (e) Relation to adjacent structure or materials.
  - (f) Field dimensions, clearly identified as such.
  - (g) Specification section name, number and clause number or drawing number and detail/section number.
  - (h) Applicable standards, such as CSA or CGSB numbers.
  - (i) Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.
- (e) Other Considerations
- (i) Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent shop drawings and resubmit.
  - (ii) Material and equipment delivered to the site of the works will not be paid for at least until pertinent shop drawings have been submitted and reviewed.
  - (iii) Incomplete shop drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.
  - (iv) No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions and review of shop drawings.

#### E4.2 Measurement and Payment

- (a) Preparation, submittal, and revisions of shop drawings will be included in the outfall pipe, chambers and effluent sampling facility construction.

### **E5. GENERAL REQUIREMENTS**

E5.1 The Contractor shall include the following items in the unit price bid for "General Requirements":

- (a) Mobilization to site;
- (b) Demobilization from site;
- (c) Insurance; and
- (d) Bonding.

E5.2 Mobilization/Demobilization, Bonding and Insurance will be measured on a unit basis and paid for at the Contract Unit Price for "General Requirements".

- (a) General Requirements will be paid on each monthly progress estimate as a percentage of the dollar value of the work completed vs. the original adjusted total contract price bid.

### **E6. HOLDBACK FOR OPERATION AND MAINTENANCE MANUALS**

E6.1 Further to Specifications E18, E40, E49, E67, and E72 a holdback in the amount of 30% of the unit price bid for the following Form B items will be applied:

- (a) A. 8;
- (b) A. 9;
- (c) A. 10;
- (d) A. 11; and
- (e) A.12.

E6.2 The 30% holdback of the unit price bid for each item that requires the submission of Operation and Maintenance Manuals will be paid once the Operation and Maintenance Manuals have been accepted as complete by the Contract Administrator.

E6.3 The initial 70% will be paid in accordance with General Condition C12.

#### **E7. STOPAGE OF WORK DURING THE WINTER MONTHS**

E7.1 The Contractor may, at his/her own discretion, choose not to work between December 24, 2009 to March 15, 2010. No Working Days will be charged if no Work is performed. If the Contractor chooses to work between the dates above, Working Days will be charged.

E7.2 Work on intermittent days will be acceptable. The Contractor shall contact the Contract Administrator 48 hours prior to any intermittent work.

E7.3 If the Contractor chooses to work on intermittent days, the Contractor shall give the Contract Administrator 48 hours notice of each intermittent day the Contractor plans on working.

#### **E8. COOPERATION WITH OTHERS**

E8.1 The SEWPCC will be in service during the construction period. Other contractors and City forces will require unrestricted access to the facility. The Contractor shall not interfere with the daily operation of the plant and shall not impede others from completing their work.

E8.2 The lands surrounding the work area is currently used for crops. The Contractor shall not interfere or impede with the farming operations. The Contractor must keep all equipment, personal and material within the work area designated on the drawings.

#### **E9. SEWPCC BUILDING ACCESS**

E9.1 Access to the interior of the SEWPCC is restricted to the following times:

- (a) Monday to Friday, 7:30 A.M. to 3:30 P.M.
- (b) Saturday and Sunday, no access will be permitted.

#### **E10. SURFACE RESTORATIONS**

E10.1 Flood Protection Berm Restoration

- (a) The Contractor shall repair all surface damage by returning it to its original or better than condition. The area between the road on the south side of the SEWPCC and the outfall consists of a flood protection berm and shall be restored in accordance with CW 3170.
- (b) No measurement will be made for flood protection berm restoration. Flood protection berm restoration shall be considered incidental to the installation of the outfall pipe and construction of the chambers/effluent sampling facility.

E10.2 Outfall Field Restoration

- (a) This specification shall cover the topsoil final surface restorations and shall supplement, revise and amend CW 3540.
- (b) After compaction of the backfill, the stockpiled topsoil shall be replaced to the equivalent depth and width that was stripped.

- (c) The treatment of the topsoil will not be required.
- (d) The topsoil will not be tested for chemical composition.
- (e) Replacing and grading of topsoil will be measured on a volume basis. Volume to be paid for will be the total cubic metres replaced, graded, and accepted by the Contract Administrator.

#### **E11. ACCESS TO THE WORK AREA**

E11.1 The Contractor shall access the work area via Ed Spencer Drive to the road on the south side of the SEWPCC. No access will be permitted via the road adjacent to the SEWPCC to the north, off Highway 100, off Seniuk Road or off St. Mary's Road.

#### **E12. SECURING THE WORK SITE DURING NON-WORK HOURS**

E12.1 The Contractor shall protect the work site during non-work hours. Any excavations left open during non-work hours shall be fenced off protecting any persons from injury that may be caused by the construction activities.

E12.2 Work associated with this specification will not be measured for payment and will be included with the pipe installation and/or Effluent Sampling Facility and/or chamber construction.

#### **E13. OUTFALL PIPE**

E13.1 Description

E13.1.1 This Specification shall revise, amend and supplement the requirements of CW 2130.

E13.1.2 This Specification covers the design, of the 2,100 mm and 2,400 mm diameter reinforced concrete outfall pipe.

- (a) This twinning pipe will be used to increase the ability to convey treated effluent from the SEWPCC to the Red River to 415 MLD.

E13.2 Reinforced Concrete Outfall Design

E13.2.1 Design the reinforced concrete outfall to ASTM C1417 and ASCE 15-98.

- (a) The following criteria shall be incorporated into the design:

- (i) Inside Diameter ( $D_i$ ) = 2,438 mm and 2,134 mm;
- (ii) Standard Installation Type 2;
- (iii) Soil Pressure Distribution = Heger Pressure Distribution;
- (iv) Energy grade line profile found in Appendix B;
- (v) Crack Width Control = 25 mm from tension reinforcement;
- (vi) Dead and Earth Load Factor (shear and moment) = 1.3;
- (vii) Dead and Earth Load Factor (thrust);
  - Reinforcement Design = 1.0; and
  - Concrete Compression = 1.3

(viii) Live Load Factor (shear and moment) = 2.17;

(ix) Live Load Factor (thrust) = 1.0;

(x) Minimum live loading requirements shall be based on the equivalent live load due to an AASHTO HS20 design vehicle.

(xi) Internal Pressure Load Factor (thrust) = 1.0;

(xii) Flexure Strength Reduction Factor ( $\Phi_f$ ) = 0.95;

(xiii) Radial Tension Strength Reduction Factor ( $\Phi_v$ ) = 0.9;

(xiv) Diagonal Tension Strength Reduction Factor ( $\Phi_r$ ) = 0.9;

(xv) Crack Control Factor ( $F_{cr}$ ) = 0.9;

- (xvi) Orientation Angle = 10°;
- (xvii) Radial Tension Process and Material Factor = 1.0; and
- (xviii) Diagonal Tension Process and Material Factor = 1.0.

The access chamber weir shall be cast monolithically in the pipe.

#### E13.2.2 Shop Drawings

This Specification shall revise, amend and supplement the requirements of CW 1100.

Contractor shall submit shop drawings for the outfall pipe including the outfall pipe that contains the weir in accordance with the Schedule requirements noted in D13 and E4, and specifically indicating the following:

- (i) Pipe wall thickness;
- (ii) Concrete strength;
- (iii) Reinforcement;
  - Type;
  - Yield strength;
  - Reinforcement placement and concrete cover;
  - Reinforcement cross sectional diameter;
  - Spacing
  - Cross sectional area
  - Description of longitudinal members; and
  - If stirrups required, stirrup stress, stirrup shape, placement, and anchorage detail.

#### E13.2.3 Acceptance of Concrete Outfall Pipe Prior to Installation

Contract Administrator to have full access to the pipe manufactures plant for inspection during production of the outfall pipe and manholes.

Submit Statement of Certification conforming to ASTM 1417, sealed by a Registered Professional Engineer in the Province of Manitoba, to the Contract Administrator prior to pipe installation.

### E13.3 Construction Methods

#### E13.3.1 Construction Limits

The Contractor shall confine the working limits to within 70 metres north of the centreline of the new outfall. No construction equipment will be permitted over top of the existing outfall where there is less than 2.4 metres of cover.

#### E13.3.2 Construction Sequencing

The outfall pipe shall be installed and backfilled prior to the installation of the Effluent Sampling Facility piles.

#### E13.3.3 Excavation

Strip and stockpile topsoil in accordance with CW3110. Stockpile location shall be within the Work area and may be distributed along the north limit parallel to the outfall.

#### E13.3.4 Existing Pipe Support

The Contractor shall support the existing pipe during excavation of Chambers 1, 3, and 5. Contractor to supply shop drawings of the shoring and pipe support system proposed. Shoring design shall be completed and sealed by a Professional Engineer registered in the Province of Manitoba.

#### E13.3.5 Bedding and Backfill

Bedding and haunch areas to be in accordance with Table CW2030.1 Type 2.

Place and compact bedding and backfill as indicated on the drawings.

### E13.3.6 CCTV

In accordance with CW 2145.

#### E13.4 Measurement and Payment

- (a) Outfall pipe will be measured for payment on a length basis and paid for at the Contract Unit Price per metre for "Outfall Pipe". Length to be paid for will be the total number of linear metres supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.
- (b) Measurement for length of outfall installed in a trench will be made horizontally at grade above the centreline of the pipe from edge of chamber or manhole to the next closest edge of chamber or manhole.
- (c) Bedding and haunch material will not be measured for payment. Payment for bedding and haunch material shall be included with the unit price bid for "Outfall Pipe".

### E14. FLOW CONTROL

#### E14.1 Further to CW 2130 Clauses 3.21 and 4.16:

- (a) the existing outfall can not be shut down or taken out of service. The outfall and associated chambers shall be constructed in a sequence such that the flow in the existing outfall remains uninterrupted until such time that the new outfall is completely installed and capable of accepting effluent from the existing outfall.
- (b) The outfall can receive flow of an undetermined amount from groundwater infiltration, snow melt and other unforeseen sources.
- (c) An estimate of daily dry weather flow and minimum and maximum season flows can be found in Appendix D.
- (d) Provide flow control measures to contend with and maintain flow in the outfall that are directed downstream of the Work area. Flow control measures can include but not be limited to diversions, flumes and by-pass pumping.
- (e) Discharge hoses for by-pass pumping shall not be laid across vehicle paths and must be protected from freezing during winter months. Pumping equipment if used, shall be set-up in a location and in such a way to not be a noise problem for nearby residences.
- (f) Provide a flow control plan to the Contract Administrator for review prior to commencement of the Work.

E14.2 In the event the river level becomes higher than the gate chamber activation level and flow in the existing outfall is expected to exceed the capacity due to spring runoff, the Contract Administrator may suspend work activities that require temporary by-pass pumping and temporary shutdown of the site. Suspension of these activities will continue until the river level drops below flood pumping activation level and the high flow diminishes in the sewer.

E14.3 If in the opinion of the Contract Administrator suspension of work activities that require temporary by-pass pumping and temporary shutdown of the site may cause a delay in completion of the Work through no fault of the Contractor, no Working Days will be charged during that shut down period.

#### E14.4 Measurement and Payment

- (a) Flow Control will be measured for payment on a lump sum basis and paid for at the Contract Unit Price for "Flow Control". The lump sum to be paid will be for any flow control completed in accordance with this specification, accepted and measured by the Contract Administrator.

### E15. CAST IN PLACE CONCRETE CHAMBERS

#### E15.1 General



(a) This specification shall cover construction of cast-in-place concrete chambers and shall supplement, revise and amend CW 2160.

## E15.2 Materials

### (a) Concrete Mix Design

(i) Concrete mix design shall be as indicated in the Construction Notes on the Drawings.

### (b) Lean-Mix Concrete Design

(i) Proportioning of fine aggregate, coarse aggregate, cement, and water for lean mix concrete shall be as follows:

(a) Cement: HS

(b) Minimum Compressive Strength @ 28 days: 15 MPa

(e) Slump: 80 mm

(f) Air Content: 4 to 7%

(g) Minimum Cement Content = 240 kg/m<sup>3</sup>

(h) Maximum Water/Cement Ratio = 0.40

### (c) Grout

(i) Grout shall be Sika Grout 212SR or approved equal in accordance with B6 for below grade work.

### (d) Reinforcing Steel

(i) Bar accessories:

(a) Shall not stain, blemish or spall the concrete surface for the life of the concrete.

(b) Shall be approved by the Contract Administrator.

(c) Tie Wire – minimum 1.6 mm annealed type on Patented system accepted by the Contract Administrator.

(d) Bar chairs shall be PVC.

### (e) Bonding Agent

(i) Bonding agent shall be ACRYL-STIX or approved equal in accordance with B6.

### (f) Waterproofing

(i) Waterproofing shall be in accordance with E16 of this specification.

### (i) Miscellaneous Metals and Accessories

(i) In accordance with E38 of this specification and as shown on the Drawings.

### (j) Shop Drawings

(i) Provide shop drawings in accordance with E4 of this specification.

(ii) Submit shop drawings for reinforcing steel a minimum of two (2) weeks prior to the fabrication of any reinforcing steel.

### (k) Backfill

(i) In accordance with CW 2030. Class of backfill to be as shown on the Drawings.

## E15.3 Construction Methods

### (a) Construction Method Submission

(i) No work shall commence on construction of cast-in-place gate chambers until after the Contract Administrator's review of the Contractor's Construction Method submission.

(ii) Excavation for the construction of the gate chambers shall be by the shored excavation method.

(iii) Prepare for the Contract Administrator's review a Construction Method submission detailing:

(i) Construction sequence to be followed including all methods to be employed to ensure no damage occurs to existing structures or adjacent properties within or adjacent to an excavation.

- (ii) Shoring system to be used.
  - (iii) Proposed method of chamber construction.
  - (iv) Specialized equipment to be used.
  - (v) Any design revisions proposed to accommodate the Contractor's proposed construction method.
  - (vi) Water control considerations including details on the Contractor's proposed method of groundwater and surface runoff control.
- (iv) The Contractor shall respond to any concerns that may be raised by the Contract Administrator after review of Construction Method submission.
- (b) Excavation
- (i) Place a minimum 75 millimetre thick lean mix concrete slab in the bottom of the excavation to provide a clean working base upon completion of the excavation to the required limits. Allow the concrete to set for twenty-four (24) hours before setting up forms or placing reinforcing steel.
  - (iii) Lean mix concrete shall be well-tamped and screeded to give a level working platform for setting up forms and placing reinforcing steel.
  - (iv) Supply and place lean mix concrete, as directed by the Contract Administrator, as backfill for any portions of the excavation, carried beyond the required limits of excavation. The limits of excavation shall be considered to be the inside face of the shoring system and the underside of the working base slab.
  - (v) All working areas below grade shall be kept adequately and securely supported during and after excavation until the shoring and bracing is in place to prevent loss of ground or injury to any person from falling material.
- (f) Shoring
- (i) The type, strength, and amount of shoring and bracing shall be such as the nature of the ground and attendance conditions may require, taking into account property lines, existing slopes, utilities and roadways.
  - (ii) Shoring and bracing shall be so spaced and dimensioned as to prevent caving, loss of ground, surface settlement, or squeezing of the soil beyond the neat lines of excavation. It shall be free from defects that might impair its strength or suitability for the work. Sheeting/shoring and bracing shall conform to the latest revisions of the "Construction Safety Act" of the Department of Labour of the Government of Manitoba.
  - (iii) Supporting design calculations as required to facilitate review of the submission for conformance with the Contract Documents.
  - (iv) Submit Shop Drawings and design calculations for the shoring/excavation system designed and sealed by a Professional Engineer registered or licensed to practice in the Province of Manitoba and experienced in the structural design of shoring systems. The designer of the shoring system shall inspect the system during construction and certify, in writing to the Contract Administrator, that construction is in conformance with the approved design.
  - (v) Shoring and bracing shall be installed such that the structure size, wall thickness, and any work relating to the construction of the gate chamber as shown on the drawings can be achieved subsequent to installation of the shoring system.
  - (vi) Shoring and bracing shall remain in place until concrete has attained 75% of the design strength.
- (g) Cast in place Concrete Chamber Construction
- (i) Construct cast in place concrete chambers in accordance with CW 2160, except as supplemented, revised or amended in this specification and as indicated in the construction notes on the Drawings.
  - (ii) Adjust the location of reinforcing steel adjacent to openings to frame those openings in accordance with good practice, and maintain the bar spacing intent.
  - (iii) Do not use welded splices for reinforcing steel.

(iv) Order all wall reinforcing steel in lengths to best suit the spacing of walers so that reinforcing bars will not be bent or misformed in order to remove the walers.

(v) Install foundation waterproofing in accordance with E12 of this Specification.

(vi) The contractor shall note that the existing gate chamber wall may not be vertical or plumb or square and may vary by +/- 150mm. It is the contractor's responsibility to ensure smooth transition for the new chamber addition.

(h) Backfill

(i) Place and compact backfill material as indicated on the Drawings in accordance with CW 2030. Do not place backfill material in a frozen state. Supply heating and hoarding in accordance with CW 2160 if required to ensure material does not freeze before compaction is complete.

(ii) Notify the Contract Administrator at least one (1) full working day in advance of any backfilling operation. No Backfill shall be placed against concrete until approved by the Contract Administrator and in no case before field cured test cylinders show the concrete strength to be 75% of that specified.

(i) Grout

(i) Mix and apply grout in accordance with the manufacturer's instructions. Consistency to be suitable for the intended application.

(l) Miscellaneous Metal Fabrications

(i) Install miscellaneous metal fabrications as shown on the Drawings and in accordance with E13 of this specification.

E15.4 Measurement and Payment

- (a) Construction of cast-in-place concrete chambers will be measured on a unit basis and paid for at the Contract Unit Price for "Reinforced Concrete Chambers". The number of units to be paid for will be the total number of reinforced concrete chambers constructed in accordance with this specification, accepted and measured by the Contract Administrator.

**E16. FOUNDATION WATERPROOFING FOR THE CONCRETE CHAMBERS**

E16.1 Description

(a) General

- (i) This Specification shall cover the supply and placement of underground concrete gate chamber foundation waterproofing.

E16.2 Materials

- (a) Waterproofing membrane: Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, reinforced with non-woven polyester weighing 180 g/m<sup>2</sup>. Top surface polyethylene film. Bottom surface: thermofusible plastic film. Acceptable material: Soprema Sopralene Flam 180, IKO Aquabarrier TG.
- (b) Primes, mastic sealant and accessories: as recommended by membrane manufacturer, applicable for substrate.
- (c) Protection board: insulating fibreboard to CAN/CSA-A247, Type II, 12 millimetres thick.

E16.3 Construction Methods

(a) Quality Assurance

- (i) Installation of waterproofing membrane shall be performed by workers approved and trained by manufacturer for application of its products. If requested, submit proof of experience, in writing, from manufacturer.

(b) Warranty

- (i) Provide written warranty, signed and issued in the name of The City of Winnipeg stating that the waterproofing is guaranteed against leaking, loss of adhesion, for a period of one (1) year from the date of acceptance

(c) Environmental Requirements

- (i) Maintain air temperature and structural base temperature at installation area above membrane manufacturer's recommendations before, during and 72 hours after installation.
- (ii) For applications in freezing weather do not commence application until authorized by membrane manufacturer.
- (iii) For enclosed applications ensure adequate forced air circulation during curing period.
- (iv) Install membrane on dry substrates, free of snow and ice. Use only dry materials and apply only during weather that will not introduce moisture beneath waterproofing membrane.

(d) Preparation

- (i) Examine substrates and site conditions to ensure acceptability for application of waterproofing membranes. Notify Contract Administrator, in writing, of unsuitable surfaces or working conditions.
- (ii) Do not commence application until all other work that will penetrate membrane is complete.
- (iii) Clean substrates of all snow, ice, loose particles, oil, grease, dirt, curing compounds, or other foreign matter detrimental to application of primers and waterproofing membranes.
- (iv) Ensure concrete surfaces are fully cured and dry using test methods recommended by membrane manufacture.
- (v) Repair defects in concrete surfaces such as spalled or poorly consolidated concrete. Remove sharp protrusions, sharp edges and form lines.
- (vi) Patch rough areas with a weld-adhered parge coat to provide smooth surface. Allow to fully cure and dry.

(e) Priming

- (i) Apply primer in accordance with manufacturer's instructions at recommended rate of application.
- (ii) Do not apply primer to frozen or damp surfaces.
- (iii) Apply primer only when air and surface temperatures are within manufacturer's recommended limits.
- (iv) Avoid pooling of primer and allow to cure until tack-free.
- (v) Prime only the area to be covered with membrane in a working day. Re-prime areas not covered with waterproofing within 24 hours of application of primer.

(f) Membrane Application

- (i) Apply membrane in accordance with manufacturer's instructions and with good construction practice to maintain continuity of waterproofing over building elements below finished grade elevation.
- (ii) Place membrane in position without stretching, taking care to avoid trapped air, creases or fish mouths.
- (iii) Ensure membrane is totally bonded to substrate.
- (iv) Apply membrane vertically in longest possible lengths to reduce number of end joints.
- (v) Overlap side laps minimum 75 millimetres and end laps minimum 150 millimetres. Stagger end laps minimum 300 millimetres in adjacent rows.
- (vi) Seal horizontal and vertical terminations by applying heavy pressure to edges with a roller to ensure positive bond. Apply a continuous bead of mastic sealant to all terminations. Make watertight. Seal daily terminations with mastic sealant.
- (vii) Terminate membrane 300 millimetres below finished grade.

- (g) Membrane Application at Corners
  - (i) Remove sharp or protruding edges from external corners prior to application of membrane.
  - (ii) Reinforce external corners with cushion strip of membrane minimum 300 mm wide at each corner. Install cushion strip below main membrane.
  - (iii) Membrane Application Over Protrusions and Penetrations
  - (iv) Apply two layers of membrane flashing around protrusions, and extend at least 150 millimetres in all directions. Cut and fit membrane neatly and snug fitting, leave no gaps. Seal all terminations with mastic sealant. Flash protrusions with liquid mastic extending 150 millimetres along pipe or conduit.
  - (v) Seal with liquid mastic all protrusions or difficult detail areas which do not allow easy installation of membrane. Make watertight.
- (h) Inspection and Repair
  - (i) Inspect membrane thoroughly before covering and make corrections immediately.
  - (ii) Patch and repair misaligned or inadequately lapped seams, tears, punctures or fishmouths.
  - (iii) Patch with piece of waterproofing membrane and extend minimum 150 millimetres in all directions from fault and seal edges with mastic sealant.
- (i) Protection Board
  - (i) Install protection board against all waterproofing membranes to protect against backfilling operations.
  - (ii) Install boards vertically without fasteners or adhesives.
  - (iii) Install protection board during backfilling operations to allow backfill materials to hold protection board tight to waterproofing membrane.
  - (iv) Terminate protection board 600 millimetres below grade.

#### E16.4 Measurement and Payment

- (a) Supply and installation of waterproofing membrane and protection board will be included in gate chamber construction.

### **E17. STOP LOGS**

#### E17.1 GENERAL

- (a) This section covers the supply, installation and commissioning of Stop Logs.

#### E17.2 SUBMITTALS

- (a) The Contractor shall submit, for approval by the Contract Administrator, shop drawings in accordance with E4, showing the following:
  - (i) Frame assembly details;
  - (ii) Concrete embedment details and attachment;
  - (iii) Spreader bar detail;
  - (iv) Installation instructions; and
  - (v) For each stop log provide seal details.

#### E17.3 PRODUCT

- (a) General
  - (i) Shop assembly and inspect stop logs to ensure that field fitting will not be required.
- (b) Acceptable Manufactures
  - (i) Fontaine
  - (ii) Armtec
  - (iii) Rodney Hunt

- (iv) Whipps
- (c) Stop Log Frames
  - (i) Provide frames of Stainless Steel Type 316, with integral concrete anchors.
- (d) Stop Logs
  - (i) Provide stop logs of stainless steel type 316 designed to limit deflection to 1/360 of span.
  - (ii) Provide lifting lugs or holes near the end of each log. Recess mating logs to accommodate the lifting lugs.
  - (iii) Provide drainage in each stop log to prevent buoyancy and water retention.
  - (iv) Make downstream welds continuous.
- (e) Guides and Seals
  - (i) Provide guides of ultra high molecular weight polyethylene (UHMWPE) with neoprene rubber J seals with Teflon facing and of sufficient length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the full open position.
  - (ii) The seals shall maintain the specified leakage rate in both seating and unseating conditions.
  - (iii) Provide resilient neoprene bottom seal set into the bottom member of the frame to form a flush bottom.
  - (iv) Provide stop logs with J-bulb or urethane seals along the sides and a neoprene bottom seal. Provide an uninterrupted seal at the face of the stop log groove and at the joint with the adjacent log. The bottom stop log seals flush with the invert of the channel.
- (f) Leakage
  - (i) Do not exceed 0.025 L/s per metre of wetted perimeter under the maximum seating and unseating pressure.
- (g) Spreader bar
  - (i) Provide one spreader bar of sufficient length to remove the bottom stop log of the lowest elevation

#### E17.4 EXECUTION

- (a) Manufacturer's Representative
  - (i) Manufacturer's Representative shall be required to attend the Site to train installation personnel; and to witness installation and testing to ensure the equipment and operated as intended.
- (b) Testing
  - (i) Operate each gate with and without liquid to show that can be operated.
  - (ii) Test each stop log installation for leakage by filling the channel on one side of the stop log and measuring leakage through the stop log. Undertake the test after twenty-four (24) hours to allow for the concrete to absorb water.
- (c) Commissioning
  - (i) Arrange for the Manufacturer's Representative to be in attendance during Commissioning of the gates specified in this section to ensure that each gate functions as intended.

#### E17.5 Measurement and Payment

- (a) Stop Logs will be measured on a unit basis for each stop log assembly installed and paid for at the Contract Unit Price for "Stop Log". Number of units to be paid will be the total number of stop log assemblies supplied, installed and tested in accordance with this specification, accepted and measured by the Contract Administrator.

## **E18. EFFLUENT SAMPLING FACILITY**

E18.1 Specifications E19 to E38 pertain to the construction of the Effluent Sampling Facility.

E18.2 Measurement and Payment

- (a) Specifications E19 to E39 will be measured for payment on a cumulative unit basis and paid for at the Contract Unit Price for "Effluent Sampling Facility". Payment will be made for the Effluent Sampling Facility constructed in accordance with this specification, accepted and measured by the Contract Administrator.

## **E19. COMMON WORK RESULTS FOR MASONRY**

E19.1 General

(a) Related Sections

- (i) Cavity wall insulation: E.26.
- (ii) Cavity wall air barrier membrane: E.28.
- (iii) Joint sealants: E36

(b) References

- (i) Canadian Standards Association (CSA)
- (ii) CAN/CSA-A179, Mortar and Grout for Unit Masonry.
- (iii) CAN/CSA-A371, Masonry Construction for Buildings.

(c) Submittals

- (i) Product Data.
  - Submit manufacturer's printed product literature, specifications and data sheet in accordance with E4.
- (ii) Shop drawings: submit shop drawings in accordance with E4. Provide shop drawings for masonry soffits, indicating masonry anchoring, reinforcing, connections. Indicate method of installation and connection to building components. Show location of control and movement joints.
- (iii) Manufacturer's instructions: submit manufacturer's installation instructions.

(d) Delivery, Storage and Handling

- (i) Deliver, store, handle and protect materials in accordance with Common Product Requirements.
- (ii) Deliver materials to job site in dry condition.
- (iii) Keep materials dry until use, except where wetting of bricks is specified.
- (iv) Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

(e) Site Environmental Requirements

- (i) Cold weather requirements:
  - (i) Supplement Clause 5.15.2 of CAN/CSA-A371 with following requirements:
    - Maintain temperature of mortar between 5°C and 50°C until batch is used or becomes stable.
    - Maintain ambient temperature between 5°C and 50° C and protect site from wind chill.
  - (ii) Maintain dry beds for masonry and use dry masonry units only. Do not wet masonry units in cold weather.
  - (iii) When air temperature is below -4°C protect and heat masonry to maintain air temperature above 0°C on both sides of walls during operations and for period of 24 hours after.
  - (iv) When air temperature is above -4°C erect windbreaks to prevent differential freezing of walls.

- (ii) Hot weather requirements:
  - (i) Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
  - (ii) 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 flashing or other permanent construction.

#### E19.2 Materials

- (a) Use same brands of materials and source of aggregate for entire project.

#### E19.3 Execution

- (a) Manufacturer's Instructions
  - (i) Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- (b) Preparation
  - (i) Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
- (c) Installation
  - (i) Do masonry work in accordance with CAN/CSA-A371 except where indicated otherwise.
  - (ii) Build masonry plumb, level, and true to line, with vertical joints in alignment.
  - (iii) Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
  - (iv) Make masonry courses uniform in height with both vertical and horizontal joints of equal and uniform thickness.
  - (v) Keep air space in cavities and weep holes free of mortar droppings and other debris to allow free air movement and positive moisture drainage to exterior.
  - (vi) Lay masonry units in full mortar bed. Do not shift or tap units after mortar has taken initial set. Where adjustments must be made, remove mortar and replace with fresh supply.
  - (vii) Bed joints evenly and fill solidly with mortar. Rock masonry into place at closures with head joints thrown against adjacent masonry units.
  - (viii) Where new masonry abuts set masonry, clean existing surfaces and dampen if necessary to obtain bond.
- (d) Construction
  - (i) Exposed masonry:
    - (i) Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.
  - (ii) Jointing:
    - (i) Allow joints to set just enough to remove excess water, then tool with jointer to provide smooth, compressed, uniform joints.
    - (ii) Use round jointer to provide concave joints where concave joints are indicated.
    - (iii) Rake joints uniformly to 6 mm depth and compress with square tool to raked joints of uniform depth where raked joints are indicated.
    - (iv) Strike flush all joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
    - (v) Point or replace defective mortar as required or where directed by Contract Administrator.
  - (iii) Cutting:



- (i) Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.
  - (ii) Make cuts straight, clean, and free from uneven edges.
  - (iii) Use masonry saw where necessary.
- (iv) Building in:
  - (i) Build in items required to be built into masonry.
  - (ii) Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
  - (iii) Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- (v) Support of loads:
  - (i) Use 20 MPa concrete to Cast-In-Place Concrete where concrete fill is used in lieu of solid units.
  - (ii) Install building paper below voids to be filled with concrete; keep paper 25 mm back from faces of units.
- (vi) Provision for movement:
  - (i) Leave 9 mm space below shelf angles to allow for movement.
  - (ii) Leave space between top of non-load bearing walls and partitions and structural elements, minimum 25 mm or as indicated on drawings. Do not use wedges.
  - (iii) Built masonry to tie in with stabilizers, with provision for vertical movement.
- (vii) Loose steel lintels:
  - (i) Install loose steel lintels. Centre over opening width.
- (viii) Control joints:
  - (i) Construct continuous control joints as indicated.
  - (ii) Provide continuous vertical control joints in masonry where indicated but at no more than 6 m on centre maximum spacing.
  - (iii) Fill control joints with expansion joint filler and joint sealants as specified in E36.
- (ix) Expansion joints:
  - (i) Construct continuous expansion joints as indicated.
  - (ii) Provide continuous expansion joints where indicated and at building expansion joints.
  - (iii) Fill expansion joints with expansion joint filler and joint sealants as specified in E36.
- (x) Provisions for other trades:
  - (i) Provide openings in masonry walls where required or indicated. Accurately locate chases and openings and neatly finish to the required sizes.
  - (ii) Where masonry encloses conduit or piping, bring to proper level indicated and as directed.
  - (iii) Do not cover pipe or conduit chases or enclosures until advised that work has been inspected and tested.
- (xi) Site Tolerances
  - (i) Tolerances in notes to Clause 5.3 of CAN/CSA-A371 apply.
- (e) Field Quality Control
  - (i) Testing of masonry mortar and grout will be carried out by Testing Laboratory designated by Contract Administrator.
  - (ii) Costs for Testing Laboratory will be paid under cash allowance.
  - (iii) Test masonry mortar and grout in accordance with CSA A179.
- (f) Cleaning

- (i) Perform cleaning after installation to remove construction and accumulated environmental dirt.
  - (ii) Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- (g) Protection
- (i) Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

## **E20. MASONRY MORTAR AND GROUT**

### **E20.1 General**

- (a) Related Sections
  - (i) Masonry work and materials specified under related sections in E19.
- (b) References
  - (i) Canadian Standards Association (CSA)
    - (i) CAN/CSA-A179, Mortar and Grout For Unit Masonry.

### **E20.2 Products**

- (a) Materials
  - (i) Use same brands of materials and source of aggregate for entire project.
  - (ii) Mortar and grout: CAN/CSA-A179.
  - (iii) Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.
  - (iv) Colour: ground coloured natural aggregates or metallic oxide pigments. Colour selected by Contract Administrator. Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample.
  - (v) Grout: to CAN/CSA-A179, Table 3.
- (b) Mortar Types
  - (i) Mortar for exterior masonry above grade:
    - (i) Load bearing: Type S based on Proportion specifications.
    - (ii) Non-load bearing: Type N based on Proportion specifications.
    - (iii) Parapet walls, unprotected walls: Type S based on Proportion specifications.
  - (ii) Mortar for interior masonry:
    - (i) Load bearing: Type S based on Proportion specifications.
    - (ii) Non-load bearing: Type N based on Proportion specifications.
  - (iii) Following applies regardless of mortar types and uses specified above:
    - (i) Mortar for concrete brick: Type O based on Proportion specifications.
    - (ii) Mortar for grouted reinforced masonry: Type S based on Proportion specifications.
- (c) Mixing
  - (i) Mix grout to semi-fluid consistency.
  - (ii) Coloured mortar:
    - (i) Incorporate colour and admixtures into mixes in accordance with manufacturer's instructions.
    - (ii) Use clean mechanical mixer. No hand mixing permitted. Wherever possible use separate mixer for coloured mortar.
    - (iii) Accurately and consistently measure all ingredients, including water, to consistently produce batches matching approved samples.
    - (iv) Pointing mortar: pre-hydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will

retain its form when pressed into ball. Allow to stand for not less than 1 hour or more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

### E20.3 Execution

- (a) Manufacturer's Instructions
  - (i) Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- (b) Construction
  - (i) Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.
- (c) Cleaning
  - (i) Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- (d) Schedule
  - (i) Use coloured mortar for decorative concrete block.
  - (ii) Grout following masonry components:
    - (i) Reinforced lintels
    - (ii) Bond beams
    - (iii) Masonry indicated on Structural drawings.

## E21. MASONRY ANCHORAGE AND REINFORCING

### E21.1 General

- (a) Related Sections
  - (i) Masonry work and materials specified under related sections in E20.
- (b) References
  - (i) Canadian Standards Association (CSA)
  - (ii) CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - (iii) CAN/CSA-A179, Mortar and Grout For Unit Masonry.
  - (iv) CAN/CSA-A370, Connectors for Masonry.
  - (v) CAN/CSA-A371, Masonry Construction for Buildings.
  - (vi) CSA G30.14 Formed Steel Wire For Concrete Reinforcement.
  - (vii) CSA G30.18 Billet-Steel Bars for Concrete Reinforcement.
  - (viii) CSA-S304.1, Design of Masonry Structures.
  - (ix) CSA-W186 Welding of Reinforcing Bars in Reinforced Concrete Construction.
- (c) Shop Drawings
  - (i) Submit shop drawings in accordance with E4.
  - (ii) Shop drawings consist of bar bending details, lists and placing drawings.
  - (iii) On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

### E21.2 Materials

- (a) Reinforcement
  - (i) Bar reinforcement: to CAN/CSA-A371 and CSA G30.18, Grade 400.
  - (ii) Wire reinforcement: to CAN/CSA-A371 and CSA G30.14, truss type. Include prefabricated corners and intersections.

- (iii) Corrosion protection: to CSA-S304.1, galvanized to CAN/CSA-A370.
- (b) Connectors
  - (i) Connectors: to CAN/CSA-A370 and CSA-S304.1 and as specified below.
  - (ii) Exterior masonry veneer on concrete block backup walls: connector assembly consisting of galvanized steel connector plate and V-tie and plastic insulation support.
    - (i) Acceptable material: Fero Block Shear Connector Assembly.
  - (iii) Exterior masonry veneer on steel stud backup walls: connector assembly consisting of galvanized steel connector plate and V-tie and plastic insulation support.
    - (i) Acceptable material: Fero Rap Tie System; or Fero Side Mounting Rap-Tie System.
  - (iv) Exterior masonry veneer on cast-in-place concrete backup walls: connector assembly consisting of galvanized steel connector plate and V-tie and plastic insulation support.
    - (i) Acceptable material: Fero Rap-Tie System.
- (c) Corrosion protection: to CSA-S304.1 galvanized to CAN/CSA-A370.
- (d) Fasteners:
  - (i) Steel studs: self tapping, sheet metal screws, length to penetrate 20 mm through stud, corrosion resistant.
  - (ii) Masonry and concrete: wedge type anchors, carbon steel, corrosion resistant finish. Of sufficient length to penetrate minimum 25 mm into solid substrate.
    - (i) Acceptable material: Gripcon Perma-Grip, Rawl Spike.
- (e) Fabrication
- (f) Fabricate reinforcing in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Ontario.
- (g) Fabricate connectors in accordance with CAN/CSA-A370.
- (h) Obtain Contract Administrator's approval for locations of reinforcement splices other than shown on placing drawings.
- (i) Upon approval of Contract Administrator, weld reinforcement in accordance with CSA-W186.
- (j) Ship reinforcement and connectors, clearly identified in accordance with drawings.

### E21.3 Execution

- (a) Manufacturer's Instructions
  - (i) Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- (b) General
  - (i) Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CAN/CSA-A23.1 and CSA-S304.1, except where indicated otherwise.
  - (ii) Prior to placing concrete, mortar and grout, notify Contract Administrator for review of placement of reinforcement and connectors.
  - (iii) Supply and install additional reinforcement to masonry as indicated.
- (c) Bonding and Tying
  - (i) Bond walls of two or more wythes using metal connectors in accordance with NBC, CSA-S304.1, CAN/CSA-A371 and as indicated.
  - (ii) Tie masonry veneer to backing in accordance with NBC, CSA-S304.1, CAN/CSA-A371 and as indicated.

- (iii) Coordinate spacing with cavity wall insulation to ensure connector plates are centred on horizontal joints of insulation boards. Refer to E26 – Board Insulation.
- (iv) Ensure fasteners are tight and secure. Remove and replace any stripped or loose fasteners.
- (v) Install plastic insulation supports over connector plates to hold insulation tight to backup walls. Provide one insulation support at each connector plate.
- (vi) For steel stud backup walls use masonry ties with flat (side mount) or L-shape (face mount) plates:
  - (i) If using side mount ties install flat plates onto stud webs; minimum two fasteners per plate. Plate shall project through sheathing board, air barrier membrane, and board insulation into air space.
  - (ii) If using face mount ties install L-shaped plates over air barrier and sheathing board. Secure with screw fasteners through air barrier and sheathing board into stud faces; minimum two fasteners per plate.
- (d) Reinforced Lintels and Bond Beams
  - (i) Reinforce masonry lintels and bond beams as indicated.
  - (ii) Place and grout reinforcement in accordance with CSA-S304.1, CAN/CSA-A371, and CAN/CSA-A179.
- (e) Grouting
  - (i) Grout masonry in accordance with CSA-S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.
- (f) Anchors
  - (i) Supply and install metal anchors as indicated.
- (g) Lateral Support and Anchorage
  - (i) Supply and install lateral support and anchorage in accordance with CSA-S304.1 and as indicated.
- (h) Movement Joints
  - (i) Reinforcement will not be continuous across movement joints unless otherwise indicated.
- (i) Field Bending
  - (i) Do not field bend reinforcement and connectors except where indicated or authorized by Contract Administrator.
  - (ii) When field bending is authorized, bend without heat, applying a slow and steady pressure.
  - (iii) Replace bars and connectors that develop cracks or splits.
- (j) Field Touch-up
  - (i) Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

## **E22. CONCRETE UNIT MASONRY AND QUARRIED LIMESTONE**

### **E22.1 General**

- (a) Related Sections
  - (i) Masonry work and materials specified under related sections in E19.
- (b) References
  - (i) Canadian Standards Association (CSA)
    - (i) CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
- (c) American Society for Testing and Materials (ASTM)
  - (i) ASTM C568 Specification for Limestone Building Stone

## E22.2 Materials

- (a) Standard concrete masonry units: to CAN/CSA-A165 Series (A165.1).
  - (i) Classification: H/15/A/M.
  - (ii) Size: modular
  - (iii) Special shapes:
    - (i) Square units for exposed corners.
    - (ii) Purpose made shapes for lintels and bond beams.
    - (iii) Provide additional special shapes as indicated.
- (b) Architectural concrete masonry units: to CAN/CSA-A165 Series (A165.1).
  - (i) Classification: H/15/A/M.
  - (ii) Size: modular.
  - (iii) Special shapes:
    - (i) Square units for exposed corners.
    - (ii) Purpose made shapes for lintels and bond beams.
    - (iii) Coping blocks at tops of parapets: solid units, nominal 200 x 100 x 400 mm.
    - (iv) Provide additional special shapes as indicated.
  - (iv) Decorative finish: integral colour, burnished face to exposed aggregate.
- (c) Limestone veneer masonry:
  - (i) Size and Bond
    - (i) 100 x 669 Bond: Soldier course.
  - (ii) To ASTM C 568, category II, medium density as quarried and supplied by Gillis Quarries Limited, Winnipeg, Manitoba, Canada.
  - (iii) Free of defects which would affect appearance or durability. Quarry seams shall be well back from finished face. Fossils and other natural markings permitted only to the extent that they do not disfigure finished appearance or durability. Loose or large fossils not permitted.
  - (iv) Colour grey to match Existing UV Building.

## E22.3 Execution

- (a) Installation
  - (i) Concrete block units.
    - (i) Bond:
      - Standard and fire rated concrete block: running stretcher.
    - (ii) Coursing height:
      - Full height units: 200 mm for one block and one joint
      - Half-high units: 100 mm for one block and one joint.
  - (ii) Jointing:
    - (i) Standard block and fire rated block: concave where exposed.
    - (ii) Struck flush where concealed.
  - (iii) Concrete block lintels.
    - (i) Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
    - (ii) End bearing: not less than 200 mm as indicated on drawings.
- (b) Cleaning
  - (i) Standard block: allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.
  - (ii) At end of each working day brush off loose mortar from stone face.

- (iii) At completion wash stonework with stiff-fibre brushes and clean water.
- (c) Cutting
  - (i) Cut stone to shape and dimensions and full to square with jointing as indicated. Dress exposed faces true. Cut stone to lay on its natural quarry bed.
  - (ii) Make beds and joints 6 mm thick and at right angles to face.
  - (iii) Back-check stone contacting structural members as indicated. Allow minimum of 25 mm clearance between back of stone and steel and concrete structural members. Shape beds of stone resting on structural work to fit supports.
  - (iv) Cut stones for anchors, cramps, dowels and support systems.
  - (v) Do not cut holes in exposed surfaces.
- (d) Finish
  - (i) Exposed surfaces of stone split faced sawn finish
- (e) Setting
  - (i) Apply asphalt emulsion to concrete surfaces, shelf angles, structural steel supports against which stone is to be applied.
  - (ii) Clean stone exposed surfaces by washing with stiff fibre brush and water.
  - (iii) Drench dry stones with clean water just before setting.
  - (iv) Install anchors, dowels and cramps.
  - (v) Set stones plumb, true, level in full bed of mortar with vertical joints slushed full except where otherwise specified. Completely fill anchor, dowel and lifting holes.
  - (vi) Place spacers under stones to maintain joint thickness. Set heavy stones and projecting courses after mortar in courses below has hardened sufficiently to support weight.
  - (vii) Use soaked softwood wedges to support stone in proper alignment until mortar has set. Remove wedges when dry and without breaking them off, fill voids with pointing mortar.
  - (viii) Tool joints after initial set has occurred.
  - (ix) Sponge stone face along joints and remove droppings and splashed mortar immediately.

## **E23. STEEL DECKING**

### **E23.1 General**

- (a) Related Work
  - (i) Steel channels, Section E.30.
  - (ii) Metal fabrications, Section E.30.
  - (iii) Openings in steel decking and areas of concentrated loads, as required for mechanical and electrical equipment.
- (b) References
  - (i) Canadian Standards Association (CSA).
    - (i) CSA C22.2 No.79 - Cellular Metal and Cellular Concrete Floor Raceways and Fittings.
    - (ii) CAN/CSA-S16.1 - Limit States Design of Steel Structures.
    - (iii) CAN/CSA-S136 - Cold Formed Steel Structural Members.
    - (iv) CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures.
    - (v) CSA W55.3 - Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
    - (vi) CSA W59 - Welded Steel Construction, (Metal Arc Welding) Metric.
  - (ii) Canadian General Standards Board (CGSB).
    - (i) CAN/CGSB-1.181 - Ready-Mixed Organic Zinc-Rich Coating.

- (iii) American Society for Testing and Materials (ASTM)
  - (i) ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - (ii) ASTM A792/A792M, Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- (iv) Canadian Sheet Steel Building Institute (CSSBI).
  - (i) CSSBI 10M - Standard for Steel Roof Deck.
  - (ii) CSSBI 12M - Standard for Composite Steel Deck.
- (c) Shop Drawings
  - (i) Submit shop drawings, erection and shoring drawings in accordance with E4.
  - (ii) Submit drawings stamped and signed by qualified professional engineer registered or licensed in the Province of Manitoba, Canada.
  - (iii) Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, and reinforcement details and accessories.
  - (iv) Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete filled decks.

## E23.2 Products

- (a) Materials
  - (i) Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A635/A635M structural quality Grade 230, with ZF075 coating (wipe coat) for roof decking and Z275 (G90) for floor decking, 0.76 mm (22 gauge) minimum base steel thickness.
  - (ii) All deck undersides to be painted white – Factory finish.
  - (iii) Acoustic insulation: sound absorbing insulation for acoustic deck, fibrous glass, 17.5 kg/cubic metre, 1.1 lbs/cubic foot density, profiled to suit deck flutes.
  - (iv) Acoustic closures: fibrous glass 17.5 kg/m<sup>3</sup> , 1.10 lbs/ft<sup>3</sup> density profiled to suit deck flutes.
  - (v) Closures: as recommended by manufacturer. Closures to exterior walls neoprene.
  - (vi) Cover plates, cell closures and flashings: steel sheet with minimum steel core thickness of 0.76 mm (22 gauge). Metallic coating same as deck material.
  - (vii) Primer: zinc rich, ready mix to CAN/CGSB-1.181.
  - (viii) Sealant: as specified in E36.
  - (ix) Shear studs: to CSA W59.
- (b) Types of Decking
  - (i) Steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, non-cellular, interlocking side laps.
  - (ii) Acoustic steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, non-cellular, perforated on vertical face of flutes, interlocking side laps.
  - (iii) Composite steel floor deck: 0.76 mm minimum base steel thickness, 38 mm deep profile, non-cellular upright interlocking side laps.

## E23.3 Execution

- (a) General
  - (i) Structural steel work: in accordance with CAN/CSA S136 and CSSBI 10M and CSSBI 12M.
  - (ii) Welding: in accordance with CSA W59, except where indicated otherwise.
  - (iii) Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding.
- (b) Erection



- (i) Erect steel deck as indicated and in accordance with CAN/CSA-S136 , CSSBI 10, CSSBI 12, and reviewed shop drawings.
  - (ii) Lap ends: to 50 mm minimum, and formed over supports.
  - (iii) Fasten steel deck to steel framework at ends and intermediate supports with 19 mm fusion welds at minimum 4 transverse welds per deck unit or 300 mm on centre for members parallel to ribs.
  - (iv) Allow minimum 38 mm bearing for roof deck and full top flange bearing for floor deck, when supported by structural steel.
  - (v) Mechanically fasten male/female side laps at 450 mm on centre maximum.
  - (vi) Immediately after decking is permanently secured in place touch up metallic coated top surface with primer where burned by welding.
  - (vii) Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale, and other foreign matter.
  - (viii) Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.
  - (ix) Place and support reinforcing steel as indicated.
- (c) Closures
- (i) Install closures to ensure effective closures against weather, thermal and acoustic effects.
  - (ii) Install closures to details indicated, to manufacturer's recommendations and as specified herein.
  - (iii) Where steel deck rests on exterior masonry walls:
    - (i) Fill web spaces with neoprene closures as recommended by manufacturer.
    - (ii) Make weather tight seal.
  - (iv) Where flutes are at right angles to exterior walls, and deck extends beyond these walls:
    - (i) Caulk interlocking side laps of decking for 400 mm immediately over walls. Install interior and exterior closures.
    - (ii) Caulk exterior closures to prevent air infiltration. Caulk interior closures to prevent water vapour exfiltration.
    - (iii) In addition, provide roofing Subcontractor with glass fibre pads to close off topside flutes directly over face of wall or use closures as recommended by manufacturer.
  - (v) Where flutes run at right angles to interior partitions:
    - (i) Fill web spaces with double run of steel closures or as recommended by manufacturer.
  - (vi) Where flutes are parallel to interior partitions:
    - (i) Install steel closure flashing to provide neat juncture between two materials or as recommended by manufacturer.
  - (vii) Acoustic closures:
    - (i) Install acoustic closures at tops of sound rated or acoustically insulated interior partitions as indicated.
    - (ii) Where flutes run at right angles to partitions fill web spaces with acoustical closures extending minimum 300 mm out from face of partition.
    - (iii) Where flutes run parallel to partitions fill web spaces with double run of acoustical closures,.
    - (iv) Where partitions are exposed in final assembly, install steel closures flashing to provide neat juncture between two materials, or as recommended by manufacturer.
  - (viii) Attach metal cell closures at locations required to contain poured concrete as recommended by manufacturer.

- (d) Openings and Areas of Concentrated Loads
  - (i) No reinforcement required for openings cut in deck that are smaller than 150 mm square.
  - (ii) Frame deck openings with any one dimension between 150 to 300 mm as recommended by manufacturer, except as otherwise indicated.
  - (iii) For deck openings over 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.
  - (iv) Refer to and frame openings as indicated on mechanical and electrical drawings.
- (e) Connections
  - (i) Install connections in accordance with CSSBI recommendations as indicated.

## **E24. BITUMINOUS DAMP PROOFING**

### **E24.1 General**

- (a) Submittals
  - (i) Submit in accordance with E4.
  - (ii) Submit WHMIS MSDS - Material Safety Data Sheets.
  - (iii) Submit product data sheets for bituminous dampproofing products. Include:
    - (i) Product characteristics.
    - (ii) Performance criteria.
    - (iii) Application methods.
    - (iv) Limitations.
- (b) Delivery Storage, Handling
  - (i) Provide and maintain dry, off-ground weatherproof storage.
  - (ii) Store materials on supports to prevent deformation.
  - (iii) Remove only in quantities required for same day use.
  - (iv) Store materials in accordance with manufacturer's written instructions.
- (c) Project/Site Environmental Requirements
  - (i) Temperature, relative humidity, moisture content:
    - (i) Apply dampproofing materials only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
    - (ii) Do not proceed with work when wind chill effect would tend to set bitumen before proper curing takes place.
    - (iii) Maintain air temperature and substrate temperature at dampproofing installation area above 5 °C for 24 hours before, during and 24 hours after installation.
    - (iv) Do not apply dampproofing in wet weather.
  - (ii) Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

### **E24.2 Materials**

- (a) Asphalt dampproofing:
  - (i) For application and curing at temperatures above 5°C: Bakor 700-01 or equivalent.
  - (ii) For application and curing temperatures above 0°C but below 5°C: Bakor 710-07 or equivalent.
- (b) Sealing compound: plastic cutback asphalt cement.

### E24.3 Execution

#### (a) Preparation

- (i) Ensure concrete and masonry surfaces are fully cured and dry, clean and free from scale, frost, dirt, dust, oil, grease and other foreign matter.
- (ii) Seal exterior joints between foundation walls and footings, joints between concrete floor slab and foundation and around penetrations through dampproofing with sealing compound.

#### (b) Application

- (i) Apply primers and dampproofing in accordance with manufacturer's instructions.
- (ii) Apply two additional coats of dampproofing to vertical corners and construction joints for a minimum width of 230 mm 10" on each side, and all around and for 230 mm 10" along pipes passing through walls.

## **E25. WATERPROOFING MODIFIED BITIMINOUS SHEET**

### E25.1 General

#### (a) Related Sections

- (i) Foundation insulation: E.26.
- (ii) Sealant and joint fillers: E.36.

#### (b) References

- (i) Underwriters' Laboratories of Canada (ULC)
- (ii) CAN/ULC-S706, Standard for Wood Fibre Thermal Insulation for Buildings.

#### (c) Quality Assurance

- (i) Applicator qualifications: approved and trained by membrane manufacturer and having minimum 5 years experience in installation of waterproofing membranes on projects of similar size. If requested, submit proof of experience to Contract Administrator.

#### (ii) Manufacturer's representative:

- (i) Inspect substrate prior to commencement of work, during application of membrane and upon completion.
- (ii) Provide technical assistant to applicator and assist where required to correct installation of membrane.

#### (d) Submittals

- (i) Submit in accordance with Section E.4.
- (ii) Product data: manufacturer's printed product literature, specifications and application instructions for waterproofing materials.
- (iii) Samples: duplicate 100 x 100 mm size samples of waterproofing membrane proposed for use on this project.

#### (e) Field Sample

- (i) Construct field sample 10 m<sup>2</sup> minimum, of waterproofing membrane including one lap joint, one inside and one outside corner, and overlap detail with exterior wall air barrier membrane.
- (ii) Contract Administrator will review sample application prior to start of waterproofing work.
- (iii) Field sample, if accepted, may be part of the finished work.

#### (f) Coordination

- (i) Coordinate delivery and application of waterproofing materials with work covering waterproofing to minimize exposure to elements or damage.

- (ii) Coordinate installation of waterproofing membrane with building air barrier membrane. Overlap and seal to air barrier membrane to ensure continuity over building substrate.
- (g) Environmental Requirements
  - (i) Maintain air temperature and structural base temperature at installation area above membrane manufacturer's recommendations before, during and 72 hours after installation.
  - (ii) Do not apply membrane to frozen, wet or damp surfaces.
  - (iii) For applications in freezing weather do not commence application until authorized by membrane manufacturer.
  - (iv) For enclosed applications ensure adequate forced air circulation during curing period.
  - (v) Install membrane on dry substrates, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture beneath waterproofing membrane.
- (h) Delivery, Storage, Handling
  - (i) Deliver materials to site in original unopened packaging with all labels intact.
  - (ii) Provide and maintain dry, off-ground weatherproof storage.
  - (iii) Store rolls of membrane in upright position, with selvage edge up.
  - (iv) Remove only in quantities required for same day use.
  - (v) Store sealants at +5°C minimum.
- (i) Extended Warranty
  - (i) Provide manufacturer's warranty stipulating that waterproofing membrane work will not leak in accordance with General Condition GC 12.3, but for five years.

## E25.2 Products

### (a) Materials

- (i) Waterproofing membrane: self-adhesive, modified bitumen prefabricated sheet, non-woven polyester reinforcing, 1.5 mm thick (minimum), top surface polyethylene film, bottom surface polyethylene release sheet.
  - (i) Acceptable material: WR Grace Bituthene 3000, Soprema Colphene 3000, W.R. Meadows Mel-Rol, IKO Aquabarrier FP, Bakor Blueskin WP 200.
- (ii) Primer: type recommended by manufacturer, applicable for substrate, water based. Solvent based primer is acceptable only when ambient and surface temperatures are below manufacturer's specifications for water based primers.
- (iii) Mastic sealant: type recommended by manufacturer, compatible with membrane.
- (iv) Liquid sealing membrane: type recommended by manufacturer, compatible with membrane.
- (v) Protection board: insulating fibreboard: to CAN/ULC-S706, Type I, square edge, board size 1219 x 2438 mm x thickness indicated.

## E25.3 Execution

### (a) Inspection

- (i) Inspect substrates and site conditions to ensure acceptability for application of waterproofing membranes.
- (ii) Do not commence application until all other work that will penetrate membrane has been completed and reviewed by Contract Administrator.
- (iii) Notify Contract Administrator, in writing, of unsuitable surfaces or working conditions.
- (iv) Commencement of work implies acceptance of surfaces and working conditions.

(b) Preparation

- (i) Clean substrates of snow, ice, loose particles, oil, grease, dirt, curing compounds or other foreign matter detrimental to application of waterproofing.
- (ii) Ensure concrete surfaces are fully cured and dry using test methods recommended by membrane manufacture.
- (iii) Repair defects in concrete surfaces such as spalled or poorly consolidated areas. Remove sharp protrusions and form lines.
- (iv) Patch rough areas with a weld-adhered parge coat to provide smooth surface. Allow parging to cure and dry before applying primer or membrane.

(c) Priming

- (i) Prime all substrates to receive waterproof membrane.
- (ii) Apply primer in accordance with manufacturer's instructions at recommended rate of application.
- (iii) Do not apply to frozen or damp surfaces. Apply only when air and surface temperatures are within manufacturer's recommended limits.
- (iv) Avoid pooling of primer and allow primer to cure until tack-free.
- (v) Prime only the area to be covered with membrane in a working day. Re-prime areas that are not covered with waterproofing within 24 hours of application of primer.

(d) Membrane Application

- (i) Apply membrane in accordance with manufacturer's instructions and with good construction practice to maintain continuity of waterproofing over building elements.
- (ii) Place membrane in position without stretching, taking care to avoid trapped air, creases or fish mouths.
- (iii) Ensure membrane is totally bonded to substrate.
- (iv) Overlap side laps minimum 75 mm, and end laps minimum 150 mm. Stagger end laps minimum 300 mm in adjacent rows.
- (v) As installation progresses roll membrane with hand roller to ensure positive bond.
- (vi) Vertical surfaces:
  - Apply membrane vertically in longest possible lengths to reduce number of end joints.
  - At end laps overlap upper sheet over lower sheet shingle fashion to ensure shedding of water.
- (vii) Terminations:
  - Seal horizontal and vertical terminations by applying heavy pressure to edges with a roller to ensure positive bond.
  - Apply a continuous bead of mastic sealant to all terminations. Make watertight.
  - Seal daily terminations with mastic sealant.
- (viii) Corners:
  - At internal corners, both vertical and horizontal, provide a fillet strip formed of liquid membrane. Do not use fibre or wood cants.
  - Provide fillet strip at junction of foundation walls with footings.
  - Remove sharp or protruding edges from external corners prior to application of membrane.
  - Reinforce external and internal corners with cushion strip of membrane minimum 300 mm wide at each corner. Install cushion strip below main membrane.
- (ix) Protrusions and Penetrations:
  - Flash and seal around protrusions and penetrations such as pipes and conduits. Make watertight.
  - Apply two layers of membrane flashing around protrusions, and extend at least 150 mm in all directions. Cut and fit membrane neatly and snug fitting, leave

- no gaps. Seal all terminations with mastic sealant. Flash protrusions with liquid mastic extending 150 mm along pipe or conduit.
- Seal with liquid mastic all protrusions or difficult detail areas which do not allow easy installation of membrane. Make watertight.
- (x) Joints:  
Reinforce control joints, construction joints, and joints at changes in building substrate with application of minimum 150 mm wide strip of waterproofing membrane centred over joint.
- (xi) Overlap and seal waterproofing membrane to air barrier membranes to maintain continuity of building air/vapour barrier system over building envelope.
- (e) Protection Board
- (i) Install protection board against all waterproofing membranes that are not covered and protected by board insulation.
  - (ii) Install boards vertically without fasteners or adhesives.
  - (iii) Install protection board during backfilling operations to allow backfill materials to hold protection board tight to waterproofing membrane.
- (f) Inspection and Repair
- (i) Inspect membrane thoroughly before covering and make corrections immediately.
  - (ii) Patch and repair misaligned or inadequately lapped seams, tears, punctures or fishmouths. Patch with piece of waterproofing membrane and extend minimum 150 mm in all directions from fault and seal edges with mastic sealant.

## **E26. BOARD INSULATION**

### **E26.1 General**

- (a) References
- (i) Canadian Gas Association (CGA)
    - CAN/CGA-B149.1, Natural Gas Installation Code.
    - CAN/CGA-B149.2, Propane Installation Code.
  - (ii) Canadian General Standards Board (CGSB)
    - CGSB 71-GP-24, Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.
  - (iii) Underwriters' Laboratories of Canada (ULC)
    - CAN/ULC-S604, Type A Chimneys.
    - CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
    - CAN/ULC-S704, Thermal Insulation, Urethane and Isocyanurate, Boards, Faced.
    - CAN/ULC-S706, Standard for Wood Fibre Thermal Insulation for Buildings.

### **E26.2 Products**

- (a) Insulation
- (i) Extruded polystyrene (XPS): to CAN/ULC-S701: Type 4, compressive strength 210 kPa. Board size 600 x 2400 x thickness indicated. Edges shiplapped; or square edge where installed between wood strapping.
  - (ii) Rigid cellular polyisocyanurate (ISO), faced: to CAN/ULC-S704: Type 1, Class 1. Polyisocyanurate core glass fibre reinforced. Facers reflective foil facer and non-reflective back. Board size: 1200 x 2400 x thickness indicated. Edges square. Flame spread classification: less than 500.
- (b) Accessories
- (i) Protection Board: Insulating fibreboard: to CAN/ULC-S706, Type I, 1200 x 2400 x thickness indicated.

- (ii) Adhesive (for polystyrene): to CGSB 71-GP-24, Type II.
- (iii) Screws: self-tapping sheet metal screws, corrosion resistant, of length to penetrate through steel stud minimum 20 mm.
- (iv) Concrete/masonry anchor: plastic anchor for attaching insulation boards with integral large head.
  - (i) Acceptable material: Hilti IDP Insulation Anchor System or equivalent.
- (v) Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm (26 gauge) thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.

### E26.3 Execution

#### (a) Examination

- (i) Examine substrates and immediately inform Contract Administrator in writing of defects.
- (ii) Prior to commencement of work ensure substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust, debris, oil, grease, or foreign materials.

#### (b) Workmanship

- (i) Install insulation after building substrate materials are cured and dry.
- (ii) Install insulation to maintain continuity of thermal protection to building elements and spaces.
- (iii) Coordinate installation with work of other trades.
- (iv) Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- (v) Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.
- (vi) Cut and trim insulation neatly to fit spaces.
- (vii) Install insulation boards in parallel rows. Butt joints tightly, offset vertical joints.
- (viii) Offset both vertical and horizontal joints in multiple layer applications.
- (ix) Interlock boards at corners.
- (x) Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- (xi) Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide strip of air barrier membrane over expansion and control joints using compatible adhesive before application of insulation.

#### (c) Installation

##### (i) Fasteners:

- (i) Install masonry anchors in accordance with manufacturer's instructions.
- (ii) Provide a minimum of four anchors per 600 x 1200 mm of insulation board.
- (iii) Provide additional anchors spaced at 300 mm on centre around perimeter of openings, corners and abutments.
- (iv) Use nailing discs
- (v) Ensure fasteners securely seated and solidly anchored. Replace loose fasteners or provide additional fastener adjacent to loose fasteners.

##### (ii) Insulation Adhesive

- (i) Ensure substrate is sound, smooth, clean, and dry.
- (ii) Clean and prepare substrate and apply adhesives in accordance with manufacturer's instructions, using proper trowels and tools.
- (iii) Bead method: apply adhesive in 12 mm diameter beads at 150 mm on centre serpentine pattern.

- (iv) Notched trowel method: apply adhesive using notched trowel having 4.5 mm notches. Spread adhesive full coverage of insulation board.
- (v) Press insulation boards onto substrate with firm hand pressure to ensure full bond.
- (iii) Masonry Cavity Walls
  - (i) Install boards horizontally between masonry ties, with horizontal joints centred on ties.
  - (ii) Install plastic insulation clips over masonry ties to hold insulation tight to backup wall.
- (iv) Schedule
  - (i) Exterior walls above grade:
    - Insulation: ISO.
    - Installation: behind masonry veneer plastic insulation supports over masonry ties. Elsewhere insulation adhesive or fasteners and nailing discs.
  - (ii) Parapets (roofing side):
    - Insulation: ISO.
    - Installation: fasteners and nailing discs.
  - (iii) Grade beams and foundation walls:
    - Insulation: XPS.
    - Installation: adhesive or fasteners and nailing discs.
  - (iv) Frost barrier:
    - Insulation: XPS.
    - Installation: install boards loose on sand leveling bed with tight butt joints. Cover with protection board.

## **E27. BLANKET INSULATION**

### **E27.1 General**

#### **(a) References**

- (i) Canadian Gas Association (CGA)
  - (i) CAN/CGA-B149.1, Natural Gas Installation Code.
  - (ii) CAN/CGA-B149.2, Propane Installation Code.
- (ii) Underwriters Laboratories of Canada (ULC)
  - (i) CAN/ULC-S604, Factory-Built, Type A Chimneys.
  - (ii) CAN/ULC-S702, Standard for Mineral Fibre Thermal Insulation for Building.

#### **(b) Submittals**

- (i) Product Data: Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section E.4.
- (ii) Submit manufacturer's installation instructions.

### **E27.2 Products**

#### **(a) Materials**

- (i) Batt and blanket mineral fibre insulation: to CAN/ULC-S702, Type 1 – no membrane. Thickness indicated. Formaldehyde free.

### **E27.3 Execution**

#### **(a) Installation**

- (i) Install insulation to maintain continuity of thermal protection to building elements and spaces.



- (ii) Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
  - (iii) Fill all voids completely. Cut and trim insulation neatly to fill voids; leave no gaps.
  - (iv) Do not compress insulation to fit into spaces.
  - (v) Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from side walls of CAN4-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.
- (b) Cleaning
- (i) Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

## **E28. AIR BARRIERS**

### **E28.1 General**

- (a) References
- (i) National Air Barrier Association (NABA)
  - (i) Quality Assurance Program.
- (b) Product Data
- (i) Submit product data in accordance with Section E.4.
  - (ii) Submit manufacturer's product data for materials proposed for use on project. Include manufacturer's printed instructions for installation.
- (c) Quality Assurance
- (i) Applicators qualifications: approved and trained by membrane manufacturer. Upon request, submit proof of experience and qualifications.
  - (ii) Manufacturer's representative shall provide on-site inspection, technical assistance and application instructions to ensure proper installation of air barrier membrane. Contractor shall include all costs for manufacturer's inspection in his bid price.
- (d) NABA Quality Assurance Program
- (i) Work of this section shall be performed by a Licensed Contractor certified by the National Air Barrier Association (NABA) who shall employ only NABA Certified Installers and apprentices. Prior to start of Work submit proof of license and certification.
  - (ii) Certified Installers shall have journeyman qualifications and be thoroughly trained and experienced in the installation of air barriers of the types being applied. Certified Installers shall perform or directly supervise air barrier Work on the project and shall be responsible to ensure compliance with the NABA Quality Assurance Program.
  - (iii) Perform air barrier Work in accordance with the NABA Quality Assurance Program including, but is not necessarily limited to:
    - (i) Inspection of site conditions and substrates prior to start of Work.
    - (ii) Daily testing of installed work by the Certified Installers.
    - (iii) Documentation and recording of work results, tests, inspections, NABA worksheets, and other information required by NABA Quality Assurance Program.
    - (iv) Audits and inspections by NABA certified agencies to ensure compliance with the NABA Quality Assurance Program. Include costs of audits in Contract Price.
  - (iv) Cooperate with the Contract Administrator by making construction drawings and records available to him, including the NABA worksheets, and providing him with other information as requested. Allow Contract Administrator access to the job site.
  - (v) Provide documentation, reports and worksheets required by the Quality Assurance Program. Job-site records shall include, but not necessarily be limited to, installation dates, wall areas covered on those dates, name of the Certified Installers and

apprentices who performed the Work, the types and lot numbers of materials used, environmental and substrate conditions (temperatures, humidity, cleanliness, etc.) during installation, variations from drawings or specifications and results of any testing or inspections done by the installation crew. Identify all areas of substrate for which the application was approved by the Certified Installer. Provide copies to:

- (i) NABA office.
- (ii) Job site office.
- (iii) Contract Administrator.

(e) Coordination

- (i) Coordinate delivery and installation of air barrier materials with work of other trades to minimize exposure of membrane to elements or damage.
- (ii) Coordinate installation of air barrier membrane with work of other trades. Overlap and seal air barrier with air barriers and vapour retarders installed by other trades to ensure continuity of building air and vapour seal over entire building envelope.

(f) Pre-Installation Conference

- (i) Prior to start of air barrier work Contract Administrator shall arrange a pre-installation conference to review and confirm installation procedures, coordination with other work trades, overlapping and sealing with other air and vapour barrier membranes, and other details.
- (ii) Representatives of the Contractor, Contract Administrator, air barrier installers, and other trades as deemed necessary by the Contract Administrator are to attend.

(g) Environmental Conditions

- (i) Apply primers and membranes in dry weather and only when air and surface temperatures are within manufacturer's recommended limits.
- (ii) For enclosed applications ensure adequate forced air circulation during curing period.

(h) Delivery Storage, Handling

- (i) Deliver materials to site in original unopened packaging with all labels intact.
- (ii) Protect materials from weather, store on raised platforms, and cover with waterproof coverings. Do not double stack pallets.
- (iii) Do not store materials at continuous temperatures above 38°C.

E28.2 Products

(a) Materials

- (i) Self-adhesive air barrier membrane: modified bitumen on high-density polyethylene film, with silicone release paper on adhesive side, nominal thickness 1.0 mm.
- (ii) Acceptable material: Soprema Sopraseal Stick 1100, Bakor Blueskin SA, WR Grace Perm-A-Barrier, IKO Aquabarrier AVB, W.R. Meadows Air-Shield.
- (iii) Primers: as recommended by manufacturer and suitable for substrate.
- (iv) Mastics and sealants: as recommended by manufacturer, suitable for substrate. Use water base low VOC materials wherever possible.
- (v) Flashing and stripping membranes: as recommended by air barrier membrane manufacturer.
- (vi) Sheet metal transition flashings: as specified in Section E.30.

E28.3 Execution

(a) Examination

- (i) Verify that surfaces and site conditions acceptable and ready for waterproofing application.
- (ii) Ensure work penetrating waterproofing membrane is complete.

- (iii) Notify Contract Administrator in writing of unsuitable surfaces or working conditions and await remedial measures. Commencement of work shall imply acceptance of surfaces and working conditions.
- (b) Preparation
  - (i) Clean substrates of all snow, ice, loose particles, oil, grease, dirt, curing compounds, or other foreign matter detrimental to installation and bonding of air barrier membrane.
  - (ii) Repair defects in concrete and masonry surfaces such as mortar droppings spalled or poorly consolidated areas, honeycombing. Patch rough areas with a well-adhered parge coat to provide smooth surface. Allow to fully cure and dry.
  - (iii) Remove sharp protrusions, form lines and rough edges.
- (c) Priming
  - (i) Apply primers in accordance with manufacturer's instructions, at recommended rate of application.
  - (ii) Do not apply to frozen or damp surfaces. Apply in dry weather when air and surface temperatures are within manufacturer's recommended limits.
  - (iii) Avoid pooling of primer and allow to cure until tack-free.
  - (iv) Prime only an area that can be covered in a working day. Re-prime areas which over dry or become soiled or dusty.
- (d) Installation
  - (i) Install materials in accordance with manufacturer's instructions using only materials approved for use with their products.
  - (ii) Apply with good construction practice to maintain continuity of air barrier membrane over building elements.
  - (iii) Roll out sheets and press firmly to substrate. As installation progresses roll with hand roller to ensure positive bond.
  - (iv) At internal corners, both vertical and horizontal, provide a fillet strip formed of liquid mastic. Do not use fibre or wood cants.
  - (v) Use largest lengths possible to minimize joints. Overlap side and end laps minimum 50 mm. Stagger end laps minimum 300 mm in adjacent rows.
  - (vi) Locate end joints minimum 300 mm from internal and external corners.
  - (vii) Masonry cavity walls:
    - (i) Install sheets horizontally between masonry ties penetrating membrane. Overlap horizontal joints minimum 50 mm. Slit membrane at each tie and seal making air tight.
    - (ii) Where masonry ties are to be installed after installation of air barrier use 1 m wide rolls.
    - (iii) Place membrane in position without stretching, taking care to avoid trapped air, creases or fishmouths. As installation progresses roll membrane with hand roller to ensure full contact and bond to substrates.
  - (viii) Expansion and control joints:
    - (i) Maintain continuity of air barrier membrane at expansion and control joints in substrates.
    - (ii) Locate lap joints minimum 300 mm from joint.
    - (iii) Continue membrane over joint. Apply an additional layer of membrane over the joint, extending minimum 300 mm on both sides of joint.
  - (ix) Flash and seal around all penetrations and protrusions such as pipes, conduits, steel angle supports, masonry ties, anchors. Cut and fit membrane neatly and snug fitting, leave no gaps. Seal and make airtight.
  - (x) Seal with mastic all difficult detail areas that do not allow easy installation of membrane. Make airtight.

- (xi) At rough openings cut air barrier membrane to form opening. Return membrane into opening and seal to rough bucks. Reinforce corners with additional piece of membrane cut and formed to seal corners.
- (xii) At windows, overlap and seal air barrier membrane to factory applied membrane on window frames.
- (xiii) Sheet metal transition flashings:
  - (i) Install sheet steel transition flashings and stripping where indicated.
  - (ii) Secure to substrates with screws or roofing nails at 300 mm on centre. Apply continuous bead of sealant under metal flashings before securing. Overlap end laps minimum 75, provide continuous bead of sealant, and secure with fasteners.
  - (iii) Apply recommended primer to metal surfaces before application of air barrier membrane.
  - (iv) Overlap and seal air barrier membrane to other air/vapour barriers and waterproofing membranes. Maintain continuity of building air/vapour barrier system over building envelope.
- (xiv) Patching and Repairing
  - (i) Inspect membrane for defects and poor workmanship before covering and make corrections immediately.
  - (ii) Ensure full contact and bond to substrates. Patch and repair loose or poorly bonded areas.
  - (iii) Patch and repair misaligned or inadequately lapped seams, tears, punctures or fishmouths to the satisfaction of the Contract Administrator.
  - (iv) Patch cuts, tears, and punctures by bonding an additional layer of air barrier membrane over damaged area. Patch shall extend minimum 150 mm in all directions from fault. Seal and make airtight.

## **E29. MODIFIED BITUMINOUS MEMBRANE ROOFING**

### **E29.1 General**

- (a) Related Sections
  - (i) Sheet metal flashing and trim: Section E.30.
  - (ii) Roof drains: Mechanical.
- (b) References
  - (i) American Society for Testing and Materials (ASTM)
    - (i) ASTM C 1177/C1177M, Specification for Glass Mat Gypsum Substrate for Use as a Sheathing.
  - (ii) Canadian Roofing Contractors Association (CRCA)
  - (iii) Canadian General Standards Board (CGSB)
    - (i) CGSB 37-GP-56, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
  - (iv) Underwriters Laboratories Canada (ULC)
    - (i) CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
  - (v) Factory Mutual (FM Global)
    - (i) Standard 4470, Class 1 Roof Coverings.
- (c) Submittals
  - (i) Submit in accordance with Section E.4.
  - (ii) Product data: provide product data sheets for all roofing materials, to describe physical properties, product installation, including installation techniques, restrictions, limitations and other manufacturer recommendations.

- (d) Quality Assurance
  - (i) Qualifications:
    - (i) Roofing contractor: must be a member in good standing of the Roofing Contractors Association of Manitoba and the Canadian Roofing Contractor's Association.
    - (ii) Workers: workers performing roofing work must be skilled and employed by a company recognized and trained as an approved applicator by the roofing materials manufacturer, and must have in their possession proof of their participation in the training course run by the roofing manufacturer for the specified products.
  - (ii) Compatibility: ensure compatibility between components of roofing system is essential. Provide written declaration to Contract Administrator stating that materials and components, as assembled in system, meet this requirement.
- (e) Storage and Handling
  - (i) Provide and maintain dry, off-ground weatherproof storage.
  - (ii) Store rolls of felt in upright position. Store membrane rolls with selvage edge up.
  - (iii) Remove only in quantities required for same day use.
  - (iv) Place plywood runways over work to enable movement of material and other traffic.
  - (v) Store caulking at +5°C minimum.
  - (vi) Store insulation protected from daylight and weather and deleterious materials.
- (f) Environmental Requirements
  - (i) Do not install roofing when temperature remains manufacturers' recommendations.
  - (ii) Minimum temperature for solvent-based adhesive is -5°C.
  - (iii) Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- (g) Protection
  - (i) Fire Extinguishers: maintain one 10 lbs. fire extinguisher on roof per torch applicator, within 10 m of torch applicator.
  - (ii) Maintain fire watch for 1 hour after each days roofing operations cease. Use an electronic thermometer to check for hot spots.
- (h) Warranty
  - (i) Provide CRCA standard 2 year warranty.

## E29.2 Products

- (a) Manufacturers
  - (i) Use materials from same manufacturer.
- (b) Deck Covering
  - (i) Glass Mat, Gypsum Board: to ASTM C1177/C1177M, water resistant treated core, glass matt facing, thickness indicated.
    - (i) Acceptable material: GP Gypsum DensDeck.
- (c) Deck Primer
  - (i) Deck Primer: Soprema Elastocol Stick, IKO Aquabarrier
- (d) Vapour Retarder
  - (i) Self-adhesive, modified bitumen sheet.
    - (i) Acceptable material: Sopreme Sopravap'R., IKO MVP
  - (ii) Vapour retarder continuity strip: vapour retarder sheet, for installation beneath upstands and parapets and at wall junctions to ensure vapour barrier continuity. Supplied by roofing Subcontractor for installation by carpentry Subcontractor

(e) Roofing Membranes

- (i) Base sheet: to CGSB 37-GP-56, SBS elastomeric polymer, prefabricated sheet, glass/polyester reinforcement. Top surface thermofusible plastic film, bottom surfaces partially self-adhesive:
  - (i) Acceptable material: Soprema Colvent Base 810, IKO Armourvent
- (ii) Cap sheet: to CGSB 37-GP-56, SBS elastomeric polymer, prefabricated sheet, glass/polyester reinforcement. Top surface granules, bottom surface thermofusible plastic film. High reflective granular surface.
  - (i) Acceptable material: Soprema Soprastar HD GR., IKO Torchflex TP-250-Cap.
- (iii) Base sheet flashing membrane (stripping): Base sheet: to CGSB 37-GP-56, SBS elastomeric polymer, prefabricated sheet, glass/polyester reinforcement. Top surface thermofusible plastic film, bottom surface self-adhesive:
  - (i) Acceptable material: Soprema Sopraflash Flam Stick, IKO Armourbond Flash
- (iv) Cap sheet flashing membrane (stripping): same as cap sheet.

(f) Roofing Insulation

- (i) Tapered shapes: extruded polystyrene (EPS) to CAN/ULC-S701, type 2, cut to tapered shape for slopes indicated.
  - (i) Acceptable material: Soprema Colgrip A., IKOTherm III with coated glass fibre facer

(g) Accessories

- (i) Insulation adhesive: Soprema Coltack.
- (ii) Mastic sealant: Soprema Sopramastic ALU.

E29.3 Execution

(a) Workmanship

- (i) Do roofing in accordance with manufacturer's instructions.

(b) Protection

- (i) Cover walls and adjacent work where materials hoisted or used.
- (ii) Use warning signs and barriers. Maintain in good order until completion of work.
- (iii) Clean off drips and smears of bituminous material immediately.
- (iv) Dispose of rain water off roof and away from face of building.
- (v) Protect roof from traffic and damage. Comply with precautions deemed necessary by Contract Administrator.
- (vi) At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.

(c) Examination Roof Decks

- (i) Examine roof decks and immediately inform of Contract Administrator in writing of defects.
  - (i) Prior to commencement of work ensure:
  - (ii) Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris.
  - (iii) Curbs have been built.
  - (iv) Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

(d) Vapour Retarder (Steel Deck)

- (i) Install self-adhesive vapour retarders to primed substrates in accordance with manufacturer's instructions. Ensure membrane is fully bonded to substrates and is free of air pockets, wrinkles, tears and fishmouths.
- (ii) Overlap adjacent membranes by 75 mm, and end laps by 150 mm. Stagger end laps by at least 300 mm.

- (e) Exposed Membrane Roofing Application
  - (i) Insulation:
    - (i) Place boards in parallel rows with ends staggered, and in firm contact with one another. Stagger joints between layers.
    - (ii) Cut end boards to suit.
  - (ii) Base Sheet Membrane: Self-Adhesive Application
    - (i) Starting at low point of roof, perpendicular to slope, unroll base sheets in parallel strips, overlapping each sheet 75 mm at side joints and minimum 25 mm for end laps.
    - (ii) Peel release paper and bond membrane to substrate.
    - (iii) Remove paper from selvedge edge and seal with hot trowel.
    - (iv) Seal the end joints by welding a 300 mm wide protection band centred on the joint.
    - (v) Application to be free of blisters, wrinkles and fishmouths.
    - (vi) Do membrane application in accordance with manufacturer's recommendations.
  - (iii) Cap sheet membrane: fully adhered, torch-on application.
    - (i) Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
    - (ii) Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
    - (iii) Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Stagger end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
    - (iv) Stagger joints between cap sheet and base sheet.
    - (v) Cover bleed-out at joints with colour matched granules. Make joints inconspicuous in final assembly.
    - (vi) Application to be free of blisters, fishmouths and wrinkles.
    - (vii) Do membrane application in accordance with manufacturer's recommendations.
  - (iv) Flashings:
    - (i) Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
    - (ii) Install base and cap sheet stripping onto substrate in 1 metre wide strips.
    - (iii) Lap flashing base sheet to membrane base sheet minimum 150 mm and seal.
    - (iv) Lap flashing cap sheet to membrane cap sheet 250 mm minimum seal.
    - (v) Provide 75 mm minimum side lap and seal.
    - (vi) Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
    - (vii) Do work in accordance with manufacturer's recommendations.
- (f) Field Quality Control
  - (i) Inspection of roofing application will be carried out by an inspection agency designated by Contract Administrator.
  - (ii) Costs of inspection will be paid under cash allowance.
- (g) Cleaning
  - (i) Remove bituminous markings from finished surfaces.
  - (ii) In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
  - (iii) Repair or replace defaced or disfigured finishes caused by work of this section.

- (iv) Check drains to ensure cleanliness and proper function, and remove debris, equipment and excess material from site.

### **E30. SHEET METAL FLASHING AND TRIM**

#### **E30.1 General**

##### **(a) References**

- (i) American Society for Testing and Materials (ASTM)
  - (i) ASTM A653/A653 M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - (ii) ASTM B32, Specification for Solder Metal.
- (ii) Canadian Standards Association (CSA)
  - (i) CSA A123.3, Asphalt or Tar Saturated Roofing Felt.
  - (ii) CSA B111, Wire Nails, Spikes and Staples.
  - (iii) CAN/CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members
- (iii) Canadian General Standards Board (CGSB)
  - (i) CAN/CGSB-37.5, Cutback Asphalt Plastic Cement.
- (iv) Canadian Roofing Contractors Association (CRCA).
  - (i) Roofing Specifications Manual.
- (v) Canadian Sheet Steel Building Institute (CSSBI)
  - (i) Manufacturers' Standard Gauge (MSG)

##### **(b) Quality Assurance**

- (i) Nominal base steel thickness: nominal base steel thickness of sheet steel specified in this section is based on the Manufacturers Standard Gauge (MSG) system of Canada. The minimum thickness shall be the design thickness (nominal base steel thickness) minus the maximum allowable under-tolerance specified by CAN/CSA-S136.

#### **E30.2 Products**

##### **(a) Sheet Metal Materials**

- (i) Zinc coated steel sheet: commercial quality to ASTM A 653/A 653M, with Z275 designation zinc coating.

##### **(b) Prefinished Steel Sheet**

- (i) Zinc coated steel sheet with factory applied silicone modified polyester Stelcolour 8000+ Series Coil Coating or high molecular paint Colorite HMP.

##### **(c) Submittals**

- (i) Submit shop drawing indicating colour for Zinc coated steel sheets in accordance with Section E.4.

##### **(d) Accessories**

- (i) Isolation coating: alkali resistant bituminous paint.
- (ii) Plastic cement: to CGSB 37-GP-5.
- (iii) Underlay for metal flashing: dry sheathing to CAN/CGSB-51.32; asphalt laminated 3.6 to 4.5 kg kraft paper; No. 15 perforated asphalt felt to CSA A123.3.
- (iv) Sealants: as specified in Section E.36.
- (v) Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- (vi) Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- (vii) Washers: of same material as sheet metal, 1 mm thick with rubber packings.



- (viii) Touch-up paint: as recommended by metal flashing and trim manufacture.
- (e) Fabrication
  - (i) Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series specifications and as indicated.
  - (ii) Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
  - (iii) Hem exposed edges on underside 12 mm. Miter and seal corners with sealant.
  - (iv) Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
  - (v) Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- (f) Metal Flashings
  - (i) Form parapet flashings, cap flashings, copings and fascias to profiles indicated of 0.759 mm (22 MSG) prefinished steel sheet.
  - (ii) Form counter flashings, curb flashings to profiles indicated of 0.607 mm (24 MSG) galvanized steel sheet.
  - (iii) Form air/vapour barrier transition flashing at roof/wall junction to profiles indicated of 0.455 mm (26 MSG) galvanized steel sheet.
- (g) Pans
  - (i) Form plastic pans from 0.607 mm (24 MSG) galvanized steel sheet with minimum 75 mm upstand above finished roof and 100 mm continuous flanges with no open corners. Solder joints. Make pans minimum 50 mm wider than member passing through roof membrane.
- (h) Scuppers and rainwater leaders
  - (i) Form rainwater leaders and scuppers from 0.759 mm (22 MSG) prefinished steel sheet metal, to sizes and profiles as indicated.
  - (ii) Provide goosenecks, outlets, and necessary fastenings.
  - (iii) For open type downspouts fabricate of prefinished sheet metal with same colour and finish on both sides of sheet.

### E30.3 Execution

- (a) Installation
  - (i) Install sheet metal work in accordance with CRCA details and as indicated.
  - (ii) Use concealed fastenings except where approved before installation.
  - (iii) Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
  - (iv) Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.
  - (v) Lock end joints and caulk with sealant.
  - (vi) Insert metal flashing under cap flashing to form weathertight junction.
  - (vii) Caulk flashing at cap flashing with sealant.
- (b) Transition Flashing At Roof/Wall Junction
  - (i) Install transition flashing at roof/wall junction as component of building envelope air and vapour barrier system.
  - (ii) Overlap joints minimum 50 mm and seal with joint sealant to provide air and vapour seal.
  - (iii) Secure in place with flat head nails or screws and seal fastener heads with joint sealant to provide air and vapour seal.
- (c) Plastic Pans
  - (i) Install plastic pans around items projecting through roof membrane. Fill pans with plastic cement.
- (d) Scuppers And Rainwater Leaders

- (i) Install rainwater leaders and provide goosenecks back to wall. Secure to wall with straps at 1800 mm oc; minimum two straps per leader.
- (ii) Install scuppers as indicated.

### **E31. HOLLOW METAL DOORS AND FRAMES**

#### **E31.1 General**

##### **(a) References**

- (i) American Society for Testing and Materials (ASTM)
  - (i) ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - (ii) ASTM E152, Methods for Fire Tests of Door Assemblies.
- (ii) Canadian General Standards Board (CGSB).
  - (i) CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
  - (ii) CGSB 41-GP-19, Rigid Vinyl Extrusions for Windows and Doors.
- (iii) Canadian Standards Association (CSA)
  - (i) CAN/CSA-G40.21, Structural Quality Steels.
  - (ii) CSA W59, Welded Steel Construction (Metal Arc Welding).
- (iv) Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA):
  - (i) CSDFMS, Specifications for Commercial Steel Doors and Frames.
  - (ii) CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors.
- (v) National Fire Protection Association (NFPA)
  - (i) NFPA 80, Fire Doors and Windows.
  - (ii) NFPA 252, Door Assemblies, Fire Tests of.
- (vi) Underwriters' Laboratories of Canada (ULC)
  - (i) CAN4-S104M, Fire Tests of Door Assemblies.
  - (ii) CAN4-S105M, Fire Door Frames.
  - (iii) CAN/ULC-S702, Standard for Mineral Fibre Thermal Insulation for Buildings.

##### **(b) Shop Drawings**

- (i) Submit shop drawings in accordance with Section E4.
- (ii) Indicate each type door and frame, materials, core thickness, mortises, reinforcements, glazed and louver opening, glazing stops, arrangement of hardware, location and methods of anchors, exposed fastenings and reinforcing, fire ratings, and finishes.
- (iii) Indicate details of jamb and head, frame types, meeting and stiles on pairs of doors, field splices.
- (iv) Indicate special features, junction boxes and conduit for electrical and electronic door hardware.
- (v) Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

##### **(c) Requirements of Regulatory Agencies**

- (i) Steel fire rated doors and frames: labeled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 and NFPA 252 for ratings indicated.
- (ii) Provide fire labeled frame products for those openings requiring fire protection ratings, as scheduled. Test products in strict conformance with CAN4-S104, ASTM E152 or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service

Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

- (d) Delivery, Storage and Handling
  - (i) Store frames in dry location, above ground to prevent corrosion.
  - (ii) Protect by suitable means until installation. Brace and stack to prevent wracking, bending, twisting and other damage.
  - (iii) Replace or make good materials that become damaged or defective as directed by Contract Administrator.

## E31.2 Products

### (a) Materials

- (i) Hot dipped galvanized steel sheet: to ASTM A653/A653M coating designation for locations as follows.
  - (i) Exterior doors and frames to be insulated
- (ii) Minimum base steel thickness (gauge) in accordance with CSDFMA Table 1, except as follows:
  - (i) Door face sheets: 1.2 mm (18 gauge).
  - (ii) Frames: 1.6 mm (16 gauge).
  - (iii) Astragals: 1.9 mm (14 gauge).
  - (iv) Floor anchors: 1.6 mm (16 gauge).
  - (v) Jamb anchors: "T" strap type 1.6 mm (16 gauge); "L" type 1.2 mm (18 gauge); stirrup-strap type 15 x 250 x 1.6 mm (16 gauge); stud type 1.2 mm (18 gauge); wire type 4.0 mm (9 gauge).
  - (vi) Reinforcing steel: locks, strikes 1.6 mm (16 gauge); butts, hinges 3.4 mm (10 gauge); surface mounted hardware 2.7 mm (12 gauge).
  - (vii) Flush bolts: 3.4 mm (10 gauge).
  - (viii) Channel reinforcement for openings: 0.9 mm (20 gauge).
  - (ix) Mortar guard boxes: 0.8 mm (22 gauge).
- (iii) Reinforcement channel: to CAN/CSA-G40.21, Type 44W, coating designation ZF75 to ASTM A653/A653M.

### (b) Door Core Materials

- (i) Honeycomb construction: structural small cell, 25 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m<sup>3</sup> minimum sanded to required thickness.
- (ii) Stiffened: face sheets laminated, insulated core: fibreglass to CAN/ULC-S702, semi-rigid Type 1 density 24 kg/m<sup>3</sup>.
- (iii) Thermal insulation material must:
  - (i) not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act;
  - (ii) be manufactured using a process that uses chemical compounds with the minimum ozone depletion potential (ODP) available.
- (iv) Batt-type thermal insulation materials must:
  - (i) contain when calculated on 12-month rolling basis:
    - ◆ over 35 % recycled material by weight of the finished product if made from glass fibre, or
    - ◆ over 45 % recycled material by weight of the finished product if made from mineral composition.

### (c) Adhesives

- (i) Select Adhesives which:

- (i) Do not contain volatile organic compounds in excess of 5 % by weight as measured by EPA Method 24-24A, 40 C.F.R., Part 60, Appendix A (1991), Method 18,48 Federal Register 48, no. 202, October 18, 1983 Method 1400 NIOSH Manual of Analytical Methods, Volume 1, February 1984, Environmental Protection Agency Method 8240 GC/MS Method for Volatile Organics, September 1986, as demonstrated through calculation from records of the amounts of constituents used to make the product.
  - (ii) Are accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance.
  - (iii) Are accompanied by information describing proper disposal methods for containers.
  - (ii) Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- (d) Accessories
- (i) Primer: to CAN/CGSB-1.181.
  - (ii) Door silencers: single stud rubber/neoprene type.
  - (iii) Top and bottom caps:
    - (i) Interior doors: steel.
    - (ii) Exterior doors: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19M.
  - (iv) Glazing stops: formed channel, minimum 16 mm height, accurately fitted, butted at corners.
    - (i) Provide removable galvanized steel glazing beads for use with glazing tapes and compounds and secured with countersunk steel screws.
    - (ii) Design exterior glazing stops to be tamperproof.
  - (v) Sealant (caulking): as specified in Section E.36.
  - (vi) Spray foam sealant: spray-applied polyurethane foam sealant, CFC and urea formaldehyde free, non-expanding, non-shrinking after cure. Ener-Foam, Insta-Seal.
  - (vii) Metallic paste filler: to manufacturer's standard.
  - (viii) Fire labels: metal riveted.
- (e) Frames Fabrication General
- (i) Fabricate frames in accordance with CSDFMA specifications.
  - (ii) Fabricate frames to profiles and maximum face sizes as indicated.
  - (iii) Provide all frames with double (drywall) returns at throat openings.
  - (iv) Exterior frames: welded, thermally broken type construction.
  - (v) Interior frames: welded type construction.
  - (vi) Blank, mortise, reinforce, drill and tap frames and reinforcements to receive hardware and electronic hardware using templates provided by door hardware supplier. Reinforce internally for surface mounted hardware.
  - (vii) Top hinge reinforcement: weld in top hinge reinforcement with 20 mm leg to hinge reinforcement, 25 mm leg to frame.
  - (viii) Reinforce head of frames wider than 1200 mm.
  - (ix) Protect mortised cutouts with steel guard boxes for frames installed in masonry and concrete walls.
  - (x) Prepare frame for door silencers, three for single door, and two at head for double doors.
  - (xi) Manufacturer's nameplates on frames and screens are not permitted.
  - (xii) Conceal fastenings except where exposed fastenings are indicated.
  - (xiii) Insulate exterior frame components with fibreglass batt insulation.

- (f) Frame Anchorage
  - (i) Provide appropriate anchorage to floor and wall construction.
  - (ii) Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
  - (iii) Provide two anchors for rebate opening heights up to 1520 mm and one additional anchor for each additional 760 mm of height or fraction thereof.
- (g) Frames: Welded Type
  - (i) Welding in accordance with CSA W59.
  - (ii) Accurately mitre or mechanically joint frame product and securely weld on inside of profile. Spot welding not acceptable.
  - (iii) Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
  - (iv) Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
  - (v) Securely attach floor anchors to inside of each jamb profile.
  - (vi) Fabrication frame assemblies in largest sections possible. Where field splices are required, weld and grind smooth. Make field splices and joints inconspicuous after assembly. Exposed fasteners not permitted.
  - (vii) Weld in two temporary jamb spreaders per frame to maintain proper alignment during shipment.
- (h) Frames: Thermally Broken Type
  - (i) Fabricate thermally broken frames using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
  - (ii) Thermal break: rigid polyvinylchloride (PVC) extrusion conforming to CGSB 41-GP-19Ma.
  - (iii) Do not fix together frame sections with screws or other fastening devices. Manufacture frames in a manner to provide adequate integral strength to ensure trouble free operation.
  - (iv) Fill closed frame sections with fibreglass insulation.
- (i) Door Fabrication General
  - (i) Doors: swing type, flush, with provision for glass and louver openings as indicated.
  - (ii) Exterior doors: hollow steel, insulated core construction.
  - (iii) Interior doors: honeycomb construction.
  - (iv) Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler, and sand to a uniform smooth finish.
  - (v) Construct rail and stile doors, and matching panels in same manner as flush doors.
  - (vi) Blank, reinforce, drill doors and tap for mortised, templated hardware, and electronic hardware.
  - (vii) Reinforce doors where required, for surface mounted hardware.
  - (viii) Make provision for glazing and louvers where indicated and provide stops.
  - (ix) Provide astragals for pairs of doors in accordance with ULC requirements.
  - (x) Where pairs of doors are fitted with top and bottom rod exit devices, doors are to be ULC approved without the use of an astragal.
  - (xi) Provide inverted, recessed, spot welded channels to top and bottom of doors. Provide flush PVC top caps to top channels of exterior doors.
  - (xii) Manufacturer's nameplates on doors permitted on hinge side of door concealed from view.
- (j) Doors: Honeycomb Core Construction
  - (i) Form each face sheet for interior doors from sheet steel with honeycomb - temperature rise rated core laminated under pressure to face sheets.

- (k) Doors: Hollow Steel Construction
  - (i) Form each face sheet for exterior doors from sheet steel.
  - (ii) Reinforce doors with vertical stiffeners, securely laminated to each face sheet at 150 mm on centre maximum.
  - (iii) Fill voids between stiffeners of exterior doors with fibreglass core.
- (l) Shop Priming
  - (i) Provide touch-up primer at areas where zinc coating has been removed during fabrication or installation.
  - (ii) For doors and frames fabricated of steel sheet with Z275 (G90) designation galvanized coating apply in factory one coat of zinc-rich primer CAN/CGSB-1.181 to all exposed surfaces. Properly pre-treat and prepare surfaces before application of primer to ensure good primer adhesion.

### E31.3 Execution

- (a) Installation General
  - (i) Install labeled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
  - (ii) Install doors and frames to CSDFMA Installation Guide.
- (b) Frame Installation
  - (i) Set frames plumb, square, level and at correct elevation.
  - (ii) Secure anchorages and connections to adjacent construction.
  - (iii) Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
  - (iv) Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
  - (v) Maintain continuity of air barrier.
  - (vi) Coordinate installation with Electrical Subcontractor for installation of junction boxes and conduit for electric hardware, wiring and controls.
- (c) Door Installation
  - (i) Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section E32 - Door Hardware.
  - (ii) Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
    - (i) Hinge side: 1.0 mm.
    - (ii) Latch side and head: 1.5 mm.
    - (iii) Finished flooring and thresholds: 13 mm, except where doors are fitted with exit rod devices margin shall be 6 mm.
  - (iii) Adjust operable parts for correct function.
- (d) Caulking and Sealing
  - (i) At exterior openings, fill head and jamb frame sections with foam sealant. Fill shim space around perimeter of frames with foam sealant.
  - (ii) For both interior and exterior frames seal joint between frames and adjacent construction with sealant (caulking). Apply sealant around full perimeter of frames, on both sides of opening.
  - (iii) For frames at exterior openings provide foam backer rod or bond breaker tape behind sealant.
  - (iv) Apply sealants in accordance with Section E36 – Joint Sealing. Provide smooth, neat bead, tooled to slight concave profile.

- (e) Finish Repairs
  - (i) Touch up with primer finishes damaged during installation.
  - (ii) Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish. Apply primer on sanded surfaces.

## **E32. DOOR HARDWARE**

### **E32.1 General**

- (a) Related Work
  - (i) Section E.31. - Hollow Metal Doors and Frames
- (b) Reference Standards
  - (i) Canadian Steel Door and Frame Manufactures' Association (CSDFMA)
  - (ii) Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- (c) Submittals
  - (i) Product Data: submit manufacturer's printed product literature, specifications and data sheet in accordance with Section E4.
- (d) Hardware List:
  - (i) Submit hardware list in accordance with Section E4.
  - (ii) Submit vertical form hardware list indicating manufacturer, model, material, function, finish and other pertinent information for each different type of hardware item proposed for use.
- (e) Closeout Submittals
  - (i) Provide maintenance data and for door closers, door holders, locksets, fire exit hardware, electrified hardware, for incorporation into manual.
  - (ii) Include manufacturer, make and model number, parts list, and information of proper care, cleaning, and general maintenance of door hardware.
- (f) Quality Assurance
  - (i) Regulatory Requirements: hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
  - (ii) Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- (g) Delivery, Storage and Handling
  - (i) Package each item of hardware including fastenings, separately or in like groups of hardware. Label each package as to item definition and location.
  - (ii) Maintain inventory list with hardware schedule.
  - (iii) Store finishing hardware in locked, clean and dry area.

### **E32.2 Products**

- (a) Hardware Items
  - (i) Door hardware: as specified in Section E.32.
  - (ii) Use one manufacturer's products for all similar items.
  - (iii) Supply hardware as specified. No substitutions will be permitted without prior written approval of the Contract Administrator.
- (b) Templates and Reinforcing Units
  - (i) Supply all necessary templates, blueprints and reinforcing units to Subcontractors requiring such items for completion of their portion of the Work.

- (c) Locksets
- (d) Bring in locksets from factory properly itemized as to keying and location.
- (e) Except where indicated otherwise provide locksets as follows:
  - (i) Knobs: 127 mm, except where door design doesn't allow deep backset use 70 mm.
- (f) Butts
  - (i) Provide doors up to and including 2150 mm in height and 900 mm in width with 1½ pair butts, unless indicated otherwise.
  - (ii) Provide doors over these sizes with two pair butts.
- (g) Kickplates
  - (i) Material: Type 316 stainless steel, satin finish. Metal thickness (gauge) as specified.
  - (ii) Sizes: width of plate less 40 mm on push side of door and 25 mm on pull side. Height of plate as specified.
  - (iii) Fasteners: oval head screws of same material and finish as kickplate being fastened.
  - (iv) Provide on one side of door, unless otherwise indicated.
- (h) Fastenings
  - (i) Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
  - (ii) Use fasteners supplied by manufacturers with each specific hardware item only. No substitutions will be permitted.
  - (iii) Exposed fastening devices to match material and finish of hardware.
  - (iv) Where pull is required on one side of door and push plate on other side provide fastening devices so pull can be secured through door from reverse side. Install push plates to cover fasteners.
  - (v) Include provisions for drilling push/pull plates to accept lock cylinder where both items occur on the same door.
  - (vi) Use fasteners compatible with material through which they pass.
- (i) Keying
  - (i) Building is to be keyed to Medeco keying system as supplied by N. H. Brown. Keying the locks in accordance with City specification.
  - (ii) Supply 2 keys per lock and 4 master keys.
  - (iii) Do not stamp keying code numbers on keys or cylinders.
  - (iv) Deliver all keys, permanent cylinders and key records to City during final inspection.

### E32.3 Execution

- (a) Manufacturer's Instructions
  - (i) Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
  - (ii) Furnish door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
  - (iii) Furnish manufacturers' instructions for proper installation of each hardware component.
- (b) Installation
  - (i) Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
  - (ii) The following dimensions are only to be used as a general guide in the placement of hardware. Where special items are concerned, or uncertainty exists, check with the



Contract Administrator before fitting. Dimensions indicated are from finish floor to centre line of item, except as noted.

- (i) Knob Locksets: 1024 mm.
  - (iii) Push and pull plates: install 127 mm from edge of door to centre of plate, unless indicated otherwise. Where pulls are mounted back-to-back use #5 mounting.
- (c) Thresholds
- (i) Install threshold plates level over entire length and width to ensure door bottom seals seal properly to thresholds.
  - (ii) Grout under thresholds with non-shrink grout to ensure solid and secure installation.
  - (iii) At exterior openings provide two beads of sealant under threshold plates.
- (d) Adjustment and Cleaning
- (i) After work is complete adjust hardware for proper function.
  - (ii) After work is complete clean and polish hardware finishes. Remove dust, dirt, smudges and other markings.

### **E33. EPOXY FLOOR COATING**

#### **E33.1 General**

- (a) Submittals
- (i) Submit in accordance with Section E.4.
  - (ii) Manufacturer's Instructions: special handling criteria, mixing, application and cleaning procedures.
- (b) Delivery, Storage and Handling
- (i) Deliver and store materials in manner to prevent damage.
  - (ii) Ensure materials remain in original wrapping and containers until used.
- (c) Environmental Requirements
- (i) Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.

#### **E33.2 Products**

- (a) Materials
- (i) Epoxy floor coating: waterborne acrylic epoxy coating, high build, low odour, non-yellowing and fade resistant, chemical and moisture-resistant
  - (ii) Acceptable material:
    - (i) H.B. Tneme-Tufcoat 113 (satin), available from A.I.F.C. Coatings, Winnipeg, Tel. 990-8744 attn: Cal Winter.
    - (ii) Sika Sikafloor 261 System 1.
    - (iii) Devoe Tru-Glaze WB4408.
    - (iv) Stonhard's Stonkote GS4.
  - (iii) Slip-resistant aggregate: fine silicone sand particles.
  - (iv) Primers, fillers and patching compounds: for surface preparation, of type recommended by flooring manufacturer. Fully compatible with finish coatings and supplied by same manufacturer.

#### **E33.3 Execution**

- (a) Examination
- (i) Verify that surfaces are smooth and flat and are ready to receive work.
  - (ii) Examine surfaces to receive coatings for defects and/or site conditions detrimental to proper application and performance of flooring system.

- (iii) Verify:
  - (i) Concrete surfaces are fully cured and exhibit negative alkalinity, carbonization, or dusting.
  - (ii) Moisture content of substrates are within coating manufacturer's maximum limits
  - (iii) Surfaces are free of substances and contaminants that may impair adhesion.
  - (iv) Work of others such as pipes and conduit penetrating substrates is complete.
  - (v) Report defects and non-conforming work to Contract Administrator and await remedial measures.
- (b) Preparation
  - (i) Prepare substrates to manufacturer's recommendations.
  - (ii) Clean concrete mechanically or acid etch to manufacturer's recommendations.
  - (iii) Remove treatments and other contaminants to expose substrate.
  - (iv) Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
  - (v) Clean surfaces and apply primer.
- (c) Application
  - (i) Apply floor coating to produce smooth surface, uniform in sheen, colour and finish, free from marks, dirt, particles, runs, crawls, curling, holes, air pockets and other defects and to achieve smooth, even finish.
  - (ii) Apply coating with roller or airless sprayer, minimum two coats, 4.0 to 6.0 dry film thickness each coat.
  - (iii) Provide textured slip resistant surface over entire area. Broadcast sand aggregate into wet base coat at coverage rate.
  - (iv) Allow proper cure time for each installation procedure.
- (d) Protection
  - (i) Prohibit traffic on floor finish until fully cured.
  - (ii) Barricade area to protect flooring until cured.

## **E34. PAINTING**

### **E34.1 General**

- (a) Quality Assurance
  - (i) Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.
  - (ii) Qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.
  - (iii) Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer.
  - (iv) Retain purchase orders, invoices and other documents to requirements when requested by Contract Administrator.
  - (v) Standard of Acceptance:
    - (i) Walls: no defects visible from a distance of 1 m at 90° to surface.
    - (ii) Ceilings: No defects visible from floor at 45° to surface when viewed using final lighting source.

- (iii) Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- (b) Environmental Performance Requirements
  - (i) "Environmentally Friendly" E2 ratings based on VOC (EPA Method 24) content levels.
- (c) Quality Control
  - (i) When requested by Contract Administrator, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss/sheen, textures and workmanship. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar on-site work.
  - (ii) Labels shall clearly indicate:
    - (i) Manufacturer's name and address.
    - (ii) Type of paint or coating.
    - (iii) Compliance with applicable standard.
    - (iv) Colour number in accordance with established colour schedule.
  - (iii) Remove damaged, opened and rejected materials from site.
  - (iv) Provide and maintain dry, temperature controlled, secure storage.
  - (v) Observe manufacturer's recommendations for storage and handling.
  - (vi) Store materials and supplies away from heat generating devices.
  - (vii) Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.
  - (viii) Store temperature sensitive products above minimum temperature as recommended by manufacturer.
  - (ix) Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Contract Administrator. After completion of operations, return areas to clean condition to approval of Contract Administrator.
  - (x) Remove paint materials from storage only in quantities required for same day use.
  - (xi) Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- (d) Fire Safety Requirements:
  - (i) Provide one 10 lbs Type ABC fire extinguisher.
  - (ii) Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
  - (iii) Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.
- (e) Site Requirements
  - (i) Heating, Ventilation and Lighting:
    - (i) Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10 °C for 24 hours before, during and after paint application until paint has cured sufficiently.
    - (ii) Where required, provide continuous ventilation for seven days after completion of application of paint.
    - (iii) Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment
    - (iv) Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.

- (ii) Temperature, Humidity and Substrate Moisture Content Levels:
  - (i) Unless specifically pre-approved by the Contract Administrator and the applied product manufacturer, perform no painting work when:
    - Ambient air and substrate temperatures are below 10°C.
    - Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.
    - The relative humidity is above 85% or when the dew point is less than 3°C variance between the air/surface temperature.
    - Rain or snow is forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
  - (ii) Perform no painting work when the maximum moisture content of the substrate exceeds:
    - 12% for concrete and masonry (clay and concrete brick/block).
    - 15% for wood.
    - 12% for plaster and gypsum board.
  - (iii) Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
  - (iv) Test concrete, masonry and plaster surfaces for alkalinity as required.
- (iii) Surface and Environmental Conditions:
  - (i) Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - (ii) Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
  - (iii) Apply paint only when previous coat of paint is dry or adequately cured.
- (iv) Additional Interior Application Requirements:
  - (i) Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
- (v) Additional Exterior Application Requirements:
  - (i) Apply paint finishes only when conditions forecast for entire period of application fall within manufacturer's recommendations.
  - (ii) Do not apply paint when:
    - Temperature is expected to drop below 10°C before paint has thoroughly cured.
    - Surface to be painted is wet, damp or frosted.
  - (iii) Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
  - (iv) Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
  - (v) Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.
- (f) Waste Management And Disposal
  - (i) Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
  - (ii) Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

- (iii) Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

## E34.2 Products

### (a) Materials

- (i) Paint materials for paint systems shall be products of a single manufacturer.
- (ii) Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:
  - (i) Be water-based water soluble water clean-up.
  - (ii) Be non-flammable biodegradable.
  - (iii) Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
  - (iv) Be manufactured without compounds which contribute to smog in the lower atmosphere.
  - (v) Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

### (b) Colours

- (i) Contract Administrator will select colours and determine total number of colours to be used on project and their locations.
- (ii) Selection of colours may be from several different manufacturers. Match colour samples exactly regardless of manufacturer.

### (c) Mixing And Tinting

- (i) Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- (ii) Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Contract Administrator.
- (iii) Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

### (d) Interior Painting Systems

- (i) Concrete Vertical Surfaces: including horizontal soffits.
  - (i) INT 3.1M - Institutional low odour/low VOC G5 finish premium grade.
- (ii) Concrete Masonry Units: smooth and split face block and brick
  - (i) INT 4.2E - Institutional low odour/low VOC G5 finish premium grade.
  - (ii) INT 5.1S - Institutional low odour/low VOC G5 finish premium grade.
- (iii) Steel - High Heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted).
  - (i) INT 5.2A - Heat resistant enamel G5 finish, maximum 205 C.
- (iv) Bituminous Coated Surfaces: cast iron pipe, concrete, etc.
  - (i) INT 10.2A - Latex premium grade.

### (e) Exterior Painting Systems

- (i) Structural Steel and Metal Fabrications:
  - (i) EXT 5.1Q – Alkyd (over surface tolerant primer) G5 finish, premium grade.
- (ii) Galvanized Metal: not chromate passivated: steel doors and frames.
  - (i) EXT 5.3B - Alkyd G5 finish, premium grade.

### (f) Building and Mechanical Process Painting Systems

- (i) Plastic pipe –

Surface Preparation	Manufacturer Number and Paint Type	Number of Coats	Dry Film Thickness
Clean and abrade slightly	Vyguard V89 Series	(1)	3-6
	Vyguard 84 Series	(2)	2-3
(ii) Sample pump and steel/iron material			
	Vyguard 13F641	1(P)	1-2
SSPC-SP-3	Vyguard V20 Series	(2)	1.5-2
Power Tool	Vyguard 13F641 or	1(P)	1-2
Clean	Vyguard V89 Series	(2)	3-6
	Vyguard V89 Series		
(iii) Copper Piping			
Solvent clean, abrade and clean	Vyguard 13Y602	(1)	1-2
	Vyguard V20 Weries	(2)	1.5-2

### E34.3 Execution

#### (a) General

- (i) Perform preparation and operations for interior painting.
- (ii) Apply paint materials in accordance with paint manufacturers' written application instructions.

#### (b) Protection

- (i) Protect items that are permanently attached such as Fire Labels on doors and frames.
- (ii) Protect factory finished products and equipment.
- (iii) Protect passing pedestrians, building occupants and general public in and about the building.

#### (c) Cleaning And Preparation

- (i) Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths.
- (ii) Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
- (iii) Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- (iv) Allow surfaces to drain completely and allow to dry thoroughly.
- (v) Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
- (vi) Use trigger operated spray nozzles for water hoses.
- (vii) Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.
- (viii) Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- (ix) Sand and dust between coats as required to provide adequate adhesion for next coat and to remove visible defects.
- (x) Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances.

#### (d) Application

- (i) Method of application shall be acceptable to Contract Administrator.

- (ii) Apply paint by brush, roller, air sprayer, airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
  - (iii) Brush and Roller Application:
    - Apply paint in a uniform layer using brush and/or roller of types suitable for application.
    - Work paint into cracks, crevices and corners.
    - Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
    - Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Contract Administrator.
    - Remove runs, sags and brush marks from finished work and repaint.
  - (iv) Spray application:
    - Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
    - Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
    - Apply paint in a uniform layer, with overlapping at edges of spray pattern.
    - Brush out immediately all runs and sags.
    - Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
  - (v) Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
  - (vi) Painting coats specified are intended to cover surface completely. If necessary apply additional coats until satisfactory coverage is obtained. Provide additional coats at not additional cost to Contract.
  - (vii) Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
  - (viii) Sand and dust between coats to remove visible defects.
  - (ix) Doors and frames:
    - For exterior doors and frames indicated for painting/staining, use exterior quality paint/stain on both interior and exterior sides of door and frame.
  - (x) Apply one coat of primer sealer to wall surfaces to receive wall finishes bonded to walls with adhesive.
  - (xi) Paint underside of steel shelf angles and steel angle lintels exposed in final assembly.
  - (xii) Do not paint door and miscellaneous hardware, unless indicated otherwise.
  - (xiii) Do not paint nameplates, signage, fire labels, or other markers or signs indicated to remain.
  - (xiv) Do not paint copper, bronze, chromium plate, nickel, stainless steel, aluminum, lead and other bright metals, unless specified otherwise.
  - (xv) Clean shop applied paint surfaces that become marked. Touch up with primer and paint as required.
- (e) Mechanical/Electrical Equipment
- (i) Interior painting:
    - Unless otherwise specified, paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.

- (ii) Exterior painting:
    - Paint exposed conduits, piping, hangers, ductwork, and other mechanical and electrical equipment unless indicated otherwise. Colour and texture to match adjacent surfaces except where indicated otherwise.
  - (iii) Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
  - (iv) Do not paint over nameplates.
  - (v) Keep sprinkler heads free of paint.
  - (vi) Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
  - (vii) Paint fire protection piping red.
  - (viii) Paint natural gas piping yellow.
  - (ix) Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- (f) Restoration
- (i) Clean and re-install all hardware items removed before undertaken painting operations.
  - (ii) Remove protective coverings and warning signs as soon as practical after operations cease.
  - (iii) Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
  - (iv) Protect freshly completed surfaces from paint droppings and dust. Avoid scuffing newly applied paint.
  - (v) Restore areas used for storage, cleaning, mixing and handling of paint to clean condition.

## **E35. GRAFFITI-RESISTANT COATINGS**

### **E35.1 General**

- (a) Related Sections
  - (i) Concrete Masonry Units: Section E.22
- (b) Sample Application
  - (i) Contract Administrator will provide samples of substrate materials for sample application.
  - (ii) Before full-scale application, apply graffiti resistant coatings to samples of substrate materials to determine coverage rates, compatibility, effectiveness, and aesthetics.
  - (iii) Apply graffiti resistant coatings to samples in accordance with manufacturer's written instructions. Allow 5 days curing time prior to applying graffiti paint to test samples. Apply graffiti paint to test samples and allow at least 24 hours longer for paint to cure.
  - (iv) Apply manufacturer's recommended cleaner to test for ease of removal of graffiti. Repeat cycles of cleanings as directed by Contract Administrator.
- (c) Environmental Conditions
  - (i) Maintain ambient and structural base temperature at installation area within limits specified by coating manufacturer.
  - (ii) Apply coating during dry weather.
  - (iii) Do not apply coating to wet or damp surfaces.

### **E35.2 Products**

- (a) Materials



- (i) Graffiti-resistant coating: one component, water based, non-sacrificial, clear penetrating sealer.
- (ii) Acceptable material:
  - Sika Anti-Graffiti Sealer.
  - Fabrishield Paint Repellent.
  - Professional Water Sealant & Anti-Graffitiant.

### E35.3 Execution

#### (a) Preparation

- (i) Prepare and clean substrate surfaces in accordance with coating manufacturer's printed instructions.
- (ii) Mix and prepare coatings to manufacturer's instructions.
- (iii) Take moisture tests on substrates to receive coating to ensure moisture levels are within limits specified by coating manufacturer.

#### (b) Application

- (i) Apply coating using brush, roller or low pressure spraying apparatus, in accordance with manufacturer's printed instructions.
- (ii) Apply at manufacturer's recommended coverage rates for substrate. Adjust for substrate porosity and absorption characteristics.
- (iii) Apply in uniform, even coats to fully wet substrate, without flooding or rundowns.
- (iv) Allow area to dry completely before applying additional coats.

#### (c) Schedule

- (i) Apply graffiti-resistant coating to exposed surfaces of exterior masonry veneer, full height from grade to top of parapet walls.

## E36. CAULKING, AND JOINT SEALERS

### E36.1 General

#### (a) References

- (i) Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- (ii) Material Safety Data Sheets (MSDS).
- (iii) Underwriter's Laboratories of Canada (ULC)
- (iv) American Society for Testing and Materials (ASTM)
  - ASTM C 834, Standard Specification for Latex Sealants.
  - ASTM C 920, Standard Specification for Elastomeric Joint Sealants.
- (v) Canadian General Standards Board (CGSB)
  - CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing.
  - CAN/CGSB-19.13, Sealing Compound, One-component, Elastomeric, Chemical Curing.

#### (b) Definitions

- (i) Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.
- (ii) Words "tightly fitted" should ensure that integrity of separation is such that it prevents passage of smoke and hot gases to unexposed side of separation.

#### (c) Submittals

- (i) Product data:
  - Submit product data in accordance with Section E.4.

- Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.
  - Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
- (d) Quality Assurance
- (i) Qualifications:
    - Installer: company specializing in Caulking and Joint Sealer installations and approved by manufacturer.
- (e) Storage and Handling
- (i) Packing, shipping, handling and unloading:
  - (ii) Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - (iii) Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
  - (iv) Storage and Protection.

## E36.2 Products

### (a) Materials

#### (i) Sealant Materials

- Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- Sealants for vertical joints: non-sagging.

#### (ii) Sealant Material Designations

- Urethane One Part, Non-Sag:
  1. To ASTM C 920, Type S, Grade NS, Class 25; CAN/CGSB-19.13, Type 2.
  2. Joint movement:  $\pm 25\%$ .
  3. Acceptable material: Sikaflex 1a, DyMonic, Chem-Calk 900, Vulkem 931.
- Urethane, One Part, Self-Leveling:
  1. To ASTM C 920, Type S, Grade P, Class 25; CAN/CGSB-19.13, Type 1.
  2. Joint movement:  $\pm 25\%$
  3. Acceptable material: Sikaflex 1C SL, Chem-Calk 950, Vulkem 45.
- Acrylic, One Part.
  1. To CGSB 19-GP-5M.
  2. Acceptable material: Mono 555, Sternson Acryflex, PRC PR 12-100, Mulco 20 Year Acrylic, Chem-Calk 600.
- Silicone, One Part, Mildew Resistant.
  1. To ASTM C 920, Type S, Grade NS, Class 25.
  2. Acceptable material: Dow Corning 786, GE Sanitary 1702.
  3. Acoustical Sealant.
  4. To ASTM C 834.
  5. Acceptable material: Tremco Tremflex 834, Chem-Calk 600.

### (b) Sealant Colours

- (i) Generally matching the predominant material to which sealant is applied.

- (c) Sealant Selection
  - (i) Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, precast masonry): Sealant type: Urethanes One Part, Non-Sag
  - (ii) Control and expansion joints in exterior surfaces of unit masonry walls: Sealant type: Urethanes One Part, Non-Sag.
  - (iii) Control and expansion joints on the interior of exterior surfaces of unit masonry walls: Sealant type: Urethanes One Part, Non-Sag.
  - (iv) Under thresholds at exterior doors. Sealant type: acrylic one part.

### E36.3 Execution

- (a) Manufacturer's Instructions
  - (i) Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- (b) Preparation of joint Surfaces
  - (i) Ascertain that sealers and coatings applied to sealant substrates are compatible with sealant used and that full bond between the sealant and substrate is attained.
  - (ii) Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and bond, if necessary.
  - (iii) Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
  - (iv) Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter that may impair work.
  - (v) Examine sizes and conditions of voids to be filled to establish correct thickness. Ensure that substrates and surfaces are clean, dry and frost free.
- (c) Expanding Foam Sealants.
  - (i) For expansion joints below grade in foundation walls and grade beams install as primary seal.
  - (ii) For expansion joints above grade that are less than 20 mm wide install as secondary seal with wet caulking as primary seal.
  - (iii) Size preformed foam sealant to suit joint depth and width allowing for proper compression of the material:
  - (iv) Horizontal expansion and control joints below grade: 20%.
  - (v) Vertical and horizontal joints in building façade: 25%.
  - (vi) Watertight joints: 20%.
- (d) Installation Sealant
  - (i) Apply sealant in accordance with manufacturer's written instructions.
  - (ii) Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - (iii) Apply sealant in continuous beads.
  - (iv) Apply sealant using gun with proper size nozzle.
  - (v) Use sufficient pressure to fill voids and joints solid.
  - (vi) Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities
- (e) Special Requirements
  - (i) Non dust generation: at all locations.
  - (ii) Movement: 25% at building expansion and control joints.
- (f) Field Quality Control

- (i) Prior to Substantial Performance of the Work inspect fire stopping work, prepare a deficiency list and submit to Contract Administrator. Repair deficiencies and request Contract Administrator's review of the Work.
- (g) Clean Up
  - (i) On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## **E37. FIRE EXTINGUISHERS**

### **E37.1 General**

- (a) References
  - (i) National Fire Protection Agency (NFPA).
  - (ii) NFPA 10 - Portable Fire Extinguishers.
  - (iii) Underwriters' Laboratories Canada (ULC).
  - (iv) CAN/ULC-S508 - Rating and Fire Testing of Fire Extinguishers and Class"D" Extinguishing Media.

#### **Products**

- (b) Multi-Purpose Dry Chemical Extinguishers
  - (i) Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection. Size 4.5 kg (10 lb).
- (c) Extinguisher Brackets
  - (i) Type recommended by extinguisher manufacturer. For wall mounting.
  - (ii) Identification.
  - (iii) Identify extinguishers in accordance with recommendations of ANSI/NFPA 10 or CAN/ULC-S508.
  - (iv) Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

### **E37.2 Execution**

- (a) Installation
  - (i) Install or mount extinguishers on wall brackets in accordance with NFPA 10 and as indicated.
  - (ii) Install and secure brackets and cabinets rigidly in place as follows:
    - (i) Hollow masonry units and stud walls: toggle bolts drilled into cell/wall cavity.
    - (ii) Solid masonry or concrete: bolt with metal expansion sleeve or expansion anchor set into drilled hole.

## **E38. HATCH COVERS**

### **E38.1 General**

- (a) This specification covers the supply and installation of a hinged hatch covers, as per the drawings.
- (b) The hatch will be flush with the floor.
- (c) Submittals
  - (i) Submit shop drawings and documentation of all materials of construction.
  - (ii) Show all anchor inserts of frame into concrete.

### **E38.2 Products**

- (a) As shown on Drawings.
- (b) Materials

- (i) Cover and frame 6.35 mm (1/4") Steel.
  - (ii) Cover diamond pattern tread plate reinforced for 732 kg/m<sup>2</sup> (150 psf) live load.
  - (iii) Extruded Steel angle frame with strap anchors bolted around the perimeter
  - (iv) Cast steel cam-action hinges concealed from the exterior of the door.
  - (v) Latch: Type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle.
  - (vi) Mill finish Steel with a bituminous coating applied to the exterior of the frame
  - (vii) Zinc plated chromate sealed hardware.
- (c) Dimensions: As shown on drawings.

### E38.3 Execution

- (a) Coordinate frame seating with placement of concrete floor.
- (b) Provide sufficient clearance for cover closure with no more than 5 mm gap horizontally with concrete floor. Install bitumastic seal in gap.

## E39. BUILDING VENTILATION

### E39.1 Description

- (a) General
  - (i) This specification shall cover construction of the building ventilation system.
- (b) References
  - (i) AMCA 99-1986, Standards Handbook.
  - ii) NFPA 90A-1999, Installation of Air Conditioning and Ventilating Systems.
  - iii) Underwriters Laboratories - UL 705.
- (c) Shop Drawing and Product Data
  - (i) Submit shop drawings and product data, for all products, in accordance with Section E.4 - Shop Drawings for additional information.
  - (ii) Provide fan shop drawings with fan curves and sound rating data, showing point of operation and efficiency.
  - (iii) Provide shop drawings for louvers, dampers, grilles and damper actuator motors.
- (d) Operation and Maintenance Data
  - (i) Provide operation and maintenance data for incorporation into Operation and Maintenance manual for the supply air fans, dampers, louvers, damper motor actuators and grilles.
- (e) Quality Assurance
  - (i) Use highest quality materials conforming to the appropriate ASTM and ANSI specifications.
  - (ii) The codes and standards herein referred to shall be those editions currently in effect or accepted by the authorities in the area of jurisdiction.
  - (iii) Comply with and be guided by standards issued by ASHRAE, SMACNA.
  - (iv) Ductwork and components to meet the requirements of NFPA 90A.
  - (v) Fans shall be listed by UL 705.
  - (vi) Fans shall be manufactured at an ISO 9001 certified facility.
  - (vii) Conform to National Building code and Provincial Statutes.

(e) Testing and Balancing

- (i) Certified testing agency to provide testing and air balancing (TAB) for supply fans and exhaust openings.

E39.2 Materials

(a) Supply Fan (SF-1)

- (i) Greenheck Model SQ-95-D direct driven in-line supply air fan, complete with AMCA Certified rating. Fan to have two access panels, minimum L50 pillow block bearings, NEMA 4 disconnect switch, inlet and discharge collar, and 25% oversized fan shaft. Fan wheel shall be an aluminium, backward inclined, non-overloading wheel. Fan to have inlet and discharge dust collars for duct connection.

(ii) Accessoires/Options:

1. Vibration isolation hangers.
2. Flexible duct connections.
3. Filter box section with removable access panels on both sides and MERV 3 pleated fabric filters.
4. Motor cover and belt guard

(iii) Capacity: 76 L/S at 19 mm H<sub>2</sub>O E.S.P.

(iv) Motor: 0.125 HP, 120 V, 1 Ph.

(b) Supply Fan (SF-2)

- (i) Twin City Fan & Blower BSI direct driven in-line supply air fan, complete with AMCA Certified rating. Fan to have two access panels, minimum L50 pillow block bearings, NEMA 4X disconnect switch and discharge collar, and 25% oversized fan shaft. Fan wheel shall be a Type B spark resistant aluminium, backward inclined, non-overloading wheel. Fan to have inlet and discharge dust collars for duct connection.

(ii) Accessoires/Options:

1. Vibration isolation hangers.
2. Flexible duct connections.
3. Filter box section with removable access panels on both sides and MERV 3 pleated fabric filters.
4. Motor cover and belt guard

(iii) Use Stainless steel threaded rod, nuts, washers and steel to support fan

(iv) Capacity: 152 L/S at 19 mm H<sub>2</sub>O E.S.P.

(v) Motor: 0.25 HP, 120 V, 1 Ph., Hazardous location, corrosion resistant motor

(c) Grilles

- (i) Type S-3 stainless steel, airfoil shaped solid blades on 19 mm centers, appliance white finish, double deflection supply grilles.
  - Acceptable material: E.H. Price Model 720/F/L. Neck size as indicated on drawings.
- (ii) Type S-4 stainless steel, airfoil shaped solid blades on 19 mm, centers, appliance white finish, fixed deflection return grilles.
  - Acceptable material: E.H. Price Model 710Z/F/L. Neck size as indicated on drawing.
- (iii) Type S-1 aluminium, airfoil shaped solid blades on 19 mm centers, appliance white finish, double deflection supply grilles.
  - Acceptable material: E.H. Price Model 620/F/L/A/B12. Size as indicated on drawings
- (iv) Type S-2 aluminium, airfoil shaped solid blades on 19 mm centers, appliance white finish, fixed deflection return grilles.

- Acceptable material: E.H. Price Model 610Z/F/L/A/B12. Size as indicated on drawings.

(d) Louvres

- (i) Type L-1 and L-2 louvres - Provide 100 mm deep stationary louvers with tested performance based on AMCA publication 511 and AMCA Certified Rating Program complete with:

1. Welded construction
2. 0.081" extruded aluminum alloy 6063-T5 frame and blades.
3. 43 degree J-blades profile.
4. Nominal free area of 50.6%
5. Integral perimeter caulking stop.
6. Factory finish baked on enamel finish to match adjacent exterior wall finish unless directed otherwise by the or Contract Administrator. Submit colour sample for approval.
7. Provide 12 mm square mesh, 1.6 mm aluminum bird-screen with standard formed U frame inside face of louvers.
8. Price Louver Products JE443. Size as indicated on drawings

(e) Dampers and Motorized Actuators

- (i) Type D-1 and D-2 Dampers - Damper Frames shall be extruded aluminum, not less than 2mm thick. Blades shall not be over 150mm (6 inches) wide and shall be extruded aluminum. Bearings shall be an aluminum pin with Celcon inner bearing and polycarbonate outer bearing. Side seals shall be extruded thermoplastic elastomer. Blade seals to be extruded EPDM. Dampers and seals shall be suitable for temperature ranges of -40°C to 93°C (-40°F to 200°F) and shall be capable of withstanding a pressure differential of 1000Pa (4 inches of W.C.) and velocities of 7.5m/s (1,500 feet per minute) without damage.

1. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
2. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 150mm (6 inches).
3. Outside supply air and exhaust air dampers shall be insulated and thermally broken.
4. All dampers and actuators are to be supplied and installed by Division 15. confirm required voltage with Division 16 prior to ordering
5. Specified Product: Tamco Series 9000. Size as indicated on drawings

(f) Damper Motor Actuators

- (i) All control damper operators shall be electric utilizing a 0-10 VDC or 4-20ma control signal.
1. Number of damper motors required is to be capable of meeting the total opening and closing torque requirement of damper.
  2. All dampers and actuators are to be supplied and installed by Division 15. confirm required voltage with Division 16 prior to ordering.
  3. Acceptable Manufacturers: Belimo.

(g) Thermal Duct Insulation

- (i) Semi-rigid glass fibre, 50 mm thick, 48 kg/cu.m., with RFFRK factory jacket, sealed and re-jacketed.
- (ii) Insulate supply and exhaust duct work.

- (h) Thermal Insulation Covering
  - (i) Lo-smoke 0.040 inches thick PVC jacket confirming to ASTM-E 84 and Canada CAN/CGSB - 51.53-95 sealed
- (i) Low Pressure Ductwork
  - (i) Low pressure rectangular and square ductwork to be as follows:
    - 1. Up to 300mm wide No. 26 U.S.S.G.
    - 2. 325mm to 750mm wide No. 24 U.S.S.G.
    - 3. 775mm to 1500mm wide No. 22 U.S.S.G.
  - (ii) Low pressure round ductwork to be as follows:
    - 1. Up to 300mm wide No. 22 U.S.S.G.
    - 2. 325mm wide and larger No. 20 U.S.S.G.
- (j) Low Pressure Duct Sealer
  - (i) Apply Duro-Dyne S-2 duct sealer, to all seams and joints.
- (k) Flexible Duct Connections
  - (i) Provide flexible connections, not less than 4 inches wide, constructed of approved fireproof, waterproof, non-asbestos, glass fabric, at the inlet and outlet connection of each fan unit.
  - (ii) Connection shall be UL listed, to meet NFPA 90 requirements and the following applications
  - (iii) DuroDyne - "Neoprene" or approved equal in accordance with B6.

### E39.3 Execution

- (a) Duct Openings
  - (i) Locate only openings in walls, floors, partitions, beams, etc. required for ducts, equipment, etc. G.C. to form all openings for same, except as noted.
  - (ii) Slope ductwork down to openings.
  - (iii) Pack area between ducts and openings with fireproof self-supporting insulation. Seal penetrations through rated walls with fire retardant sealer as per NFPA.
  - (iv) Flash and make all openings weather tight.
  - (v) Seal standard ductwork with Duro-Dyne S-2 until watertight.
- (b) Low Pressure Ductwork
  - (i) Where duct width exceeds 457 mm in largest dimension, stiffen by breaking sheets diagonally.
  - (ii) Construct rectangular ducts by breaking corners, grooving longitudinal seams, using Pittsburgh or other approved airtight seam. Elbows and transformation pieces are to have Pittsburgh corner double seam corners. Transverse joints are to have S-Slips, Bar Slips, Drive Slips, etc. as recommended in ASHRAE Guide. Slips are to be one gauge heavier than duct material. Open corners not accepted. Laps to be in air flow direction. Use rivets and bolts throughout. Hammer edges and slips for smooth interior duct. Construct tees, bends, and elbows with radius 1-½ widths of ducts on centre.
  - (iii) Adequately brace and support to provide good installation.
  - (iv) Prior to commissioning of system, clean and degrease ductwork. Use 6.4 mm bead of sealer at all seams and joints.
  - (v) Duct sizes are inside dimensions. If ducts are acoustically lined, outside duct sizes to be increased as required.



(c) Fans

- (i). Comply with manufacturer's requirements. Ensure vibration free installation. Leave access for servicing. Install belt guards and weatherproof covers as required.
- (ii). Suspend all Exhaust Fans complete with vibration isolating hangers. Provide flexible duct connections.

(d) Thermal Insulation

- (i) For slab insulation
  1. Apply so that product on the horizontal face overlaps that on the vertical face to maintain thickness at corners.
  2. Secure insulation with adhesive and corrosion resistant fasteners affixed to the ductwork. Adhesive is to be compatible with ductwork, insulation and vapour seal.
  3. Follow manufacturer's guidelines.

(e) Hangars and Supports

- (i) Metal strapping for supporting and hanging ductwork may be attached to metal roof decks with the following conditions;
  1. The metal roof deck is 22 gauge or heavier.
  2. For round ductwork 18 inch diameter or less and rectangular ductwork having a perimeter of 96 inches or less and duct thickness of 20 gauge or lighter.
  3. Metal strapping must be attached to the side flute of the metal deck with one each No. 10 Buildex screw (or other equal load rated fastener) at each end for U-shaped straps and two each No. 10 screws for single point attachments.
- (ii) Hangers shall be installed plumb and shall present a neat appearance.
  1. Strap hangers shall extend the full depth of the duct, bend and extend 1 inches under and against the bottom of the duct.
  2. Attach hangers to the ducts using rivets or screws of appropriate sizes 6 inches on center (minimum of 2 each side) and on the bottom return.
- (iii) All ducts shall be rigidly supported.
  1. Where vertical ducts pass through floors or roofs, supporting angles shall be attached to ducts and to the structure.
  2. Place supporting angles on at least two sides of the duct.

(f) Connectors

- (i). Securely fastened to the unit and to the ductwork by a galvanized iron band provided with tightening screws. There shall be no metal-to-metal contact at flexible connections. There shall be no stretching of the flexible material at flexible connections.

(g) Access Doors

- (i) Duct Access Doors: Provide in locations indicated on drawings and as required to properly and easily service, maintain, and inspect duct coils, fire dampers and other equipment.

(h) Vibration and Objectionable Noises

- (i) Install ductwork free from pulsation, chatter, vibration or objectionable noises. Should any of these defects appear after the system is in operation, correct it by either removing, replacing or reinforcing the work as directed by the Contract Administrator.

(i) Testing and Air Balancing

- (i). All tests must be at least 12 hours, and if there are leaks these must be met with test

repeated to the satisfaction of the Contract Administrator. Notify Contract Administrator two (2) days prior to commencement of all tests.

- (ii). After the work is completed, adjust and put all parts of the system into proper working condition, adjust deflectors and dampers on the ventilation system and in short, put all parts of the system included in this contract, into condition for regular operation all to the satisfaction of the Contract Administrator.
- (iii) Provide fan sheaves to accommodate air flow rate.
- (iv). Permanently mark all dampers and valves to show the final position.

#### **E40. PROCESS MECHANICAL**

E40.1 Specifications E40 to E48 pertain to Process Mechanical.

E40.2 Measurement and Payment

- (a) Specifications E40 to E48 will be measured for payment on a cumulative unit basis and paid for at the Contract Unit Price for "Process Mechanical Works". Payment will be made for the Process Mechanical Works constructed in accordance with this specification, accepted and measured by the Contract Administrator.

#### **E41. PROCESS MECHANICAL - GENERAL**

E41.1 Description

- (a) This section specifies general clauses applicable to the supply and installation of all process mechanical systems. This Specification covers the design, supply and installation of process piping, valves, fittings, and equipment in the SEWPCC Effluent Sampling Facility and the mobile Manitoba Conservation effluent sampler.

E41.2 The process mechanical systems for the SEWPCC Effluent Sampling Station include:

- (a) Process Piping
- (b) Process Valves
- (c) Sample Water Pump
- (d) Air Compressor
- (e) Installation, connection, and testing of Sampling Equipment which is provided by the Owner
- (f) Refrigerator

E41.3 The process mechanical systems for the mobile Manitoba Conservation Effluent Sampling Station include:

- (a) Process piping and tubing
- (b) Pressure reducing valve
- (c) Three way ball valve
- (d) Three way ball valve input / output alarm box
- (e) Air flushing line

E41.4 The Work under this section shall include the supply, installation, testing and start-up of the process mechanical material and products to provide a complete and workable installation in accordance with the contract drawings and specifications and all applicable codes, standards and ordinances. Any work and/or other necessary materials not specifically mentioned in the specifications or shown on the drawings, but necessary to complete the installation, shall be furnished by the Contractor as if specifically mentioned herein and detailed.

#### E41.5 Related Work

- (a) Electrical and instrumentation and controls.
- (b) General Conditions and Supplemental Conditions
- (c) Part E – Specifications, General
- (d) The process mechanical drawings do not show structural details and any information involving accurate measurements of buildings. Refer to architectural and structural drawings as well as all other divisions of this specification.
- (e) Piping and mechanical work shall be painted in accordance with the painting specifications and in accordance with this specification with regard to pipe identification.

#### E41.6 Permits, Certificates, Fees

- (a) The Contractor shall give all notices, obtain all permits and pay all fees so that the work specified herein may be carried out.
- (b) The Contractor shall make all necessary arrangements with Utilities Companies for services and meters as required and pay for all the costs involved.
- (c) Arrange for inspection of all work by the authorities having jurisdiction over the work including local building, plumbing and electrical representatives. On completion of the work, present to the Contract Administrator the final unconditional certificate of approval of the inspecting authorities.
- (d) Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Contract Administrator. Prepare and furnish any additional drawings, details or information as may be required. Change orders for extra work will be considered for items with the exception of those relating to code conformance (National Building Code, National Plumbing Code, Electrical Code).

#### E41.7 Codes and Standards

- (a) Welding shall conform to the ANSI/ASME Power Piping Code and the ASME Boiler and Pressure Vessel Code.
- (b) Welders shall be qualified and licensed in Manitoba, and welder qualifications shall be in accordance with CSA-Z662.
- (c) Work shall be performed in accordance with the Regulations of the Occupational Health and Safety Act.
- (d) Installation shall be in accordance with the National Building Code and all regulations and codes of the Province, Territory or Municipality in which the work is located.
- (e) In case of conflict, the codes shall be taken as the minimum acceptable criteria where they exceed those in the Contract Documents. In no instance reduce the standard or scope of work, or intent established by the Contract Documents by applying any of the codes referred to herein. Where the Contract Documents indicate a standard exceeding code requirements, the Contract Documents shall take precedence.

#### E41.8 Approved Alternatives

- (a) Approval of alternative equipment shall be in accordance with the Bidding Procedures.

#### E41.9 Product Delivery, Storage, Handling

- (a) All materials and equipment shall be delivered, handled and stored subject to the provisions contained herein and according to the manufacturer's recommendations.
- (b) Provide temporary storage facilities and heated storage where required for sensitive items such as motors.
- (c) Equipment, including pumps and motors, shall not be placed in temporary or final locations in the new structures before a date approved by the Contract Administrator. The date of

delivery into the structure shall be commensurate with the construction progress and the suitability, with respect to temperature, humidity, etc. of the building.

- (d) Take precautions to maintain equipment in good condition and to avoid corrosion or other damage which may affect the equipment's performance. Provide temporary coatings as required to prevent corrosion.
- (e) Leave factory covers in place and prevent entry of foreign materials into working parts of equipment.
- (f) Protect members and bearings with plastic covers.
- (g) Grease all shafts and sheaves to prevent corrosion.
- (h) The Contractor shall recognize the time interval required for complete construction before the structure is suitable for equipment installation. If equipment is manufactured before it is required at the site, the Contractor shall provide suitable heated dry storage space for the equipment, to the approval of the Contract Administrator. All equipment and motors shall be rotated at least weekly during the storage period, and after installation, until the equipment is placed in normal use.
- (i) All material damaged or otherwise harmfully affected during delivery, storage, handling or installation shall be replaced by the Contractor at his/her own expense.

#### E41.10 Equipment Supports, Anchors, Bases

- (a) The Contractor shall provide all structural work required for foundation and support of units, foundation bolts, sleeves, washers, nuts, shims and templates to locate bolts.
- (b) Sleeved anchor bolts as detailed may be set in concrete. Expansion type bolts drilled into concrete may not be used in lieu of anchor bolts.
- (c) Provide a minimum of 25 mm non-metallic grout between bedplates and concrete foundation, fill voids, finish and remove wedges after grout is set. Grout shall be Embecco or approved equivalent alternative, non metallic type.
- (d) All floor level equipment shall be mounted on housekeeping pads minimum 100 mm high. Not all housekeeping pads are detailed on the drawing.
- (e) Where grouting is required for bedplates and equipment bases on concrete foundations, the surface of the concrete foundation shall be roughened to provide a bond.
- (f) All bases shall be finished to match the floor.

#### E41.11 Materials

- (a) Provide new materials and equipment of first class quality, delivered, erected, connected and finished in every detail, and supplied with the acceptance of the Contract Administrator.
- (b) Assume responsibility of ensuring that equipment provided performs as specified.

#### E41.12 Installation

- (a) Follow the recommended installation details and procedures for all equipment as found in the supplier's technical data, supplemented by the shop drawings, the contract drawings and the specifications and the directions of the Contract Administrator. Coordinate work with the work of other trades to avoid conflict.
- (b) Install mechanical sleeve work in advance of concrete pouring.
- (c) For equipment or material of the same type or classification, install only products of one manufacturer.
- (d) Install all equipment with adequate access for inspection and servicing, and to provide minimum interference. Conserve headroom and leave maximum usable space.
- (e) Employ only skilled tradesmen properly licensed by the Province or Territory, for all work requiring tradesmen with special skill.

- (f) Motors shall be aligned, shimmed and coupled to fit shafts, to the tolerances given by the manufacturer.
- (g) The relocation or redirection of any and all piping or equipment must be approved by the Contract Administrator, regardless of reason.
- (h) Set equipment in place and install piping, fittings, valves and other items. Make final adjustments in alignment and elevation before securely fastening equipment and other items in place.
- (i) Control alignment so that excess forces are not imposed on equipment when piping connections are tightened.
- (j) Do not tighten pipes until grout is set.
- (k) Tighten so that there are no excessive stresses set up in flanges.

#### E41.13 Vibration Isolation

- (a) Provide vibration isolators for all mechanical motor driven equipment throughout the project, unless specifically noted otherwise. This shall include but not be limited to the sample water pump, air compressor and all piping connected to vibration isolated equipment.
- (b) Provide Vibration Isolators as manufactured by Vibro-Acoustics, Vibron or Air Master.
- (c) Provide all sound and vibration elimination materials by one supplier unless otherwise specified. Provide shop drawings showing isolator location, load forces, anchor positions, etc. and installation instructions.
- (d) Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.
- (e) Provide flexible connectors for pipes to all equipment supported by vibration isolators.
- (f) Provide flame proof flexible connectors between fans, heaters, equipment and ducts.
- (g) Equipment installed by the Contractor shall operate smoothly without excessive wear, adjustment and attention. Vibration shall not exceed the manufacturer's specified limits for individual products. Vibrations in pumps shall be within acceptable field vibration limits as outlined in the Standards of the Hydraulics Institute.

#### E41.14 Guards

- (a) Provide vibration free guards on all exposed drives and rotating parts, to meet safety requirements.
- (b) Provide means to permit lubrication, use of test instruments and movements of motors to adjust belt tension.

#### E41.15 Minor Deviations

- (a) The Contractor shall allow for additional material such as pipe and ducts for modifications that may be required to correct minor conflicts or deviations.

#### E41.16 Shop Drawings

- (a) Shop drawings shall be submitted in accordance E4.
- (b) The Contractor shall submit shop drawings and data for all process mechanical equipment, piping, valves, and appurtenances.
- (c) If valves, pumps, and other equipment are installed prior to the submission and review of shop drawings, they shall be removed and replaced entirely at the Contractor's expense.

#### E41.17 Operation and Maintenance Manuals

- (a) Operation and Maintenance Manuals are to be provided and delivered to the Contract Administrator for review at least 6 weeks before the commissioning review.

- (b) Operation and Maintenance Manuals Specific to Process Mechanical shall include and be arranged as follows:
- (i) Tab 1.1 List of Process Drawings
  - (ii) Tab 1.2 Description of Systems: Provide a complete description of each mechanical system within the building. Include an explanation of each component comprising the system and a description of how each component interfaces with others within the system. Indicate the location of mode of energization, switches and controls and sequence of operation.
  - (iii) At the end of each system list the manufacturer, type, designation and location of each mechanical component.
  - (iv) Tab 1.3 Operation Division: Provide a comprehensive explanation of operation for each mechanical component. Include start up procedures, remote set point adjustments, condition indicators, alarms, how the mechanical component interfaces with other components, control sequences, operational changes for summer and winter operation and how to accomplish changeover, and safeguards to check if equipment goes off line.
  - (v) Tab 1.4 Maintenance and Lubrication Division: Provide a preventive maintenance schedule for each of the major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Include this information as a separate preventive maintenance schedule. Provide lubrication information and instructions which will explain the various bearings and lubrication procedures.
  - (vi) Tab 1.5 List of Equipment Suppliers and Contractors: Provide a complete list of equipment suppliers and contractors, including address and telephone number, separate from that which is indicated in "Tab 1.2".
  - (vii) Tab 2.0, 2.1, etc. Certification: Include copy of test data, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of valve tag identification and pipe colour code.
  - (viii) Tab 3.0, 3.1, etc. Manufacturer's Shop Drawings and Maintenance Bulletins: Include materials as received in compliance with the General Conditions and Supplemental Conditions.
  - (ix) Provide two complete manuals including system description two weeks prior to startup. These are for Owner's and Contract Administrator's review.
  - (x) Upon completion of performance tests and debugging, provide corrected system description and correct differences in manuals noted by Owner and Contract Administrator.
  - (xi) Individual check sheets shall be prepared for all mechanical equipment. Each check sheet will contain specified design, shop drawing and actual on site information as follows:
    - designation
    - location
    - manufacturer
    - model number
    - serial number
    - voltage
    - current
    - phase
    - power
    - peak load performance
    - control set points
    - safety limit set points
    - equipment interlocked by controls
    - control sequence

E41.18 Manufacturer's Representative

- (a) Refer to the General Conditions and the Supplemental Conditions with regard to start up and check out services by the manufacturers of equipment.
- (b) Arrange and pay for field services of Manufacturer's representatives required for instruction.

E41.19 Painting

- (a) Piping and valves shall be painted in accordance with painting specification E34.
- (b) All unpainted equipment and appurtenances shall be given shop prime paint suitable for field painting as specified in the painting specification.
- (c) Hangers, supports and fabricated equipment shall be primed and painted.
- (d) Equipment having a finished shop coat shall be touched up.
- (e) Do not paint over nameplates.

E41.20 Identification of Equipment

- (a) Provide a manufacturer's nameplate on each piece of equipment.
- (b) Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
- (c) Provide Underwriter's Laboratories of Canada and CSA registration plates as required by respective agency.
- (d) Provide system nameplates on each piece of mechanical equipment as follows:
- (e) Minimum size 75mm x 35mm x 2.5mm thick laminated plastic with black face and white centre. Letters to be 6 mm high.
- (f) Fasten nameplates securely in a conspicuous place. Where nameplates cannot be mounted on a cool surface, provide stand off.
- (g) Identify each piece of equipment by type and number.

E41.21 Identification of Piping

- (a) Colours will be primary colours, numbered in accordance with CGSB Standard Paint Colours.
- (b) The entire length of each pipe will be painted in the basic colour, with bands to indicate the specific fluid and an arrow to indicate flow direction. Pipe colour to conform to the City of Winnipeg colour scheme. Confirm colours with Engineer.
- (c) Direction arrows shall be black 150 mm x 25 mm.
- (d) Arrows shall be painted at each branch and termination point.
- (e) Locate markers from usual operating areas and identify piping runs at least once in each room and where piping enters or leaves a room.
- (f) Use stencil painted or glue-on lettering for pipe identification.

E41.22 Valve Directories

- (a) Tag all valves and floor stands to the corresponding valve number.
- (b) Tags shall be 75 mm x 35 mm x 25 mm laminated plastic with black faced and white lettering, secured to the valve stem with a key chain.
- (c) Prepare a schematic diagram of the various piping systems in the building and on each diagram show the valve number and the purpose of the valve. Frame one copy of each under glass for wall mounting as directed.

- (d) All branch and main valves shall be consecutively numbered and identified on the schematic and on the list.
- (e) Tag automatic controls, instruments and relays and key to control shop drawing identification numbers. Tag all equipment excluding pipes and ducts.

E41.23 Cleanup and Disinfection

- (a) All piping and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances.
- (b) Disconnect, clean and reconnect whenever necessary for purposes of locating and removing obstructions.

E41.24 Lubrication

- (a) For all equipment furnish all lubricants used during testing and trial runs.
- (b) For equipment supplied by the Contractor, furnish lubricants in sufficient quantity for 12 months operation by the Owner.
- (c) Identify lubricants furnished by brand, grade and item of equipment for which it is intended.
- (d) Operate, drain and flush out bearings and refill with a new change of oil before completion.

E41.25 Record Drawings

- (a) Record Drawings are required for all process mechanical equipment and piping installations.
- (b) The Contractor shall maintain, at the site, a separate set of "red line" process mechanical drawings on which he/she shall record all changes and deviations from the original contract plans and specifications.

E41.26 Motors

- (a) Refer to the electrical specifications for all motor design requirements.

E41.27 Patents

- (a) Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner and the Contract Administrator harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture, or composition of matter on the work, in violation or infringement of such letters patent or rights.

E41.28 Trial Usage and Test

- (a) The Owner has the privilege of trial usage of mechanical systems or parts thereof for the purpose of testing and learning operational procedures.
- (b) Assist in trial usage for a five-day period following commissioning, at no extra cost and do not waive any responsibility become of trial usage.
- (c) Trial usage shall not be construed as acceptance by the Contract Administrator.
- (d) Provide and pay for all testing required on the system components where, in the opinion of the Contract Administrator, Manufacturer's ratings or specified performance is not being achieved.

E41.29 Instructions to Owners

- (a) Supply tools, equipment and personnel to demonstrate and provide training to the Owner's operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment.
- (b) Where specified elsewhere, manufacturers to provide demonstrations and instructions.



- (c) Provide instruction to operating staff during regular work hours prior to acceptance and turn-over.
- (d) Use as-built drawings, audio visual aids, etc. as part of instruction manual.
- (e) Where deemed necessary, Owner may record these demonstrations on videotape for future reference. Coordinate operational demonstrations with availability of videographer.
- (f) Additional sections of the specifications may define and describe training and number of days for start up of each type of equipment. Utilize the most stringent.

#### E41.30 Documentation and Systems Acceptance

- (a) Meet requirements stated in the General Conditions and the Supplemental Conditions.
- (b) In addition, ensure the following on completion of the work:
- (c) As constructed reproducible prints and electronic digital files of drawings, figures, and text.
- (d) Operating and maintenance manuals.
- (e) Contractor shall obtain suitable document signed by the Owner or his representative, confirming:
- (f) Owner has received satisfactory instruction in operation and maintenance of all equipment and systems.
- (g) Operation and maintenance manuals have been provided to the Owner.
- (h) Specified spare parts of components, keys, removables, handles, tools and the like, have been accepted by the Owner.

### **E42. PROCESS MECHANICAL TESTING**

#### E42.1 General

- (a) Description
  - (i) This section refers to testing of process mechanical piping and equipment.
- (b) Related Work
  - (i) General Conditions and Supplemental Conditions
  - (ii) Process Mechanical General
  - (iii) All process mechanical piping and valve specifications
  - (iv) All process mechanical equipment specifications
  - (v) Electrical specifications
  - (vi) Instrumentation and control specifications
- (c) Quality Assurance
  - (i) Use the services of factory trained representatives and submit manufacturer's check sheets for starting the following specialty equipment:
    - Pumps
    - Air compressor
    - Sampling Equipment
    - Sample Refrigerator
    - Control components
- (d) Prior to starting, testing, adjusting, and cleaning processes, verify with Contract Administrator any tests required to be witnessed. Provide sufficient notice to Contract Administrator prior to commencement of procedures.
- (e) Contract Administrator shall be allowed to witness any testing, adjusting, starting, and cleaning procedures.
- (f) Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.

- (g) Prior to starting equipment or systems, secure and review manufacturer's installation, operation, and starting instructions. Read in conjunction with procedures defined herein.
- (h) Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.
- (i) Compare installations to published manufacturer's data and record discrepancies. Items proving detrimental to equipment performance shall be corrected prior to equipment starting.
- (j) Some processes involved in starting procedures defined in this section may be duplications of authorities verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures.
- (k) All starting, testing, procedures shall be in accordance with applicable portions of ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM, and ASPE.
- (l) Personnel involved in starting, testing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the readings and tests.
- (m) Assume all liabilities associated with starting and testing procedures.

#### E42.2 General Testing

- (a) Test all equipment and material where required by contract specification or authority having jurisdiction to demonstrate its proper operation. All tests shall be witnessed by the Contract Administrator.
- (b) Provide all equipment, materials and labour for tests and pay all expenses for conducting same. All instruments shall be tested by an approved laboratory and test results and certificates showing degree of accuracy shall be furnished to the Contract Administrator. If permanent gauges, thermometers, etc. are used for tests these shall not be installed until just prior to the tests to avoid possible changes in calibration.
- (c) Meet with electrical equipment manufacturers, supplies, and other specialists as required to ensure all phases of work are properly coordinated prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.
- (d) Should tests indicate defective work or performance at variance with specified requirements, make all changes immediately to correct the defects.
- (e) The Contractor shall be in charge of the work during tests. He/she shall assume responsibility for damages in the event of injury to the personnel, building or equipment and shall bear all costs for liability, repairs and restoration.
- (f) Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.
- (g) Confirm voltages and operating amperages at full load.
- (h) Perform tests as specified and upon completion of mechanical installation, provide certification of tests with detailed data as required. Itemize each test as to time performed and personnel responsible. Obtain certificates of approval, acceptance and compliance with rules and regulations from authorities having jurisdiction. Include these certificates in the Operation and Maintenance manuals. This work will not be considered complete until such certificates have been delivered to the Contract Administrator.

#### E42.3 Procedures

- (a) Procedure shall be identified in the following three (3) distinct phases:
- (b) Pre-Starting: Visual inspection.
- (c) Starting: actual starting procedure.
- (d) Post-Starting: Operational testing, adjusting or balancing, and equipment run-in phase.
- (e) Check the installation is as defined by contract documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

#### E42.4 Pressure and Leakage Testing

- (a) Hydraulic tests shall be carried out for a period of 8 hours and pressure maintained with no appreciable pressure drop. Where leakage occurs, repairs shall be made and the entire system shall be retested.
- (b) Process piping shall be tested at normal operating pressure plus 300 kPa (45 psi) or 1030 kPa (150 psi) water pressure, whichever is greater, measured at the low point in the system or as specified otherwise.
- (c) Lines which will be normally open-ended on completion of the work shall be initially plugged for testing purposes.
- (d) Air shall not be used a test medium for systems not using air.
- (e) Leaks in screwed fittings shall be corrected by remaking joints; leaks in PVC joints shall be cut out and re-glued; leaks in welded joints shall be cut out and rewelded. Caulking will not be permitted.
- (f) Leaks in valves shall be rectified by replacement of the valve.
- (g) Test air lines with compressed air. Maintain a pressure of 70 kPa for a period of 24 hours. Pressure drop shall not exceed 3.5 kPa in 24 hours, after allowance for temperature changes.

#### E42.5 Contractor Testing Responsibilities

- (a) The contractor shall be required to provide the following tests as part of his construction contract. For each test, a test form is to be filled out, witnessed, kept on site for the Contract Administrator to verify at any time during construction and then they are to be included in the final submission of the contractor O&M manuals.

#### E42.6 Performance Testing

- (a) Sample Water Pump
  - (i) Prior to operation, check that valves and pressure gauges are in place.
  - (ii) Check pump operation to confirm base, motor and drive shaft alignment.
  - (iii) Set pump in accordance with applicable design requirements.
  - (iv) Synchronize clocks being used for test program, with resolution to one second or better.
  - (v) Use portable clamp-on flowmeter with visual flowrate display and digital printout including real time entries. Apply flowmeter to pump discharge piping at a point in the discharge piping recommended by the pump manufacturer.
  - (vi) Record suction side water level throughout the test.
  - (vii) Record both pressure gauge readings, on the suction side and the discharge side of the pump.
  - (viii) Adjust valve on discharge side of the pump to throttle the pump discharge flowrate to four conditions. Allow for at least 2 minutes for stabilization of each condition.
  - (ix) Record pump amperage draw for each test condition.
  - (x) Provide calibration curves using at least four flowrate / head field data points.
  - (xi) Test one maximum dry priming condition with the water level in the outfall pipe no more than 20 cm deep in the outfall pipe invert, and the pump and recirculation piping loop empty of liquid. Record the time required for pump priming under this condition. Record the pressure gauge readings on both the suction and discharge sides of the pump throughout the priming portion of the test.
  - (xii) Provide test report comparing pump test performance with rated performance.
- (b) Process Valves
  - (i) Test operation of all manually actuated valves
  - (ii) Test operation of all electrically actuated valves through both system operation and manual override.

- (c) Air Piping
  - (i) Test in accordance with CSA
  - (ii) Test to 1 ½ times working pressure for 3 hours
- (d) Air Compressor
  - (i) Prior to operation check that filters are clean and in place
  - (ii) Check and set all fluid levels
  - (iii) Check and tighten all belts.
  - (iv) Ensure all protective guards are in place
  - (v) Check compressor operation and set for proper flow
  - (vi) Set pressure relief valves as per manufacturer's instructions
- (e) After the mechanical installations are completed and pressure tested, conduct performance tests to demonstrate that the equipment and systems actually meet the specified requirements.
- (f) Lubricate all bearings, adjust and/or replace and set all direct drives and "V" belt drives for proper alignment and tension; calibrate and adjust all thermostats, thermometers, operate and test all motors and speed switches for correct wiring, sequences, check all heaters in motor starters; replace and clean all filters, flush out lines and equipment, remove and clean all strainers; fill all water systems and purge all air; clean fan wheels, heating and cooling coils; fasten all loose and rattling pieces of equipment. Equipment and other apparatus must operate quietly and develop specified capacities; control valves must operate freely.
- (g) Operating tests shall be made on all systems and items of equipment. For testing, vary conditions to simulate operating conditions to test start up, operation sequence, normal shutdown, safety shutdown and all automatic and manual functions.
- (h) Furnish written test reports to the Contract Administrator noting the tests made and any adjustments made.
- (i) Furnish acceptance tests by independent lab on water samples and supplier to provide a performance guarantee.

## **E43. PROCESS MECHANICAL PIPING**

### **E43.1 General**

- (a) This section specifies the general requirements for supply and installation of all process mechanical and plumbing piping systems and is supplemented by other specific details shown or specified in the respective piping system section.
- (b) Related Work
  - (i) General Conditions and Supplemental Conditions
  - (ii) Part E Specifications - General
  - (iii) Painting
  - (iv) Process Mechanical, all other sections
  - (v) Electrical
  - (vi) Process Control and Instrumentation
- (c) Piping Material
  - (i) Unless otherwise specified the pipe material to be used at different areas of the process piping system shall be as follows:
    - Pumped Sample Water Piping – Schedule 80 PVC.
    - Compressed Air Piping – Type K or L hard tempered copper.
    - Sanitary drain line - Schedule 80 PVC
    - Trap primer line – Type K or L hard tempered copper

- Sample line stilling well pipe – Type 416 Stainless steel
- Manitoba Conservation piping - Schedule 80 PVC

#### E43.2 Products

- (a) Material provided by the City of Winnipeg to be installed by the Contractor
- (i) 100 mm diameter by 381 mm long class 150 epoxy coated steel sampler spool piece with flanged ends and transverse port to receive the sampler header.
  - (ii) Air operated IN2Process Quantum sampler with sleeve end clamp for connecting to transverse port of spool piece. Sampler has a sample discharge port for discharging the collected liquid sample into the refrigerator.
    - Contractor to commission operation of sampler and sample control panel.
    - Contractor to include the operation and maintenance information of the IN2Process sampler in the operation and maintenance manuals.
  - (iii) Sample refrigerator with port to receive the clear poly vinyl tube from the sampler.
    - Contractor to provide food grade clear polyvinyl tubing between the sample container in the refrigerator to the sampler discharge port.
- (b) Polyvinyl Chloride (PVC) For Non-Buried Service
- CSA-B137.3
  - Class 12454B PVC compound
  - Schedule 80
  - Solvent weld joints
  - Threaded True Unions where shown on plans
- (c) Pipe Fittings
- (i) PVC
    - For pressure service to CSA3-B137.3
    - For non-pressure service to CSA-181.2
    - Schedule 80 for all pressure fittings and process waste piping
    - Solvent joint fittings to match pipe
    - To AWWA-C111 - rubber gasket type where required
    - Flanges, reducing bushings and other fittings to be compatible with line pipe material
- (d) Flanges
- (i) Flange class shall be plainly marked on all flanges.
- (e) Bolts and Nuts
- (i) Bolts and nuts shall be to AWWA C207.
  - (ii) Bolts and nuts shall be stainless steel to ASTM-280, Type 304 hexagonal heads.
  - (iii) Size and length to match flanges and valves.
- (f) Flange Gaskets
- (i) For flanges, 1.6 mm cloth inserted rubber SBR, Garlock Style 22 or approved alternate for temperatures below 100°C.
  - (ii) Use flat ring gaskets with raised face flanges.
  - (iii) For flanges in air piping use 1.6 mm neoprene, Garlock 7797 gasket or approved alternate.
  - (iv) Use full faced gaskets with flat face flanges.
  - (v) Stainless Steel Pipe - roll grooves to coupling manufacturer's standards.

- (g) Pipe Sleeves
  - (i) Pipe sleeves through exterior walls shall be of standard weight steel pipe and shall be, unless detailed otherwise, one size larger than the penetrating pipe for 100 mm and larger pipe, and two sizes larger for pipe smaller than 100 mm.
  - (ii) Process pipes passing through concrete walls shall be galvanized steel with a diameter equal to the process pipe. These sleeves shall be puddle flanged and be flanged for a bolted pipe connection each end as indicated on the Drawings.
  - (iii) Pipe sleeves shall have a 50 mm by 10 mm thick steel ring continuously welded all around the middle of the pipe length.
  - (iv) Special sleeves shall be as shown on the drawings.
- (h) Supports and Hangers - General
  - (i) Hangers and supports shall conform to ANSI Code for Pressure Piping B31.1.
  - (ii) Materials, design and manufacture for Pipe Hangers and Support shall be in accordance with ANSI/MSS SP-58.
  - (iii) Hot dip galvanize all supports (unless noted otherwise), hangers, guides, sway braces, restraints, and dampeners after fabrication and before installation.
  - (iv) Hangers and supports shall be sized to suit the pipe sizes as shown on drawings and as recommended by the manufacturer.
- (i) Pipe Supports
  - (i) Wall supports - use Grinnell Fig. 194, Fig. 195, or Fig. 199 welded steel brackets hot dipped galvanized, or as shown on the drawings.
  - (ii) Floor Supports - use supports as detailed on drawings.
  - (iii) Pipe saddle supports - use Grinnell Fig. 264 adjustable pipe saddle support complete with riser pipe and floor flange.
  - (iv) Strap supports - use Grinnell Fig. 262 for 100 mm and smaller pipe. Provide straps for larger pipe as detailed on drawings.
  - (v) Wall supports for copper tubing up to 50 mm diameter shall be Grinnell tube strap or approved alternate.
- (j) Pipe Hangers
  - (i) For non-insulated steel pipe of 150 mm and smaller use Grinnell Figure CT97C coated adjustable pipe ring complete with hanger rod and expansion case or insert for mounting on concrete surface.
  - (ii) For non-insulated steel pipes to 600 mm use Grinnell Fig. 260 adjustable clevis galvanized.
  - (iii) For concrete inserts use Grinnell Fig. 152, Fig. 117 and Fig. 285 to suit service conditions and pipe size.
  - (iv) For ceiling flanges, use Grinnell Fig. 153.
  - (v) Hanger rods shall be machine threaded both ends and shall be hot dipped galvanized after fabrication.
  - (vi) Spring hangers shall be Grinnell Fig. 80-V or 81-H constant support spring hangers.
  - (vii) Any part of a hanger or other pipe support in direct contact with stainless steel shall be nylon coated with NCA-1477 nylon thermoplastic 0.5 mm thick or shall be of 304 stainless steel. Provide felt paper between pipe and concrete pipe supports to prevent bonding.
- (k) Floor Drain
  - (i) Galvanized cast iron floor drain with anchor flange, weepholes, trap seal primer tapping and standard heavy duty, 150 mm polished stainless steel strainer. MIFAB series F1000.
- (l) Floor Drain Piping
  - (i) Poly vinyl chloride Schedule 40 piping conforming to ASTM D 2665.

- (m) Trap Primer Valve
  - (i) Manual brass full port ball valve with stainless steel
- (n) Trap Primer Piping
  - (i) Type K or L Hard tempered copper conforming to ASTM B 88.
  - (ii) Use dielectric unions between dissimilar metals. Female Brass Pipe Thread to Female Solder Connections. Watts 3008.
- (o) Trap Primer Valves
  - (i) Threaded, 2-Piece, Full Port, Brass Ball Valve, 600 CWP, Sizes: 1/2" (DN 8 to DN 100), Approvals: CSA, FM, UL, NSF 61. Apollo 64 series

#### E43.3 Execution

- (a) Nuts and Bolts
  - (i) Install nuts and bolts so that bolts have a minimum of two exposed threads projecting after tightening; with a maximum of 8 threads projecting.
  - (ii) Apply Denso paste to exposed threads, flanges and coupling bolts.
- (b) Installation of Pipe and Fittings
  - (i) Prior to commencing piping work, examine route for conflicts and notify the Engineer of any conflicts. Obtain approval of the Engineer for any relocations.
  - (ii) Install to piping lines and elevations shown on the drawings.
  - (iii) Install all piping parallel to building walls.
  - (iv) Determine exact location of each pipe in the field with respect to adjacent and interconnecting piping and equipment.
  - (v) Install all piping systems in accordance with the ANSI code for pressure piping, B31.1.
  - (vi) Provide unions intermittently in all screwed piping systems to facilitate removal of valves and every section of the piping system without cutting any pipe or joint.
  - (vii) Provide temporary bracing and supports to adequately support pipes and fittings during installation.
  - (viii) Where the required piping is not shown on drawings or is shown diagrammatically, the pipes shall be installed in such a way as to conserve head room and interfere as little as possible with the spaces through which they pass.
  - (ix) Maintain grade on all draining pipes. Horizontal water piping shall be run with a grade of 2% to drain.
  - (x) Where piping is to connect to equipment, dimensions shown on the drawings are based on catalogue information of first named supplier.
  - (xi) Modify work to suit final dimensions shown on shop drawings for equipment.
  - (xii) Ascertain the correct equipment dimensions before ordering piping closure lengths and fittings. Review of drawings by the Engineer will not relieve the Contractor of his/her obligation in this respect.
- (c) Jointing Pipes - General
  - (i) Clean pipes inside and outside before assembly. Remove welding slag.
  - (ii) Ream pipes and tubes.
  - (iii) Make screwed joints using approved compound or teflon tape applied to male threads. Use thread tape on P.V.C. pipe.
  - (iv) Connect pipes to equipment as shown or specified, without springing the pipes.
  - (v) Provide complete isolation of dissimilar metals. Do not connect copper to any ferrous metal.
  - (vi) Use standard fittings for direction changes.

- (vii) Follow the recommendations of the manufacturer for jointing pipes and installing couplings and fittings.
- (d) Rubber Gasket Joints
  - (i) Make rubber gaskets and mechanically coupled victaulic joints in carbon steel pipe, PVC pipe or other pipes in accordance with the manufacturer's instructions. Use appropriate tools to pull joints, to field cut joints and to prepare pipes for joining. After assembly check the gasket position.
- (e) Flanged Joints
  - (i) Fit flanged joints so that gaskets are bearing uniformly and joints are even. Apply an anti-seize compound to bolt threads and tighten bolts evenly.
- (f) Valves and Operators
  - (i) Install all valves and operators in strict accordance with manufacturer's shop drawings and instructions.
- (g) Expansion Pieces
  - (i) Install piping to permit free movement of piping caused by thermal expansion and contraction except where it is anchored.
  - (ii) Provide for expansion and contraction by installing suitable expansion pieces as is necessary or where indicated.
  - (iii) Provide expansion pieces having ratings equivalent to the test pressures specified for the particular piping system and wetted surfaces of material similar to that of the piping system.
  - (iv) Design expansion pieces for the lengths of straight runs shown and the temperature differentials specified.
  - (v) Provide anchors and guides where necessary to direct expansion into expansion pieces.
- (h) Installation of Supports and Hangers
  - (i) Support all piping after alignment and before tightening joints.
  - (ii) Do not move pipe after tightening joints.
  - (iii) Provide all hangers, supports, anchor bolts, washers and nuts to support pipes at the lines and elevations indicated and/or as detailed on the drawings.
  - (iv) Provide inserts in concrete, concrete piers and anchor bolts as required. Provide reinforcing bars in concrete for inserts carrying pipe over 100 mm in diameter.
  - (v) Bolt base flanges to the floors or to concrete.
  - (vi) Provide all necessary sway braces, dampeners, flexible hoses and restraints to eliminate all movements of piping due to vibration. Install additional braces and anchors as necessary to eliminate vibrations.
  - (vii) Provide hangers, supports, anchors, guides, dampeners, flexible hoses, restraints and sway braces that will cope with the loads and thrust forces from all directions so that all pipe joints will function and thrust is not transferred to the equipment to which the pipe is connected.
  - (viii) Maximum hanger spacing and minimum rod size shall be in accordance with the following:

Pipe Size	Rod Size	Maximum Spacing Steel	Maximum Spacing P.V.C.
25 - 50 mm	10 mm	1800 mm	1800 mm
65 - 90 mm	12 mm	2400 mm	2100 mm
100 - 125 mm	16 mm	2400 mm	2100 mm
150 mm	20 mm	3600 mm	2400 mm



200 - 300 mm	22 mm	5500 mm	2400 mm
350 and up	25 mm	6500 mm	2800 mm

- (ix) A pipe hanger, support or brace shall be provided at each fitting, which changes the direction of flow or splits flow, and at each proposed valve.
- (x) Install sufficient hangers and supports to provide an adequate safety factor as outlined in ANS1-B31.1.
- (xi) Drilling into concrete, and using expansion type inserts will be permitted only on approval of the Engineer.
- (i) Pipes Through Floors and Walls
  - (i) Provide standard steel pipe sleeves where pipes pass through floors and walls (PVC, tin, or blocked out sleeves are only acceptable where indicated on the drawing).
  - (ii) Install sleeves flush at walls and projecting at floors as detailed or 50 mm above floor surfaces and flush with bottom.
  - (iii) Provide continuously welded rings on pipes passing through walls below grade or where walls are watertight. The thrust/seepage rings shall be as detailed on the drawings.
  - (iv) Remove coating from pipes to be cast in concrete to permit a good bond.
  - (v) Where electrical insulation from concrete rebar is required, use link seals with pipe sleeves where shown on drawings.
  - (vi) Where thrust restraint is required design according to AWWA Manual M11 or as detailed.
  - (vii) There shall be no direct contact between structural steel and stainless steel.
  - (viii) Seal space between sleeves and pipes with non-hardening mastic -Daraseal-A or approved alternative.
- (j) Cleaning
  - (i) Clean all pipes, fittings and miscellaneous items after installation.
  - (ii) Remove all materials from pipes, whatever their origin, by flushing with water, blowing with air and dismantling and manually cleaning.
  - (iii) Prevent entrance of foreign materials from pipes to equipment or pumps.
- (k) Shop Finishes
  - (i) Shop priming of the equipment shall be as specified in Painting section.
- (l) Field Painting
  - (i) Field painting shall be in accordance with Painting section.

#### **E44. PROCESS MECHANICAL VALVES**

##### **E44.1 General**

- (a) Description
  - (i) This section specifies the supply and installation of all process valves applicable to the process piping system.
  - (ii) Conform to General Conditions and Supplemental Conditions.
  - (iii) Conform to Part E – Specifications, General.
- (b) Submittals
- (c) The Contractor shall submit shop drawings and product data as follows:
  - (i) Assembly drawings and material list.
  - (ii) Details of all parts and principal dimensions.
  - (iii) Submit installation manuals before shipment of any equipment.

- (iv) Submit operation and maintenance manuals 30 days prior to start up.
- (d) Suppliers
  - (i) All valves and operators of the same type shall be provided by one manufacturer.

#### E44.2 Products

- (a) Ball Valves
  - (i) Ball Valves up to 50 mm for Steel Pipe:
  - (ii) Two piece bronze body.
  - (iii) Full standard port.
  - (iv) Chrome plated.
  - (v) Solid bronze ball.
  - (vi) TFE seat and packing.
  - (vii) Lever handle
  - (viii) Threaded ends.
  - (ix) Kitz 58 and 59, Flowtek 759, Matco, Jenkins 910J, or approved equal in accordance with B6.
- (b) For PVC / CPVC Pipe:
  - (i) PVC or CPVC body.
  - (ii) EDPM or Viton available.
  - (iii) 12 mm to 25 mm sizes to 1564 kPa working pressure and larger sizes to 1020 kPa working pressure.
  - (iv) All valves shall have double stem blow out stem o-rings.
  - (v) Socket ends to be Schedule 80 conforming to ASTM D-2467.
  - (vi) PVC or CPVC compound shall have an ASTM cell classification 23567-A with a minimum suffix "A" chemical resistance.
  - (vii) Chemline Type 21 True union ball valve (EPDM and socket), George Fisher, or approved equal in accordance with B6.
- (c) Check Valves
  - (i) 80 mm and smaller
    - Bronze swing check
    - Bronze disc
    - 1725 kPa WOG rating
    - Threaded ends Jenkins Fig. 4092, Kite, Matco 521N or approved alternative
  - (ii) 80 mm and smaller (PVC)
    - PVC body
    - True union type so that valve can be entirely removed from the line (union each end)
    - EPDM seat
    - PVC ball
    - Chemline PVC Ball Check Series BCV or George Fisher.
- (d) Air Release Valve
  - (i) Water Service
  - (ii) Single lever type for pressures to 1200 kPa
  - (iii) Compound lever type for pressures to 2000 kPa
  - (iv) Cast iron body and cover ASTM A48 Class 30
  - (v) Stainless steel float and other internal parts
  - (vi) Buna-N seat

- (vii) Threaded inlet
  - (viii) 1035 kPa maximum working pressure
  - (ix) Valve outlet piped to drain or wet well as indicated on drawings
  - (x) Orifice size 10 mm (compound) or 5 mm (single lever).
  - (xi) Inlet size as shown on drawings
  - (xii) APCO Model 200A or approved alternative compound lever type (general use)
  - (xiii) APCO Model 141DAT with APCO Model 50 or approved alternative (vertical turbine pumps).
- (e) Drain Valves Up To 50 mm
- (i) Forged brass body, brass cap, stem and ball. Teflon stem seals and Teflon seat. Hose thread end full port. Working pressure 1725 kPa at 120°C. (Dahl 50.430, Jenkins Fig 901CJ, Toyo 5046, Kitz 58CC, Matco 759), or approved equal in accordance with B6.
  - (ii) Drain valves 65 mm and over: bronzed body, bronze ball, threaded ends, twin seal Teflon seats and Viton seals, O-ring, lever handle, rating 2070 kPa at 120°C water. (Matco 759), or approved equal in accordance with B6.
  - (iii) Terminal unit brass T-body drain valve, wheel handle, ground body-bonnet joint, renewable disc, brass chain, forged brass gasketed cap. Working pressure 1725 kPa at 120°C. (Dahl 21.616).
- (f) Pressure Gauges
- (i) Provide 114 mm diameter, cast aluminum pressure gauges – black finish - stainless steel internals - liquid filled - dial type to CGSB 91-GP-1 – glass window, white dial, black lettering - ½ of 1% accuracy unless otherwise stated.
    - Pressure range: 0-700 kPa.
    - Pressure range: 0-1500 kPa as detailed.
    - Provide brass gauge cock and “RAY” Center joint piston pressure snubber for pulsating operation.
    - Use materials compatible with system requirements.
    - Porous stone style pressure snubbers are not acceptable.
    - Acceptable Gauge Manufacturers: Trerice, Taylor, Weiss, Weksler, Winters, Marshall Town, or approved equal in accordance with B6.
- (g) Pressure Switches
- (i) Pressure switches to be provided per Electrical and instrumentation sections.
  - (ii) Provide ball valve on all pressure switches.
- (h) Sampling Valve
- (i) Type 316 stainless steel wetted parts.
  - (ii) Viton stem seal.
  - (iii) 410 kPa pressure rating.
  - (iv) c/w lever actuator.
  - (v) Fabri-Valve Figure 151 sampling valve, North Port, or approved alternative.
- (i) Shop Finishes
- (i) All unfinished iron and steel work on the valves shall be thoroughly cleaned and painted with approved shop coat, refer to Painting specification. All finished parts shall be coated with heavy grease or a mixture of white lead and tallow to prevent corrosion during shipment and installation. Bronze work shall be left bright.
- (j) Field Painting
- (i) All exposed surfaces of valves shall be painted after installation, refer to Painting specification.

- (a) Valves and Operators
  - (i) Install all valves and operators in strict accordance with manufacturer's shop drawings and instructions.
  - (ii) Valve floor stands and operators shall be oriented as shown on the drawings.
  - (iii) Install extension stems, stem supports and other accessories as required and as shown on drawings for the connection of valve operators to floor stand units.
  - (iv) If pipe sleeves through concrete slab for floor stands are not in vertical line with gear operators other than as shown on the drawings, provide universal joints on the extension operating stem for the correction of alignment.

## **E45. SAMPLE WATER PUMP**

### **E45.1 General**

- (a) This section specifies the sample water recirculation pumping equipment complete which is to be installed in the SEWPCC Effluent Sampling Station as shown on the drawings. The pump is a dry-priming suction lift pump.
- (b) The pump supplier shall be responsible for the design, fabrication, assembly in factory and testing of the equipment. The pump supplier shall supply all necessary shop drawings and installation and maintenance manuals for Contractor. The Contractor shall be responsible for taking the delivery of the equipment and assembly (as required) and installation of the equipment to produce an operational pumping system including pump controls.
- (c) Related Requirements:
  - (i) General Conditions and Supplemental Conditions.
  - (ii) Electrical and instrumentation specifications.
  - (iii) Mechanical general specifications.
  - (iv) Process mechanical piping and valve specifications.
- (d) Submittals
  - (i) The pump supplier shall submit all shop drawings and maintenance and installation manuals to the Contractor. Shop drawings must show pump performance characteristics with pump and system operating point plotted. Include NPSH curve where applicable.
- (e) Quality Assurance Control
  - (i) Provide certified factory performance test curve for the pump.

### **E45.2 Products**

- (a) The pump shall be a dry-priming, suction lift, solids handling centrifugal pump. The Pump shall be supplied as a completely assembled unit.
- (b) Operating Conditions:
  - (i) Liquid: Secondary Treated and Degritted Raw Wastewater
  - (ii) Design Flowrate: 6.3 L/s (100 usgpm)
  - (iii) Design TDH: 13.1 m (43.1 ft.)
  - (iv) Temperature: Ambient plant effluent, indoor heated station
  - (v) Design Suction Priming: 4.1 m
  - (vi) Dry Priming Lift Capacity: 6.4 m
  - (vii) Duty: Continuous operation
- (c) Pump
  - (i) Open type 2-vane impeller: ductile iron No. 60-40-18
  - (ii) Solids handling capability of 2.5 inches diameter
  - (iii) Casing: Gray cast iron No. 30, Maximum operating pressure: 70 psi
  - (iv) 3 inch NPT suction and discharge connections

- (v) Impeller shaft: Steel No. 1045
- (vi) Replaceable wear plate: Steel No. 1018
- (vii) Removable cover plate: Gray cast iron No. 30, weight 7 kg
- (viii) Pedestal: Gray cast iron No. 30
- (ix) Seal plate: Gray cast iron No. 30
- (x) Flap valve: Neoprene reinforced with steel
- (xi) Seal liner: Brass No. 70-30
- (xii) Radial thrust bearing: Open single ball
- (xiii) Bearing lubrication: oil
- (xiv) Flange: Gray cast iron No.30
- (xv) Gaskets: Vegetable fiber, rubber, and compressed synthetic fibers
- (xvi) Hardware: Standard plated steel
- (xvii) Horizontal base plate with coupling and coupling guard
- (xviii) Direct coupled to motor
- (xix) Pump efficiency at design condition: 33%
- (xx) Shutoff head: 15.4 m (50.5 ft)
- (xxi) NPSH required: 1.16 m (4.4 ft)
- (xxii) NOL power: 5.56 hp at 24.1 L/s (382 usgpm)
- (d) Motor
  - (i) 7.5 hp
  - (ii) 575 V, 3 phase, 60 Hz
  - (iii) 1750 rpm
  - (iv) High efficiency motor
  - (v) WEG motor suitable for Div I Class I Group C
- (e) Accessories
  - (i) Air release valve on discharge
  - (ii) Discharge pressure gauge
  - (iii) Suction compound pressure gauge
  - (iv) Strainer
- (f) Spare Parts:
  - (i) One spare impeller
  - (ii) One flap seal
  - (iii) One set of gaskets
- (g) Pump Manufacturer and Model:
  - (i) Gorman-Rupp Model # 13C2-B;
  - (ii) Or approved equal in accordance with B6 Flow Serve

### E45.3 Execution

- (a) Delivery
  - (i) Provide for unloading and storage of the pumping units on the site of the work.
- (b) After installation, thoroughly clean the pumping units and repaint the complete unit as specified in the Painting specification.
- (c) Testing
  - (i) Field test the pump in presence of the Contract Administrator to demonstrate the installation is correctly completed and all pumps are operating satisfactorily without vibration, and to the required operating performance.
  - (ii) Test pump as described in the mechanical equipment testing specification.

- (d) Training
  - (i) The Contractor shall provide a minimum of 2 hours of training to the SEWPCC operators. Training shall include suggested maintenance, inspection, replacement of moving parts, seal replacement, etc.

## **E46. AIR COMPRESSOR**

### **E46.1 General**

- (a) This section specifies the air compressor to be installed in the SEWPCC Effluent Sampling Station as shown on the drawings. The air compressor is electric-powered, and provides compressed air to operate the sampling device. The air compressor system shall be a unified package including compressor, air receiver tank, and internal pressure controls to automatically maintain sufficient supply of compressed air.
- (b) Related Requirements:
  - (i) General Conditions and Supplemental Conditions
  - (ii) Electrical and instrumentation specifications
  - (iii) Mechanical general specifications
  - (iv) Process mechanical piping and valve specifications
- (c) Submittals
  - (i) The compressor supplier shall submit all shop drawings and maintenance and installation manuals to the Contractor..
- (d) Quality Assurance Control
  - (i) Provide factory performance test certification for the compressor

### **E46.2 Products:**

- (a) Cast-iron twin stack air compressor
- (b) 4.5 gallon nominal air receiver tank volume
- (c) Air tank orientation: horizontal
- (d) Free air output: 4.4 cfm at 90 psi
- (e) Motor: 2 hp
- (f) Maximum pressure: 125 psi
- (g) Voltage: 115 V
- (h) Hard-wired to station electrical panel circuit
- (i) Outlet: 3/8 inch NPTF
- (j) Weight: 26 kg (58 lbs)
- (k) Manufacturer and Model:
  - (i) Ingersoll Rand GSS3F2GM
  - (ii) Or approved equal in accordance with B6 by Gast
- (l) Appurtenances:
  - (i) Air line moisture condensate trap with drain
  - (ii) Air line filter
  - (iii) Air dessicant cartridge (initial 6 month supply)

### **E46.3 Execution:**

- (a) Delivery
  - (i) Provide for unloading and storage of the compressor on the site of the work.

- (b) After installation, thoroughly clean the compressor.
- (c) Testing
  - (i) Field test the compressor in presence of the Contract Administrator to demonstrate the installation is correctly completed and the compressor is operating satisfactorily without vibration, and to the required operating performance.
  - (ii) Test compressor as described in the mechanical equipment testing specification.
  - (iii) Test the compressor in conjunction with testing of the sampling device.
- (d) Training
- (e) The Contractor shall provide training to the SEWPCC operators in the operation and maintenance of the compressor. Training shall include suggested maintenance, inspection, replacement of moving parts, etc.

## **E47. INSTALLATION OF SAMPLING EQUIPMENT**

### **E47.1 General**

- (a) This section specifies the installation of wastewater effluent sampling equipment that is being supplied by the Owner for installation in the SEWPCC Effluent Sampling Station. The sampling equipment will draw samples from the pumped recirculation water line, controlled by signal from the controller on the basis of elapsed effluent flow volume increments. The sampling device will periodically pull samples from the recirculating water loop and will automatically deposit those samples immediately into a sample container in the refrigerator.

A second sampling area is identified as the Manitoba Conservation Effluent Sampling Station and is located on the wet side of the building. This sampling station is set up for a mobile sampler, either an ISCO model 6712 or ISCO model 3700 sampler. The mobile sampling equipment draws liquid from the pumped recirculation water line described above. The sample line is equipped with a pressure reducing valve, three valve and an air clean out. A signal from the controller will initiate the pump and activate the mobile sampler. The sampler with activated the three way for line flushing via the input / out alarm box and then change the three way valve for sampling.

- (b) Related Requirements:
  - (i) General Conditions and Supplemental Conditions
  - (ii) Electrical and instrumentation specifications
  - (iii) Mechanical general specifications
  - (iv) Process mechanical piping and valve specifications
  - (v) Specifications for the air compressor
  - (vi) Specification for Refrigerator.
- (c) Sampling Equipment Documentation
  - (i) The manufacturer's documentation for the sampling equipment being provided by the Owner is included in Appendix C to these specifications. Those documents include Installation and Maintenance Manual and assembly and parts diagrams.
- (d) Submittals
  - (i) The Contractor shall submit a record drawing and diagrams of the installed sampling equipment showing compressed air connections, controls and control wiring, and actuators.
  - (ii) The Contractor shall submit a record drawing and diagrams of the installed Manitoba Conservation sampling equipment showing compressed air connections, valves, controls and control wiring, and actuators.
- (e) Quality Assurance Control
  - (i) The Owner is providing the sampling equipment.

**E47.2 Products Supplied by the City of Winnipeg**

(a) **Manufacturer and Model:**

- (i) In2 Process Quantum Sampler for 5 cc to 50 cc sample volumes. Design samples will be 25 cc volumes.

(b) **Appurtenances:**

- (i) Sample Spool assembly

**E47.3 Execution:**

(a) **Delivery**

- (i) The City will provide for unloading and storage of the sampling equipment on the site of the Work.

(b) **Install and thoroughly clean the sampler following the manufacturer's instructions.**

(c) **Install Manitoba Conservation sampler equipment and set pressure reducing valve to 68 kPa (10 PSI)**

(d) **Testing**

- (i) Field test the sampler in presence of the Contract Administrator to demonstrate the installation is correctly completed.
- (ii) Test the sampler as described in the mechanical equipment testing specification and the manufacturer's instructions.
- (iii) Loan a mobile ISCO model 6712 sampler and ISCO model 3700 sampler for the field testing of the Manitoba Conservation sampler equipment. Demonstrate that the system is able to collect a suitable hourly sample over an 8 hour period for each sampler model.

(e) **Training**

- (i) The City has personnel experienced in the operation and maintenance of the sampling equipment, and will coordinate training for the SEWPCC operational personnel

**E48. REFRIGERATOR**

E48.1 Refrigerator supplied by the City and installed by the Contractor.

**E49. ELECTRICAL WORK**

E49.1 Specifications E49 to E66 pertain to the construction of the Electrical Works.

**E49.2 Measurement and Payment**

- (a) Specifications E49 to E66 will be measured for payment on a cumulative unit basis and paid for at the Contract Unit Price for "Electrical Works". Payment will be made for the Electrical Works constructed in accordance with this specification, accepted and measured by the Contract Administrator.

**E50. ELECTRICAL SCOPE OF WORK**

**E50.1 Description**

- (a) A brief but not necessarily all inclusive list of electrical work to be performed under this contract is given herein.
- (b) The Contractor shall supply all labour, material, equipment, transportation, services and facilities necessary to make, test and place into operation a complete electrical installation as shown on the drawings and/or as specified herein.



- (c) Where the term "provide" is used herein, it shall mean "supply, install, adjust, test and place into operation".
- (d) All systems shall be completely assembled, adjusted, tested and demonstrated to be ready for operation to the satisfaction of the Contract Administrator.
- (e) The Contractor shall satisfy himself as to working space, storage space, access facilities and all other conditions pertaining to the Site, relating to the conduct of his operations, by the inspection of the Site and examination of the drawings.
- (f) Refer to electrical drawings E0001, E0002, and E0003.
- (g) Provide and install direct buried conduits and fiber optic between UV Building and Effluent Sampling Facility.
- (h) Provide and install one 90 A, 600V, 3P breaker in Panel A in UV Building electrical room.
- (i) Provide and install one fiber converter in Panel C in UV Building electrical room. Connect fiber media converter to existing Modicon Modbus Plus Bridge Multiplexer.
- (j) Provide and install electrical/instrumentation equipment as indicated on drawings and specifications – Panel A, Panel B, distribution transformer, disconnect switches, lighting switches, emergency/exit lights, receptacles, door contacts, unit heaters, sample pump enclosed motor starter enclosure and main control panel.
- (k) Make connections between main control panel and:
  - (i) Flow meter control panel.
  - (ii) Sampler control panel.
  - (iii) Sample pump enclosed motor starter enclosure.

#### E50.2 Extent of Work

- (a) This work shall consist of furnishing of all labour, material, equipment and all incidentals required for the new Effluent Sampling Facility and all associated works.
- (b) Provision of new electrical system as required.
- (c) Wire to and make connections to, all electrical power and control items required, including motors, controls, etc.

#### E50.3 General

- (a) All work to be carried out by qualified journeymen of the related trades.

#### E50.4 Installation

- (a) Install to make a complete and working system.

### **E51. GENERAL ELECTRICAL PROVISIONS**

#### E51.1 Scope

- (a) Refer to E50 - Electrical Scope of Work for general description of electrical work to be carried out under this Contract.

#### E51.2 Examination of Drawings

- (a) The electrical drawings do not show all architectural, mechanical and structural details. All electrical schematics are shown diagrammatically unless otherwise noted. The Contractor shall review the mechanical and structural drawings to obtain building dimensions and details. Verify dimensions accurately by measurements.
- (b) To change the location of electrical equipment, submit a request in writing to the Contract Administrator for approval. If approved, such changes are to be made at no additional cost to the City.
- (c) No extra will be allowed for any additional labour or materials required for relocation of equipment due to interference with equipment of other trades, beams, joists, walls, etc.

### E51.3 Approved Design and Installation

- (a) Equipment and material to be of approved design and manufactured in accordance with all governing regulations such as "Canadian Standards Association", "Canadian Electrical Code", "Provincial Department of Labour", "Underwriters Laboratory", etc. Equipment and material must bear applicable acceptance labels of all associations and governing bodies recognized by the municipal, provincial and federal authorities.
- (b) Install equipment in strict accordance with manufacturer's recommendations and governing rules, regulations and codes.
- (c) Where requirement conflict occurs, install all materials in accordance with the most severe requirements.
- (d) Material installed under this Division to be new and of uniform construction.
- (e) All installation to ensure maximum headroom, minimum interference with free use of surrounding areas, and best access to equipment.
- (f) To deviate major service runs from the location shown on the drawings, submit to the Contract Administrator suitable drawings showing such deviations together with reasons for deviations and obtain approval from the Contract Administrator before proceeding with the installation.

### E51.4 Codes and Standards

- (a) Install all equipment in accordance with current editions of CSA 22.1 and 22.2, including all local amendments unless otherwise specified.
- (b) Perform all work in accordance with drawings, specifications, applicable municipal and provincial regulations, and any pertinent inspection bulletins issued by the electrical inspection authority having jurisdiction over the installation. In no instance shall the standard established by the drawings and specifications be reduced.
- (c) Provide a copy of all standards referred to in this Section for use on Site.

### E51.5 Permits, Inspections and Fees

- (a) Deliver to the Contract Administrator all necessary interim and final certificates of inspection and approval which may be required by all inspection authorities having jurisdiction over the Work, as evidence that the Work installed conforms with the laws and regulations of all governing authorities.
- (b) Submit copies of all plans and specifications to the authority having jurisdiction for inspections as may be required prior to commencement of work to comply with the above.
- (c) Notify the inspection authorities in sufficient time for them to arrange to inspect the Work.
- (d) Pay all associated fees.

### E51.6 Abbreviations

- (a) Abbreviations for electrical terms shall be to CSA Z85-1983.
- (b) Names used throughout these specifications are:
  - (i) EEMAC                      Electrical & Electronic Manufacturers Association of Canada (formerly CEMA)
  - (ii) CSA                         Canadian Standards Association
  - (iii) FM                         Factory Mutual
  - (iv) NEMA                      National Electrical Manufacturers Association (U.S.)
  - (v) JIC                         Joint Industry Conference
  - (vi) IPCEA                     Insulated Power Cable Contract Administrators Association
  - (vii) ISA                        Instrument Society of America

(viii)	CEC	Canadian Electrical Code
(ix)	IEEE	Institute of Electrical and Electronic Contract Administrators
(x)	IES	Illuminating Contract Administrating Society
(xi)	NBC	National Building Code
(xii)	ANSI	American National Standards Institute

#### E51.7 Record Drawings

- (a) Submit record drawings in accordance with General Requirements.
- (b) The Contractor shall record all changes made during construction and provide record drawings to the City upon completion of the Work.
- (c) At the completion of the project, the Contractor shall submit one (1) set of record drawings on disk, accurately recording all changes, deviations and relocations necessitated by job conditions and equipment approved shop drawings all done on CADD using AutoCad Release 2007 or later to the satisfaction of the Contract Administrator.
- (d) Include with the record drawings a list for each motor indicating motor or equipment number and name, nameplate voltage, horsepower and current, the size of overload and breaker or fuse protection provided.

#### E51.8 Definitions

- (a) The following are definitions of terms and expressions used in the specification:
  - (i) "Inspection Authority" means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on Site.
  - (ii) "Supply Authority" means electrical power company or commission responsible for delivery of electrical power to project.
  - (iii) "Electrical Code" means Canadian Electrical Code C22.1 or code in force at project location.
  - (iv) "Indicated" means as shown on contract drawings or noted in contract documents.
- (b) Refer to CSA C22.2 No.0 for "Definitions and General Requirements".

#### E51.9 Cooperation and Coordination

- (a) Schedule expediting of all materials and execution of the Work.
- (b) Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 galvanized steel pipe, sized for free passage of conduit, and protruding 50 mm (2").
- (c) Cables, conduits and fittings to be embedded or plastered over neatly and close to building structure so furring can be kept to a minimum.
- (d) Arrange for holes through exterior walls and roof to be flashed and made weatherproof.

#### E51.10 Source Quality Control

- (a) Arrange for a plant inspection by Contract Administrator where specified.
- (b) Inform Contract Administrator of manufacturing progress and arrange inspections at appropriate times.
- (c) Action required by factory inspection shall not be construed as final acceptance.
- (d) Obtain a Certificate of Acceptance from the inspection authority on completion of the Work and provide it to the Contract Administrator.
- (e) The Contract Administrator may carry out inspections and prepare deficiency lists for action by the Contractor, during and on completion of project.

#### E51.11 Guarantee

- (a) Guarantee all work of the specification against all defects and labour and materials.

#### E51.12 Care, Operation and Start-Up

- (a) Instruct the City's operating personnel in the operation, care and maintenance of equipment.
- (b) Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, test, adjust, balance and calibrate components.
- (c) Provide these services for such period, and for as many visits as necessary, to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

#### E51.13 General

- (a) All materials shall be fully approved by the Canadian Standards Association (CSA) for use as installed and meet the requirements of this specification in all respects.
- (b) Where there is no alternative to supplying equipment which does not have CSA approval, submit such equipment to Provincial Hydro inspection authorities for special inspection and obtain approval. Pay all associated fees.
- (c) Materials and equipment shall be of Canadian manufacture except where specified otherwise or where Canadian made materials or equipment do not exist.
- (d) Where two or more units of the same class or type of equipment are required, the units shall be the product of a single manufacturer, although components of equipment need not be products of the same manufacturer.
- (e) Use material and equipment available from regular production of manufacturer.
- (f) Control panels and component assemblies to be shop manufactured.

#### E51.14 Finish

- (a) Finish metal enclosure surfaces by removing rust and scale, cleaning, and applying rust resistant primer inside and outside with at least two coats of finish enamel.
- (b) Paint all outdoor electrical equipment "equipment green" finish to EEMAC-Y1.
- (c) Paint all indoor switchgear and distribution enclosure "light grey" to ASA 61 grey.
- (d) Clean, prime and paint exposed hangers, racks, fastenings, etc., to prevent rusting.

#### E51.15 Voltage Ratings

- (a) Operating voltages to be within those defined in CSA Standard C235-1969.
- (b) All motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment must be able to operate in extreme operating conditions established in above standard without damage to equipment.

#### E51.16 Wiring Terminations

- (a) Lugs, terminals, screws used for termination of wiring must be suitable for copper conductors.

#### E51.17 Enclosures

- (a) Minimum enclosure type to be used is EEMAC 12 unless otherwise specified.

#### E51.18 Manufacturers and CSA Labels

- (a) Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed.

#### E51.19 Warning Signs

- (a) Provide warning signs with suitable background color and lettering as required to meet requirements of inspection authorities and Contract Administrator. Use decal signs, minimum size 178 mm x 250 mm.

#### E51.20 Plywood Mounting Boards

- (a) Surface wall mounted panelboards and other electrical equipment shall be installed on plywood mounting boards. Boards shall be provided under this section of the specifications, sized to suit equipment indicated and/or implied.
- (b) Plywood mounting boards shall consist of 20 mm fir plywood fastened securely to wall.
- (c) Plywood mounting boards, strapping and trim shall be treated with wood preservative prior to installation and painted with one coat of primer and two coats of grey enamel ASA61. Painting shall be completed before any electrical equipment is mounted on the plywood.
- (d) Service entrance equipment shall be spaced from the plywood mounting boards to the satisfaction of the inspection authorities.

#### E51.21 Workmanship

- (a) Where sheet metal enclosures are not provided with knockouts, Greenlee punches shall be used in all cases. Cutting torches shall not be used for making holes.

#### E51.22 Installation

- (a) Determine manufacturers' recommendations regarding storage and installation of equipment and adhere to these recommendations.
- (b) Check all factory joints and tighten where necessary to ensure continuity.

#### E51.23 Mounting Heights

- (a) Mounting height of equipment is given from finished floor to top of equipment.
- (b) Exact mounting height of unnoted equipment must be verified with Contract Administrator before proceeding with installation.
- (c) Install electrical equipment at heights listed below unless otherwise indicated. (All heights in millimetres from finished floor unless indicated):
  - (i) Local Switches: 1420
  - (ii) Wall Receptacles: 450
  - (iii) Lighting Panels: 1800
  - (iv) Cabinets: 1800
  - (v) Emergency Lights: 2400 (minimum)
- (d) All dimensions indicated are to the top above finished floor elevations.

#### E51.24 Special Protection

- (a) Accept the responsibility to protect those working on the project from any physical danger due to exposed electrically energized equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts "LIVE - 600 VOLTS" or with the appropriate voltage.
- (b) Arrange for the installation of temporary doors, barriers, etc., for all electrical equipment. Keep these doors locked at all times except when under direct supervision.

#### E51.25 Fireproofing

- (a) Where sleeves or openings are installed in walls, floors, roof or partitions to accommodate raceways, cables or bus duct, provide all necessary seals, fittings, barriers and fire-resistant materials to restore the installation to its original fire rating to the satisfaction of the Contract Administrator and the City's insurance underwriters.

#### E51.26 Equipment Identification

- (a) Supply and install identification nameplates on all equipment such as motor starters, safety switches, panelboards, pushbutton stations, etc. and any equipment not so supplied. All nameplates shall be securely fastened to equipment with galvanized steel screws.
- (b) All identification nameplates, except for motors, shall be laminated phenolic with minimum 6 mm (1/4 inch) black letters on white background, the wording of which shall be identical to that on the single line diagrams and the title of the equipment controlled. Motor nameplates to be of non-corroding metal stamped or engraved with black lettering on light background.
- (c) Warning nameplates shall be laminated phenolic with minimum 6 mm (1/4 inch) white letters on red background, the wording to be reviewed by the Contract Administrator. All warning nameplates to be screwed to equipment.
- (d) Warning nameplates required by inspection authorities shall be provided for all electrical switchgear and equipment and on access doors to electrical rooms, vaults, switchyards, etc. in accordance with the applicable Code regulations. Obtain all necessary details from the inspection authorities.
- (e) Where wording not specified on the drawings, obtain exact wording from the Contract Administrator.
- (f) Identify pull boxes, terminal cabinets and junction boxes enclosing cables or connections with nameplates indicating voltage, box number and circuit number.
- (g) Provide junction boxes, relay panels and miscellaneous equipment energized from two or more sources with a warning nameplate prominently displayed, noting number and location of sources and their voltage.
- (h) Provide a typewritten circuit directory with a clear plastic cover for each panelboard in a suitable holder on the inside of each panel door. Unless otherwise noted, the directory shall indicate breaker or switch circuit number, rating, load description and associated load data.
- (i) Manufacturer's nameplates and CSA labels to be visible and legible after equipment is installed.
- (j) Welding receptacle shall be 60A, 600V, 3 pole, 3 wire with threaded cap. Acceptable manufacturer is Crouse-Hinds No. AR337.

#### E51.27 Wiring Identification

- (a) Provide permanent indelible identifying markings, either numbered or colored plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and identification throughout system, i.e. panelboards, starters, terminal blocks, disconnect switches.
- (b) Maintain identification system at all junction boxes, splitters, cabinets and outlet boxes.
- (c) Use color coded wires in communication cables, matched throughout system. All color coding must adhere to CSA C22.1.

#### E51.28 Touch-Up Painting

- (a) Be responsible for field touch-up painting of all shop painted electrical equipment installed in this Contract.
- (b) All surfaces to be painted shall be dry, clean, free from dust, dirt, grease, frost, rust, loose crystals or extraneous matter, tool and machine marks. Feather out edges of scratch marks to make patch inconspicuous.
- (c) Apply one or more coats of paint until the damaged surface has been restored to original finish condition. Do not apply succeeding coats until preceding coat is dry and hard. Sand lightly between coats with No. 00 sandpaper.
- (d) Be responsible for obtaining the necessary touch-up paint of the original type and quality from the equipment manufacturer.

- (e) Supervise priming and finish painting of all electrical equipment and material not shop painted.

#### E51.29 Sleeves and Openings

- (a) Provide sleeves and openings for exposed conduits, busways, and wireways, where they pass through walls or floors conforming to relevant fire codes where applicable.
- (b) Sleeves for individual conduits shall be galvanized or stainless steel.
- (c) Pack or fill sleeves and openings after the completed work is in place. Filling shall provide a waterproof seal to prevent leakage of water or other liquids through the sleeve or opening.
- (d) Sleeves and openings shall not displace reinforcing steel, and shall receive approval of the Contract Administrator prior to placement.

#### E51.30 Cutting and Patching

- (a) Do all drilling, cutting, fitting and patching necessary for the running and securing of conduits, wireways, and other electrical equipment.
- (b) Provide supports necessary for same.
- (c) Provide bracing and anchorage of work subject to Contract Administrator's approval.
- (d) No cutting of the structural members or of the fireproofing shall be done without the written consent of the Contract Administrator.
- (e) Caulk and flash all conduits passing through walls, roofs or other surfaces exposed to weather or as indicated on the drawings to prevent the passage of water and/or sewer gases.

#### E51.31 Hangers and Supports

- (a) Provide hangers, angles, channels, and other supports necessitated by field conditions to install all items of electrical equipment. Design of supports and methods of fastening to building structures shall be subject to the Contract Administrator's approval.
- (b) All local motor control devices are to be grouped and mounted on a free-standing frame of galvanized steel construction easily accessible and as close to the motor as possible.
- (c) Provide weight-distribution facilities, where required, so as not to exceed the load-bearing capacities of floors or walls that bear the weight of, or support, electrical items.
- (d) Paint all exposed parts of hangers and supports with an anti rust inhibiting primer.
- (e) Equipment shall not be held in place by its own weight. Provide base anchor fasteners in each case.

#### E51.32 Protection of Equipment

- (a) Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps.
- (b) Fixtures, materials, equipment, or devices damaged prior to final acceptance of the Work shall be restored to their original condition or replaced by the Contractor.

#### E51.33 Testing of Electrical Systems

- (a) General
  - (i) Prior to the Contract Administrator's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Contract Administrator to ensure that the operation of the system and components satisfy the requirements of the Specifications.
  - (ii) Ensure that the system and its components are ready prior to the inspection and test for acceptance.
  - (iii) All testing shall be conducted by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Contract

Administrator. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the City. Submit six copies of the test certificates to the Contract Administrator. Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

- (iv) Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.
- (v) Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.
- (vi) Supply the necessary labour and for all electrical systems equipment for operational tests required and make final adjustments to the electrical controls at no additional cost to the City.
- (vii) Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.
- (viii) Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.
- (ix) Supply all instruments, meters and personnel required for the tests.

#### E51.34 Cable and Wire 1000 Volt and Below

- (a) Tests on cables in this voltage range shall be limited to insulation resistance measurements using a 500V megger for systems up to 350V and a 1000V megger for 351-600V systems.
- (b) Record all test results in a log book and submit to the Contract Administrator for reference. Replace or repair all circuits which do not meet minimum requirements specified in the CEC, Table 24. Insulation resistance of the following circuits shall be measured:
  - (i) Power, lighting and motor feeders (with equipment disconnected): phase-to- phase, phase-to-neutral and phase-to- ground.
  - (ii) Control circuits: measure to ground only.
  - (iii) Do not perform megger tests on control circuits containing transistorized or solid-state components.
  - (iv) Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

#### E51.35 Ground System

- (a) Test the grounding system efficacy for compliance with CSA Standard C22.1 and Supply Authority requirements. Verify that the ohmic resistance values specified therein are not exceeded.
- (b) Notify inspection and supply authorities that they may be present to witness Contractor testing and provide any assistance required by these authorities for their own testing procedures.

#### E51.36 Training

- (a) Provide for the training of the City's representatives in the operation, maintenance and testing of all systems and equipment including the provision of qualified manufacturer's technical representatives for specialized systems.
- (b) Provide these services for such period, and for as many visits as necessary to put installation in working order, and to ensure that operating personnel are conversant with all aspects of its care and operation.



## **E52. CONDUIT, CONDUIT FASTENINGS AND CONDUIT FITTINGS**

### **E52.1 Scope**

- (a) Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install a complete conduit raceway system. The raceway systems shall be comprised of the supply and installation of all conduits, fittings, supports, hangers and miscellaneous support materials and hardware required.

### **E52.2 Quality Assurance**

- (a) Rigid PVC (Unplasticized) conduit to CSA C22.2 No. 211.2-M1984. Liquid-tight flexible metal conduit to CSA C22.2 No. 56-1977.

### **E52.3 Location of Conduit**

- (a) The drawings do not show every specific conduit run. All wiring shall be surface or run in the slab unless otherwise indicated in the specifications and/or shown on the drawings. All devices shall be surface mounted type except as shown.

### **E52.4 Conduits**

- (a) Conduit shall be Rigid metal and epoxy coated conduit. Minimum size to be 20 mm.
- (b) Liquid-tight flexible metal conduit for motor and equipment connections.
- (c) EMT conduit shall not be utilized anywhere in the installation.

### **E52.5 Conduit Fastenings**

- (a) Two hole PVC straps to secure surface conduits.
- (b) Beam clamps to secure conduits to exposed steel work.

### **E52.6 Conduit Fittings**

- (a) Couplings, terminal adapters, female adapters shall be of the IPEX type of equal. PVC fittings shall be installed in all areas.

### **E52.7 Expansion Fittings for PVC Conduit**

- (a) All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately 450 mm in length between the PVC conduit and the outlet box or device which is being supplied. All conduits, bus duct, wireways, etc., passing through or across expansion joints of the building shall be installed with the use of approved expansion fittings.

### **E52.8 Fish Cord**

- (a) Polypropylene

### **E52.9 General Installation Requirements**

- (a) Install surface mounted conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- (b) Cut conduit ends square and ream to remove burrs and sharp edges. Ensure that conduits butt in couplings and other fittings.
- (c) Bends and offsets shall have a minimum radius of curvature not less than the minimum bending radius of the cable to be installed.
- (d) Temporarily plug all conduits terminating in cabinets and boxes where moisture and foreign matter may enter.
- (e) Blow all conduits through with clean compressed air to clear all foreign matter and moisture prior to the installation of wires or cables.
- (f) Install fish cord in all conduits.

- (g) Group exposed conduits together wherever possible and run parallel to building lines, supported from structural members and protected by the flanges of the structural member where practical.
- (h) Support horizontal and vertical runs of individual exposed conduits by one-hole or two-hole conduit straps and suitable fasteners or beam clamps for mounting to building structure or bracket. Make no holes in building structural members for supporting conduits without the permission of the Contract Administrator.
- (i) Securely fasten exposed conduits in place at regular intervals with hangers, supports or straps. Provide additional supports at each elbow and terminations at a box or cabinet.
- (j) Perforated metal straps used to support conduits are unacceptable.
- (k) Install conduits at least 150 mm (6") clear of all steam pipes and flues, and 1 m (39") clear of heaters. Do not bend over sharp objects or improperly form.
- (l) The maximum length of straight conduit run shall be 30 M (100 feet) between pull boxes or other terminations. This length shall be reduced by 10 M (32 feet) for each 90 degree bend or 5 M (12.5 feet) for each 45 degree bend or offset. Conduit runs shall not include more than the equivalent of two 90 degree bends between pull boxes except where indicated otherwise on the drawings.
- (m) Where conduits pass through roof, seal with flashing and make weatherproof. For conduits passing through exterior walls, above or below grade, seal with waterproof sealing compound.

## **E53. WIRE AND CABLE**

### **E53.1 Scope**

- (a) Furnish all labour, materials, supervision, equipment and services specified herein, indicated or requested to install the complete wiring system including but not limited to:
  - (i) Low voltage wire and cable (1000 V and below)
  - (ii) Control wiring
- (b) The wiring system shall include all wiring, terminations, wire markers, cable tags, cable ties, splice fittings, insulating tapes, connectors and miscellaneous materials necessary to complete the wiring system.

### **E53.2 Low Voltage Wire 1000 Volt and Below**

- (a) All wire shall have stranded, annealed copper or compact stranded 8000 Series aluminium alloy conductors, 600 volt rating, cross-linked polyethylene (XLPE) insulation, minus 40°C, 90°C maximum conductor temperature, limited flame spread.
- (b) The wiring shall be suitable for installation in wet environment and rated RW-90.
- (c) For direct buried installations or for installation in direct buried polyethylene pipe, the cable shall be cross-linked polyethylene, rated RWU-90.
- (d) Minimum conductor size shall be #12 AWG unless otherwise specified. #14 AWG may be used for control wiring, #6 for aluminium.
- (e) Use GTF fixture wire, 600 volt, 125 C, flexible copper conductor for all connections between lighting fixtures and outlet boxes.
- (f) Color coding of insulated conductors shall conform to the following:

#### **Single Phase Systems**

Phase A	Red
Phase B	Black
Neutral	White

Ground            Green

### **Three Phase Four Wire Systems**

Phase A            Red

Phase B            Black

Phase C            Blue

Neutral            White

Ground            Green

- (g) Insulated ground conductors forming part of a multi-conductor cable assembly shall have green color coding.
- (h) Cable and wire shall be as manufactured by Alcatel Canada Wire Inc., Phillips Cables Ltd., Pirelli Cables Inc., Alcan Cable Inc.

#### **E53.3 Teck Cable/ACWU90**

- (a) Conductors:
  - (i) Grounding Conductor: copper or 8000 series Aluminium.
  - (ii) Circuit conductors: copper or 8000 series Aluminium, size as indicated.
- (b) Insulation:
  - (i) Chemically cross-linked thermosetting polyethylene rated RW90, 600 volt.
- (c) Inner Jacket: polyvinyl chloride material (Teck cable)
- (d) Armor: interlocking aluminium
- (e) Overall covering PVC material, color black, flame retardant, FT4 rated, AG14.
- (f) Fastenings:
  - (i) One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole straps for cables larger than 50 mm. All straps to have inert spacers between spacer and concrete.
  - (ii) Channel type supports for two or more cables.
  - (iii) 3/8" diameter threaded rods to support suspended channels.
- (g) Connectors:
  - (i) Watertight approved for Teck or ACWU90 cables.
- (h) Lugs:
  - (i) Dual rated AL7CU or AL9CU listed by CSA for use with Aluminum or Copper conductors and sized to accept aluminium conductors of the ampacity specified.

#### **E53.4 Wiring Accessories**

- (a) Wire markers, black letters on white background, shall be heat shrink type as manufactured by Critchley.
- (b) Cable markers for cables or conductors greater than 13 mm (1/2 inch) diameter, shall be strap-on type, rigid PVC, black letters on white background, with PVC covered aluminum straps, as manufactured by Electrovert Cat. No. 510.
- (c) Terminal blocks shall be minimum 600 volt rated, modular, sized to accommodate conductor size used, as manufactured by Weidmuller, Phoenix, Allen-Bradley.
- (d) Where screw-type terminals are provided on equipment, field wiring shall be terminated with insulated fork tongue terminals, as manufactured by Thomas & Betts, Sta-Kon.
- (e) Splice connectors for wire sizes #14-10 AWG inclusive, shall be of the compression spring type, as manufactured by Ideal Waterproof Type DP.

- (f) Splice connectors for wire sizes #8 AWG and larger shall be split-bolt type, sized to suit number and size of conductors, as manufactured by Burndy Servit Type KS.
- (g) Cable ties shall be nylon, one-piece, self-locking type, as manufactured by Thomas & Betts, Burndy, Electrovert.
- (h) Electrical insulating tape as manufactured by 3M Scotch 88.
- (i) Cable grips shall be provided for all vertical and catenary cable suspension installations to reduce cable tension at connectors or at cable bends. The cable grips shall be selected to accommodate the type and geometry of cable supported and shall be of the single wave, variable mesh design, as manufactured by Kellems, Arrow-Hart.
- (j) Cable pulling lubricant shall be compatible with cable covering and shall not cause damage and corrosion to conduits or ducts.

#### E53.5 Installation

- (a) Install all wire according to the drawings with a minimum size of #12 AWG unless indicated otherwise.
- (b) Pull wire into ducts and conduits in accordance with the manufacturer's recommendations, using patented wire grips suitable for the type of wire or using pulling eyes to be installed directly onto the conductors.
- (c) Limit pulling tensions to those recommended by the manufacturer to avoid overstressing wire.
- (d) Utilize adequate lubricant when pulling wires through ducts and conduits to minimize wear on cable jackets.
- (e) Make connections to equipment "pig-tails" with mechanical, insulated, screw-on connectors for wire sizes #14-10 AWG. For wire sizes #8 AWG and larger utilize split-bolt connectors, taped with three layers minimum of insulating tape. For both copper and aluminium terminations, wire through the conductor, apply joint compound anti-oxidant, and torque to lug manufacturer's recommended torque levels.
- (f) No splices shall be permitted in cable or wiring runs without the written permission of the Contract Administrator, and shall only be permitted in junction boxes.
- (g) Neutral conductors shall be identified. Paint or other means of coloring the insulation shall not be used.
- (h) Unless otherwise specified, make all wiring taps, splices and terminations with identified compression screw type terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Make connections for interior and exterior lighting circuits and 120 volt, 15 amp convenience receptacle circuits using screw-on or split-bolt connectors and insulating tape.
- (i) Determine the exact length of cable required to avoid splices.
- (j) Identify each conductor by specified markers at each termination indicating the circuit designation or wire number.
- (k) Identify each cable by attaching a suitable marker, stamped or indelibly marked with the cable number, at each end of the cable and in all junction boxes and pull boxes.

### E54. WIRE AND BOX CONNECTORS

#### E54.1 Scope

- (a) This section covers the supply and installation of all wire and box connectors.

#### E54.2 Quality Assurance

- (a) Solder lugs to CSA C22.2 No. 19-1935 (R1981).
- (b) Wire connectors to CSA C22.2 No. 65-M1988.
- (c) Connectors shall be copper or copper alloy.

- (d) Bushing stud connectors to EEMAC 1Y-2-1961 and shall be suited for conductor type.
- (e) Clamps or connectors for cable to CSA-C22.2 No. 18, 1972.

#### E54.3 Materials

- (a) All lugs, terminals and screws used for termination of wiring must be suitable for copper conductors.
- (b) Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- (c) Fixture type splicing connectors: with current carrying parts of copper sized to fit copper 10 AWG or less.
- (d) Clamps or connectors for flexible conduit, as required.
- (e) All cable terminations shall be with compression type connectors.

#### E54.4 Installation

- (a) Remove insulation carefully from ends of conductors.
- (b) Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65-M1988.
- (c) Install fixture type connectors and tighten. Replace insulating cap.
- (d) Install crimp type connectors to the satisfaction of the Contract Administrator.
- (e) Install box connectors to CSA requirements.

### **E55. FASTENINGS AND SUPPORTS**

#### E55.1 Scope

- (a) This section covers the supply and installation of all fastenings and supports for equipment mounted under the electrical contract.

#### E55.2 Materials

- (a) Expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions shall not be used. All fastenings used shall be corrosion resistant stainless steel.
- (b) Power-actuated fasteners and devices shall not be used.
- (c) Support channels, length as required, U shaped, size as required, of stainless steel.
- (d) Support equipment, conduit or cable clips, spring loaded bolts, cable clamps etc., to be purpose-built accessories to basic channel members.
- (e) Two-hole PVC straps to secure surface conduits 50 mm and smaller.
- (f) Beam clamps to secure conduit to exposed steel work.
- (g) Support individual cable or conduit runs with 6.0 mm diameter galvanized steel threaded rods and spring clips.
- (h) Support two or more cables or conduits on channels supported by 6.0 mm diameter stainless steel threaded rod hangers where direct fastening to building construction is impractical.

#### E55.3 Installation

- (a) Install fastenings and supports as required for each type of equipment, cables and conduit to manufacturer's installation recommendations.
- (b) Provide metal brackets, frames, hangers, clamps and related support structures where indicated or as required to support conduit and cable runs.
- (c) Do not use wire lashing or perforated strap to support or secure raceways or cables.

- (d) Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- (e) Do not use supports of other equipment installed for conduit or cable support except with permission and approval of the Contract Administrator.
- (f) Any aluminum support bracket or channel that is in direct contact with concrete is required to have inert spacers to reduce chemical reaction between support and concrete.

## **E56. OUTLET PULL, SPLITTER AND JUNCTION BOXES**

### **E56.1 Scope**

- (a) Furnish all labour, materials, equipment and services specified, indicated or requested to install the electrical boxes specified herein and on the drawings.

### **E56.2 Outlet Boxes**

- (a) Size boxes in accordance with CSA C22.1-1986.
- (b) 100 mm square or larger outlet boxes as required for special devices.
- (c) Gang boxes where wiring devices are grouped.
- (d) Blank cover plates for boxes without wiring devices.
- (e) Outlet boxes to be PVC.
- (f) All outlet boxes shall be supplied with ground stud.
- (g) Outlet boxes to be Series FS or FD as manufactured by Ipex.
- (h) Surface mounted outlet boxes shall be EEMAC 12 unless otherwise indicated.
- (i) All outlet boxes to CSA C22.2 No. 18-M1987.

### **E56.3 Installation**

- (a) Install boxes to clear all building and mechanical services equipment. Where two or more devices are shown at one location, utilize multi-gang boxes. Supply all outlet boxes with covers as required.
- (b) Size all boxes to accommodate the number of conduits, conductors and terminal blocks. Provide junction boxes with 20% spare terminal blocks.
- (c) Securely fasten surface-mounted boxes to the building or mounting structure and support independently of the conduits entering the box.
- (d) Install junction and pull boxes mounted on brick, concrete or block walls with 3 mm (1/8 inch) thick lead or nylon washers between box and wall face.
- (e) Provide pull boxes sized to CEC requirements, in all conduit raceway systems to limit length of straight conduit runs to 30 m (100 ft). Reduce this length by 7.5 m (25 ft) for each 90 degrees bend or 4 m (12 ft) for each 45 degree bend or offset.
- (f) Mark location and size of all pull boxes on the record drawings.

### **E56.4 Application**

- (a) Location of outlets indicated may be changed by the Contract Administrator at no extra cost or credit, providing distance moved does not exceed 3000 mm, and notice is given before installation is completed.

### **E56.5 Mounting Heights**

- (a) Refer to General Electrical Provision.
- (b) Exact mounting height of unnoted equipment must be verified with the Contract Administrator before proceeding with installation.

## **E57. WIRING DEVICES**

### **E57.1 Scope**

- (a) This section covers the supply and installation of all receptacles, toggle switches, and cover plates.
- (b) All wiring devices shall be at the same manufacturer throughout the Contract.

### **E57.2 Receptacles**

- (a) This specification applies to single and duplex receptacles and receptacles of other voltage and ampacity as indicated on the drawings.
- (b) Type EEMAC 5-15R, 125V, 15A, U-ground, heavy duty specification grade to CSA C22.2 No. 42-M1984.
- (c) Receptacle shall have heavy duty nylon face with steel reinforcing plate in centre.
- (d) Receptacle shall have spring loaded back wiring.
- (e) Receptacle shall have raised ground for safety.
- (f) Receptacle contacts shall have spring steel clips to reduce contact fatigue.
- (g) Receptacle shall be suitable for No. 10 AWG back and side wiring.
- (h) All screws shall be combination slotted socket head design to accept #6 socket head screwdriver on all screws.
- (i) Acceptable manufacturer is Bryant, Arrow Hart, Levton No. 5262 duplex receptacle.

### **E57.3 Switches**

- (a) Switches shall be 15A, 120V, single pole, double pole, or three way as indicated on the drawings.
  - (i) Must adhere to CSA 22.2 No. 111-M1986.
  - (ii) Switches to be manually-operated heavy duty with the following features:

#### **Heavy duty mounting strap**

One piece Lexan toggle, lever, and cam

Silver alloy contacts

Spring loaded back wired

Green hex head grounding terminal

All screws socket/slotted head suited to accommodate #6 socket head screwdriver

Switches to be fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

Acceptable manufacturer is Bryant, Arrow Hart, Leviton No. 1201 (number to suit application and amperage).

### **E57.4 Cover Plate**

- (a) Cover plates from one manufacturer throughout project to match switches and receptacles.
- (b) Cover plates to be PVC.
- (c) For wiring devices mounted in flush-mounted outlet boxes, thickness to be 2.5 mm.
- (d) Cover plates shall be suitable for Ipex FS/FD boxes.
- (e) Acceptable manufacturer is Ipex.

### **E57.5 Weatherproof Cover Plates**

- (a) Weatherproof covers for duplex receptacles shall be self closing, two spring loaded independent doors, PVC complete with non-corrosion stainless steel springs and stainless steel mounting screws.

- (b) Weatherproof covers for light switches shall be plunger style, PVC complete with non-corrosive stainless steel mounting screws.
- (c) Covers shall be complete with EPDM gasketry material suitable for -45°C to 85°C.
- (d) Acceptable manufacturers are IPEX, Leviton.

#### E57.6 Installation

- (a) Switches:
  - (i) Install single throw switches with handle in "UP" position when switch is closed.
  - (ii) Utilize gang type outlet box where more than one switch is required in one location.
- (b) Receptacles:
  - (i) Install all 15A receptacles with "U" ground slot up.
  - (ii) Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - (iii) Mount receptacles at height specified in Section 16010 or as indicated.
  - (iv) The location of all outlets as shown on the electrical plans is approximately correct at the time of planning, but as these drawings do not show all structural details, measure any work requiring accurate dimensions either on the project or from the architectural details.
  - (v) The location of outlets shown on the drawings may be changed by the Contract Administrator at no extra cost to the City, providing the distance does not exceed 3000 mm and the information is given before installation.
- (c) Cover Plates:
  - (i) Install all cover plants prior to energization.
  - (ii) Cover plates shall be straight and true.
  - (iii) Flush-mounted cover plants shall be flush with the wall.
  - (iv) Do not use cover plants meant for flush-mounted outlet boxes on surface-mounted boxes.

### **E58. DISCONNECT SWITCHES**

#### E58.1 Scope

- (a) This section covers the supply and installation of all motor and equipment disconnect switches.

#### E58.2 Submittals

- (a) Submit shop drawings in accordance with the general provisions including the following information:
  - (i) Scale drawing of switch and enclosure.
  - (ii) Switch voltage rating.

#### E58.3 Unfused Disconnect Switches

- (a) Provide unfused disconnect switches, voltage and amperage rated to suit loads.
- (b) Disconnect shall be front-operational, heavy duty, industrial grade, quick-make, quick-break type.
- (c) Make provision for padlocking in the "OFF" position.
- (d) Mechanically interlocked door to prevent opening when handle in "ON" position.
- (e) "ON/OFF" switch position indication on switch enclosure cover.
- (f) Disconnect enclosures shall be EEMAC 12 unless otherwise indicated.



**E58.4 Manufacturers**

- (a) Disconnects for all equipment specified shall be as manufactured by Cutler-Hammer HD series.

**E58.5 Installation**

- (a) Install disconnect switches as per manufacturer's recommendations.
- (b) Mount switches at 1400 mm above finished floor to the underside of the switch enclosure.

**E58.6 Identification**

- (a) Provide lamacoid nameplates on front face of switch identifying equipment.

**E59. GROUNDING**

**E59.1 Scope**

- (a) Furnish all labour, materials, equipment and services specified, indicated or requested to install a complete grounding system. The grounding system shall include ground rods, all wiring, ground bus, thermit welds, mechanical fittings, connectors, links and miscellaneous materials necessary to complete a grounding system acceptable to the inspection authorities.

**E59.2 Quality Assurance**

- (a) Grounding equipment to CSA C22.2 No. 41-M1987.
- (b) Copper grounding conductors to ASA A7.1 1964.

**E59.3 Ground Conductors**

- (a) Ground conductors shall be concentric stranded, soft drawn copper. Insulated conductors, where required by inspection authorities or specified, shall be type TW, 600 volt rating, green color.
- (b) Where direct buried bare ground conductor comes into contact with corrosive material, the conductor shall be tinned.

**E59.4 Ground Clamps**

- (a) Ground clamps for connecting ground conductors to metal water piping not suitable for thermit weld connections shall be sized to accommodate the system ground conductor and the water pipe, as manufactured by T & B, Burndy.

**E59.5 Compression Connections**

- (a) Compression devices shall be of pure wrought copper material, factory fitted with oxide inhibiting compound and shall meet latest IEEE 80 Standard, as manufactured by T & B, Burndy.

**E59.6 Mechanical Connections**

- (a) Mechanical connectors shall be of bronze, copper or brass construction with stainless steel hardware selected and sized specifically for the particular application and shall meet latest IEEE standard.

**E59.7 Ground Rods**

- (a) Ground rods shall be 19 mm (3/4") diameter, 3 m (10 feet) long, copper clad steel construction with the copper exterior coating permanently bonded to the steel core.

**E59.8 Installation**

- (a) Make all conductor joints, splices and connections with permanent type thermit welds or mechanical compression connectors utilizing hydraulic tools.

- (b) Make ground connections to building steel or flat metallic surfaces with thermit welds. Locate connections where they will not be subject to mechanical damage and, where possible, be accessible for inspection.
- (c) Protect grounding conductors or bus subject to mechanical damage by rigid steel conduit or steel guards which shall be effectively grounded at both ends to the ground conductor they are protecting, regardless of their length.
- (d) Make connections to ground bus using mechanical clamp type connectors.
- (e) Securely bond metal enclosures, motor frames, steel supports for starters, panels, switches, etc., which are not rigidly secured to and in contact with grounded structural steel of a building or conduit system, or which are subject to excessive vibration, to building steel or conduit system with stranded copper conductors.
- (f) Install ground conductors passing through masonry walls, floors, foundations, etc. in 25 mm (1") rigid PVC conduit sleeves. Where sleeves are installed in walls or floors below grade, seal the sleeves watertight after installation of ground conductor.

#### E59.9 Equipment Grounding

- (a) Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steelwork, distribution panels, outdoor lighting, telephone backboard.

#### E59.10 Tests

- (a) Perform tests in accordance with general provisions.
- (b) Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Contract Administrator and inspection authority having jurisdiction.
- (c) Perform tests before energizing electrical system.
- (d) Disconnect ground fault indicator during tests.
- (e) Perform tests in presence of the Contract Administrator.
- (f) Submit written test results to the Contract Administrator.

### **E60. DRY TYPE TRANSFORMERS**

#### E60.1 Scope

- (a) This section covers the supply and installation of all dry type transformers.

#### E60.2 Quality Assurance

- (a) To CSA C22.2 No. 47-1961 and C9-1966
- (b) To C.E.C. Section 26-260 "Marking of Transformers"

#### E60.3 Submittals

- (a) Shop drawings in accordance with the general provisions.
- (b) Voltage ranges and taps
- (c) KVA rating
- (d) Mounting configurations
- (e) Weight
- (f) Cable terminal sizes
- (g) Nameplate data.

#### E60.4 Transformers

- (a) Use transformers of one manufacturer throughout project.

- (b) Transformers to have the following characteristics:
- (c) Type: Epoxy encapsulated
- (d) Three phase, 600V delta connected primary, 120/208V wye connected secondary
- (e) kVA rating as indicated on drawings
- (f) Operating frequency of 60 Hz
- (g) Winding insulation of 1000 V class, 115 degree temperature rise
- (h) Maximum impedance of 5%
- (i) Sound rating of 40 dB
- (j) Basic Impulse Level (BIL) is standard
- (k) Hipot is standard
- (l) Taps 4 – 2 1/2 percent FCAN, FCBN
- (m) Air ventilated via louvres
- (n) Termination at bottom of transformer
- (o) Finish shall be ASA 61 grey

#### E60.5 Manufacturers

- (a) Acceptable manufacturer is Hammond, Square "D", Bemag.
- (b) Mounting wall or ceiling
- (c) Installation to C.E.C. Section 26-248.
- (d) Units shall be wall or ceiling mounted as indicated on drawings.
- (e) Mount transformers in level upright position.
- (f) Units shall be clear of air obstructions on five sides by minimum of 75 mm to ensure adequate ventilation.
- (g) Remove shipping supports only after transformer is installed and just before putting into service.
- (h) Loosen isolation pad bolts until no compression is visible.

#### E60.6 Connections

- (a) Make primary and secondary connections.
- (b) Energize transformers immediately after installation is completed, where practicable.

#### E60.7 Equipment Identification

- (a) Provide equipment identification in accordance with the general provisions.

### **E61. PANELBOARDS**

#### E61.1 Scope

- (a) This section covers the supply and installation of all distribution and power panelboards, including mounting hardware and breakers or fuses.

#### E61.2 Quality Assurance

- (a) All equipment to CSA Standard C22.2 No. 29-M1989.
- (b) Fault current ratings to be indicated on nameplates.

#### E61.3 Submittals

- (a) Submit shop drawings in accordance with the general provisions.

#### E61.4 Panelboards

- (a) Panelboards shall be supplied by one manufacturer.
- (b) 120/208V, 3 phase, 4 wire power panelboard bus and breakers to be rated 10,000 amps (symmetrical) interrupting capacity.
- (c) 347/1600V, 3 phase, 4 wire power panelboard bus and breakers to be rated 18,000 amps (symmetrical) interrupting capacity.
- (d) Panelboard mains, number of circuits, and number and size of branch circuit breakers shall be as indicated on the drawings.
- (e) The main bus bars shall be copper and shall be equipped with solderless lugs for incoming cables. Neutral to be of same ampere rating as mains.
- (f) Distribution section to accommodate circuit breakers. Breakers shall be the interchangeable trip type.
- (g) Doors shall have spring hatches and cylinder locks, and all locks shall be keyed alike with two keys per panelboard.
- (h) EEMAC 12 rated enclosure.
- (i) Distribution panelboard acceptable manufacturer shall be Cutler-Hammer Pow-R-Line Series.
- (j) Power panelboard acceptable manufacturer shall be Cutler-Hammer Pow-R-Line series, Siemens type NDP.

#### E61.5 Circuit Breakers

- (a) Refer to Circuit Breakers for breaker specification.
- (b) Breakers shall be numbered with odd numbers on left and even numbers on right sides of the panel.
- (c) Breakers shall be the bolt-on type and shall provide instantaneous trip on over-currents and time-delay trip on overloads.
- (d) Breakers shall be compatible with fault current rating of the panel.
- (e) Breakers shall be of the thermal magnetic tripping type.
- (f) Main breaker shall be separately mounted on top or bottom of panel to suit cable entry as required. When mounted vertically, down position should open breaker.

#### E61.6 Plant Assembly

- (a) Install circuit breakers in panelboards before shipment.

#### E61.7 Installation

- (a) Locate panelboards as indicated on the drawings and mount securely, plumb true and square.
- (b) Install each panelboard 1980 mm above finished floor measured to the top of the enclosure.
- (c) Install panelboards mounted on brick, concrete or block walls on plywood backboards or use 3 mm thick lead washers between enclosure and wall face. Where practical, group panels on common backboard.
- (d) Make all field wiring connections and terminations. Connect loads to circuits as indicated and connect neutral conductors to common neutral bus with respective neutral identified.

#### E61.8 Equipment Identification

- (a) Provide nameplate for each panelboard engraved as directed.
- (b) Provide complete circuit directly with typewritten legend showing location and load of each circuit.

## **E62. CIRCUIT BREAKERS**

### **E62.1 Scope**

- (a) This section covers the supply and installation of all magnetic and thermal magnetic circuit breakers.
- (b) Specific circuit breaker voltage, phase, ampacity, pole numbers, interrupting capacity, breaker type and setting are indicated elsewhere in the specifications or on the drawings.

### **E62.2 Quality Assurance**

- (a) All equipment to CSA Standard 22.2, No. 5-M1986.

### **E62.3 Submittals**

- (a) Submit shop drawings in accordance with these provisions, including:
  - (i) Component function, make and model no.
  - (ii) Breaker voltage and amperage.
  - (iii) Breaker phase, number of poles & number of wires.
  - (iv) Indication of solid neutral if required.
- (b) Submit time-current characteristic curves for breakers with ampacity of 15 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

### **E62.4 Breakers – General**

- (a) Bolt-on moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- (b) Common-trip breakers with single handle for multipole applications.
- (c) Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- (d) Circuit breakers with interchangeable trips as indicated.

### **E62.5 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.

### **E62.6 Magnetic Breakers**

- (a) Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping.

### **E62.7 Enclosures**

- (a) All breakers shall be housed in an EEMAC 12 rated panelboard or in an MCC cubicle.

### **E62.8 Manufacturers**

- (a) For circuit breakers protecting fans, heating elements, transformers and panelboards, acceptable manufacturer is Schneider Canada Federal Pioneer FHL, Cutler-Hammer Series C, Siemens type SB.
- (b) For circuit breakers protecting electric motors, acceptable manufacturer is Culter-Hammer Series C HMCP.

### **E62.9 Installation**

- (a) Install circuit breakers in panelboard and MCC as indicated.

## **E63. SURGE SUPPRESSORS**

### **E63.1 Scope**

- (a) This section covers the supply and installation of all transient voltage surge suppressors.

### **E63.2 Submittals**

- (a) Submit shop drawings in accordance with General Electrical Requirements including:
  - (i) Unit dimensions, mass, installation instruction details and wiring configuration.
  - (ii) Clamping voltage test data, in a graph form, for a Category B3 ringwave and a Category B3 combination wave, as defined by ANSI/IEEE C62.41 and tested in accordance with ANSI/IEEE C62.45.
  - (iii) Insertion loss test data, in a graph form, over a frequency bandwidth from 0 to 100 MHz and tested in accordance with MIL-STD 220A.
  - (iv) A nameplate showing the electrical ratings, including UL 1449 surge suppression ratings and the UL and CSA monograms, shall be permanently affixed to the unit.

### **E63.3 General Product**

- (a) The transient voltage surge suppressors (TVSS) described by this specification are to be installed in the various panels as indicated.
- (b) All TVSS devices shall be listed under UL 1449 and certified by CSA.

### **E63.4 Specific Product Requirements**

- (a) TVSS device installed on the MCC shall be suitable for a Category C3 environment in accordance with ANSI/IEEE C62.41.
- (b) TVSS device shall be wired in parallel into the electrical system.
- (c) TVSS device shall feature full-cycle tracking clamping profiles that follow the AC sine wave contour for uniform transient voltage surge suppression regardless of phase angle.
- (d) TVSS device circuit shall be a MOV-based, hybrid design; surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform shall be rated and internally fused to a minimum of 100kA in relation to available interrupting capacity (AIC) per phase and provide equal impedance paths to each matched MOV bank. TVSS device design shall not be based on components such as gas tubes, which may crowbar the system.
- (e) The maximum continuous operating voltage (MCOV) shall be greater than 115% of the nominal system operating voltage.
- (f) TVSS devices shall protect against surges between phase and neutral (L-N) and neutral and ground (N-G) in wye configured systems (four-mode TVSS device). TVSS devices for branch panels shall protect against surges between phase and neutral (L-N), phase and ground (L-G) and neutral and ground (N-G) in wye configured systems (seven-mode TVSS device). All delta configured systems shall be protected between phases (L-L) and phase to ground (L-G).
- (g) TVSS devices shall be capable of sustaining a single pulse transient current (based on a single pulse 8 x 20µs waveform specified in IEEE C62.45) of 150 kA in the L-N mode for wye configured systems, or L-L and L-G for delta configured systems, and 50kA in the N-G mode. TVSS devices for branch panels shall be capable of sustaining a single pulse transient current (based on a single pulse 8 x 20µs waveform specified in IEEE C62.45) of 90 kA in the L-N and L-G modes, or L-L and L-G for delta configured systems, and 50kA in the N-G mode.
- (h) Maximum let through voltage shall not exceed the following UL 1449 Classification, for Category B3 ring and combination waves:

Max. Let Through Voltage per Mode	L-N, N-G; L-G (when present)	L-L
120/240 VAC, 1 $\phi$	500	-
120Y/208 VAC	500	-
220 VAC Delta	-	500
220Y/380 VAC	800	-
240 VAC Delta	-	800
277Y/480 VAC	1000	-
347Y/600 VAC	1200	-
480 VAC Delta	-	1500
600 VAC Delta	-	2000

- (i) MI/RFI rejection, measured in accordance with the 50 ohms insertion loss procedures outlined in MIL-STD 220A, shall reflect a minimum noise attenuation of 10 db over a frequency bandwidth from 20 kHz to 10 MHz.
- (j) TVSS device endurance shall meet the UL Category C3 as an adjunct to its TVSS UL listing, consisting in the application of 1000 surges at 30-second intervals with 20 kV full peak voltage values for IEEE Category C3.

**E63.5 Safety and Diagnostic Monitoring**

- (a) TVSS device shall have visual indicators and an audible alarm to advise that the system is active and functioning properly or that TVSS protection has been lost or damaged and that device maintenance or replacement is necessary.
- (b) TVSS device shall include a set of 1 N.O. and 1 N.C. contacts for remote monitoring of device status and be capable of incorporating an optically-coupled sensing circuit option, which will permit monitoring of the TVSS device from a remote site.
- (c) TVSS device shall include a test and diagnostic circuit to ensure proper functioning of the monitoring circuit.

**E63.6 Acceptable Manufacturer**

- (a) All TVSS devices shall be from the same manufacturer.
- (b) TVSS device manufacturer shall provide a full 5 year warranty from the date of installation against any part failure when installed in compliance with the manufacturer's instructions and all applicable national and local electrical codes.
- (c) Acceptable manufacturer for the TVSS devices shall be Leviton No.57120-M3 or approved equal in accordance with B6.

**E63.7 Wiring Requirements**

- (a) All TVSS devices shall be installed in accordance with the applicable sections of the C.E.C. Part I and following the manufacturer's recommended practice. Conductor lead lengths to the TVSS device shall be kept as short as possible, without unnecessary bends. Conductors shall be twisted and tightly bound together. Refer to manufacturer's instructions for required size of conductors.

**E63.8 Externally Mounted TVSS**

- (a) Provide a breaker sized in accordance with TVSS device manufacturer's instructions for connection of TVSS device into panel.

- (b) Maximum conductor lead length between breaker and TVSS device shall not exceed 500mm (18").

#### E63.9 Integrated Distribution Panel Installation

- (a) TVSS device shall be factory-installed into the panelboards and main control panel.

### **E64. LIGHTING FIXTURES**

#### E64.1 Scope

- (a) This section covers the supply and installation of lighting fixtures and lamps.

#### E64.2 General Requirements

- (a) Supply and install where shown and as specified on the drawing, all lighting fixtures c/w suspension devices, lamps and other attachments as specified or required to give the best appearance and mechanical installation.
- (b) All fixtures shall carry the approval of the Canadian Standards Association and/or the approval of the Inspection Department having jurisdiction.
- (c) All fixtures, stem hangers, ballast compartments, canopies, reflectors, wireways, brackets, etc., used in conjunction with the fixtures shall be factory finished, baked white enamel, unless otherwise specified.
- (d) All fixtures which have minor scratches after installation shall be "touched up" with an approved enamel to match the fixture finish to the complete satisfaction of the Contract Administrator.

#### E64.3 Submittals

- (a) Submit shop drawings in accordance with these provisions showing information such as width, depth, finish, etc. of each fixture in addition to all pertinent lamp data.

#### E64.4 Lamps

- (a) Incandescent:
  - (i) Bulb Shapes "A" and "PS", medium base, inside frosted, extended service, minimum 2500 hours rated life, rated 130 volts, wattage as indicated.
- (b) Fluorescent:
  - (i) T8 lamps with minimum CRI85. Fluorescent lamps colour same as Phillips Alto 11 TL841.

#### E64.5 Fluorescent

- (a) Fluorescent ballasts shall be CSA and CBM certified electronics.
- (b) Designed for the operation of lamps in the lighting fixtures as specified, rated 120 volts, 60Hz integrated circuit design for use with one or two F32T8 lamps as indicated.
- (c) Designed to provide over 95% power factor with 95% of rated lamp lumen.
- (d) Non PCB, thermally protected capacitor.
- (e) Class P, automatic reset thermal protector.
- (f) Input:
  - (i) 1-lamp, maximum 32W
  - (ii) 2-lamp, maximum 65W
- (g) Class A sound rating.
- (h) Total harmonic distortion less than 10%.



- (i) Shall meet FCC limits on EM and RF interference.
- (j) Three year warranty from date of substantial completion.
- (k) Acceptable manufacturer is Advance System V or approved equal in accordance with B6.

#### E64.6 Fixture Schedule

##### (a) Type "A"

- (i) Surface fluorescent fixture, fibreglass, enclosed and gasketed, suitable for damp environments complete with 2-32WT8 lamps.

CFI # EE248-120-SO

##### (b) Type "B"

- (i) Outdoor wall mounted metal halide fixture c/w rugged die-cast single-piece housing, 150 W 120 V ceramic metal halide lamp, photocell control. Wall mount fixture 2.4 m from bottom of wall.

KEENE #313-150-LXL-T, c/w #VP300 vandal pack guard and photocell.

##### (c) Type "C"

- (i) Emergency light, supply voltage: 120 V AC, output voltage: 12 V DC, operating time: 60 minutes. Lamp heads: Integral on unit, single and/or double as shown. Remote heads, single and/or double as shown. Lamp type 9 watt high intensity tungsten. Finish: Baked enamel.

Battery bank EBB-1, Emergi-Lite #12ESL144/2  
Remote heads, Emergi-Lite #EF28 and #EF28D

##### (d) Type "D"

- (i) LED exit sign, white colour, extruded aluminum housing, wall mounting. The exit sign in a self-powered configuration shall be equipped with a Nickel-Cadmium battery and shall stay illuminated during emergency operation for at least 90 minutes upon AC failure.

Emergi-Lite #LPEX52W-P3A/2MK

#### E64.7 Installation

- (a) As per C.E.C. Section 22 and Section 30.
- (b) Unit shall conform to building lines being parallel or perpendicular.
- (c) Installation of all lighting equipment shall comply with the relevant Section of this Specification and the Canadian Electrical Code.
- (d) At the completion of construction and acceptance of the Work, all lighting fixtures shall be clean, complete with all necessary accessories and provided with the required operating lamp(s).

### E65. MOTOR STARTERS

#### E65.1 Scope

- (a) This section covers the supply and installation of the motor starters.

#### E65.2 Shop Drawings and Product Data

- (a) Submit shop drawings in accordance with these provisions. Indicate:
  - (i) Mounting method and dimensions
  - (ii) Starter size and type
  - (iii) Layout of identified internal and front panel components
  - (iv) Enclosure types

- (v) Wiring diagram for each type of starter
- (vi) Interconnection diagrams

#### E65.3 Standards

- (a) IEC Standards are acceptable for magnetic starter and contactors if application size doubled.
- (b) EEMAC North American Standards to apply.
- (c) Open wound starters or relay coils not allowed.
- (d) All coils to be epoxy potted.

#### E65.4 Operation and Maintenance Data

- (a) Provide operation and maintenance data as specified in general provisions.
- (b) Include operation and maintenance data for each type and style of starter.

#### E65.5 Maintenance Materials

- (a) Provide maintenance materials in accordance with the general provisions.
- (b) Provide listed spare parts for each different size and type of starter:
  - (i) 2 sets of contacts, stationary.
  - (ii) 2 sets of contacts, movable.
  - (iii) 1 set of contacts, auxiliary.
  - (iv) 1 control transformer for each VA rating supplied.
  - (v) 1 operating coil for each starter size supplied.
  - (vi) 2 fuses of each rating.
  - (vii) 4 indicating lamps, for each type supplied.
- (c) List local suppliers all above parts.

#### E65.6 Materials

- (a) Starters shall be EEMAC E140-1.
- (b) Half size starters not acceptable.
- (c) Smallest size starter to be size 1.

#### E65.7 Full Voltage Magnetic Starters

- (a) Magnetic and combination magnetic starters of size, type and rating, with components as follows:
  - (i) Contactor solenoid operated, rapid action type.
  - (ii) Motor overload protective device in each phase, manually reset from outside enclosure.
  - (iii) Power and control terminal blocks.
  - (iv) Wiring and schematic diagram inside starter enclosure in visible location.
  - (v) Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
  - (vi) EEMAC 12 enclosure or MCC.
- (b) Combination type starters to include motor circuit protector with operating lever on outside of enclosure to control motor circuit protector and provision for:
  - (i) Locking in "OFF" position with up to 3 padlocks.
  - (ii) Locking in "ON" position.
  - (iii) Independent locking of enclosure door.
  - (iv) Provision for preventing switching to "ON" position while enclosure door open.
- (c) Accessories

- (i) Pushbuttons and selector switches: standard heavy duty oil tight labelled as indicated.
- (ii) Indicating lights: Push-to-test transformer heavy duty oil tight type and color as indicated.
- (iii) 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.
- (d) Starter sizes shall be CEC suitable to applied HP as indicated on drawings.
- (e) Acceptable manufacturer is Telemecanique LE1 series, Cutler- Hammer Freedom series type AN16, Siemens.

#### E65.8 Two Speed Magnetic Starters

- (a) Two speed magnetic starters of size, type and rating indicated with components as follows:
  - (i) One-3-pole contactor for each winding for separate winding motors.
  - (ii) 3 overload relays with three heater and manual reset for each speed.
  - (iii) Power and control terminal blocks.
  - (iv) Wiring and schematic diagram inside starter enclosure in visible location.
  - (v) Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
  - (vi) EEMAC 12 panels.
- (b) Combination type starters to include motor circuit protector with operating lever on outside of enclosure to control motor circuit protector and provision for:
  - (i) Locking in "OFF" position with up to 3 padlocks.
  - (ii) Locking in "ON" position.
  - (iii) Independent locking of enclosure door.
  - (iv) Provision for preventing switching to "ON" position while enclosure door open.
- (c) Accessories:
  - (i) Pushbuttons and selector switches: standard heavy duty oil tight labelled as indicated.
  - (ii) Indicating lights: Push-to-test transformer heavy duty oil tight type and color as indicated.
  - (iii) 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.
- (d) Starter sizes shall be CEC suitable to applied HP as indicated on drawings.
- (e) Acceptable manufacturer is Telemecanique LE9 series, Culter-Hammer type W960.

#### E65.9 Control Transformers

- (a) Single phase, dry type, control transformer with 600 volt primary voltage and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- (b) Size control transformer for control circuit load required plus 100% spare capacity.

#### E65.10 Finishes

- (a) Apply finishes to enclosure in accordance with these provisions.

#### E65.11 Equipment Identification

- (a) Provide equipment identification in accordance with these provisions.
- (b) Magnetic starter designation label, engraved as indicated in the motor equipment description column on the electrical motor schedule.

#### E65.12 Installation

- (a) Install starters, connect power and control circuits as indicated.
- (b) Install auxiliary contacts and connect wiring.
- (c) Ensure correct MCP settings and overload devices elements installed.
- (d) Manual motor starters shall be mounted 1500 mm above finished floor level to top of starter enclosure.

#### E65.13 Tests

- (a) Perform tests in accordance with these provisions and manufacturer's instructions.
- (b) Operate switches, contactors to verify correct functioning.
- (c) Perform starting and stopping sequences of contactors and relays.
- (d) Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

### **E66. MOTOR CONTROL WIRING**

#### E66.1 Scope

- (a) This section covers the following:
  - (i) Electrical work pertaining to installation of all mechanical and automatic equipment specified.
  - (ii) Wiring associated with control wiring schematics shown on electrical drawings.

#### E66.2 Quality Assurance

- (a) Coordinate with mechanical shop drawings for electrical requirements. Where mechanical shop drawings differ in control or power requirements this shall be reported to the Contract Administrator.

#### E66.3 Materials

- (a) Refer to other sections for equipment specifications.
- (b) Circuit breaker and feeder sizes as indicated on the electrical drawings for all motors, fans, HVAC equipment, etc., are based on preliminary data only. Contractor responsible for coordinating with the supplies to determine exact voltage and amperage of all equipment on Site and ensure starters, breakers, feeder wiring, conduit sizes, etc., are correctly sized for the equipment being fed in addition to informing the Contract Administrator of all required changes. No extras will be allowed for costs incurred resulting from failure to properly execute this coordination.

#### E66.4 Installation

- (a) Refer to individual sections for execution.
- (b) Coordinate overcurrent and overload protective devices with the nameplate ratings of the motors.
- (c) Fill out a "MOTOR DATA SHEET" for each single phase and 3 phase motor.

### **E67. PROCESS CONTROL AND INSTRUMENTATION**

#### E67.1 Specifications E67 to E71 pertain to the construction of the Process Control and Instrumentation.

#### E67.2 Measurement and Payment

- (a) Specifications E67 to E71 will be measured for payment on a cumulative unit basis and paid for at the Contract Unit Price for "Process Control and Instrumentation". Payment will

be made for the Process Control and Instrumentation constructed in accordance with this specification, accepted and measured by the Contract Administrator.

## **E68. PROCESS CONTROL AND INSTRUMENTATION – GENERAL PROVISIONS**

### **E68.1 Description**

- (a) This section specifies the General Provisions for the supply, delivery, installation, calibration and commissioning of the process control and instrumentation system, including all control and graphic panels, as specified herein and/or detailed on the drawings.
- (b) It is the intention of these specifications and drawings, to provide for a complete and fully operating control and instrumentation system, with facilities and services to meet the requirements described herein, and in complete accord with applicable codes and ordinances. The specifications do not purport to cover details entering into the design of the system which shall be the responsibility of the Contractor.
- (c) The work to be done shall include the provision of all labour, materials, tools and equipment as well as the application of a competent knowledge of construction, whether or not directly specified or shown on the plans, required for the installation testing and placing into service the complete control and instrumentation system, except when it is specifically mentioned that certain materials and/or labour are not part of the contract.
- (d) These specifications shall apply to and govern all trades doing control and instrumentation work and shall be read in conjunction with and form a part of the general specifications of the project.
- (e) The Control and Instrumentation work includes but is not limited to the following:
  - (i) Control panels
  - (ii) Programmable Logic Controller System
  - (iii) Primary Elements for flow, level, pressure, temperature, etc.
  - (iv) Indicators and annunciators
  - (v) Uninterruptible power supplies
  - (vi) Control Wiring and conduit
  - (vii) Spare Parts & Manuals

### **E68.2 Equipment Manufacturers**

- (a) All equipment shall be manufactured by experienced manufacturers who can demonstrate in-use records for all equipment offered.
- (b) Requests for approval of alternative suppliers shall be submitted to the Contract Administrator.
- (c) The majority of equipment shall be supplied by a single manufacturer, particularly where aesthetics are of concern, such as in panels.

### **E68.3 Codes, Permits and Fees**

- (a) The Work shall comply with the requirements of the current edition of the Canadian Electrical Code, Part 1, and the regulations of the Manitoba Government, Department of Labour, Electrical Protection Branch.
- (b) Obtain the required construction permits, arrange for inspections and supply the Contract Administrator with approval certificates pertaining thereto including a certificate of final inspection.

### **E68.4 Reference Standards**

- (a) Unless otherwise specified, equipment shall conform to appropriate standards and recommendations of:

- (i) The American Society of Mechanical Contract Administrators, hereinafter referred to as ASME Standards.
  - (ii) The Instrument Society of America, hereinafter referred to as ISA.
  - (iii) The Canadian Standards Association, hereinafter referred to as CSA.
- (b) All equipment shall be metric - SI Standard.

#### E68.5 Manuals

- (a) Provide operating and maintenance brochures for all equipment and arrange for their insertion into the Operation and Maintenance Manuals. The brochures shall include all applicable, descriptive and technical data, maintenance and operating procedures, wiring diagrams, spare parts lists, service representatives, and suppliers for replacement parts. The brochures shall be neatly and orderly assembled in binders.
- (b) Requirements for operation and maintenance of process control and instrumentation equipment shall be as specified in these provisions.

#### E68.6 Shop Drawings

- (a) Provide layout drawings of instrument panels and schematic diagrams as well as detailed drawings of all devices listed in the instrumentation data sheets. The Contract Administrator's review of shop drawings shall be for general arrangement only and shall not relieve the Contractor from responsibility for errors, proper fitting, construction of the Work and furnishing of materials.
- (b) The layout drawings and ladder drawings shall be prepared on reproducible sheets of the same size as the Contract drawings. These drawings shall be updated as the work progresses and shall be submitted to the Contract Administrator as Drawings of Record when the Work is completed.
- (c) Submit shop drawings for the following items:
  - (i) Control Panels
  - (ii) Panel wiring schematics and interconnection drawings
  - (iii) Field instruments
  - (iv) Power supplies
  - (v) PLC and I/O enclosure
  - (vi) PLC and I/O modules
  - (vii) PLC terminals
  - (viii) Interconnection drawings, showing system equipment and field device connections
  - (ix) PLC software documentation, which shall include as a minimum:
    - (x) I/O listing entailing a complete list of all system addresses, both used and spare, with a service description for each including mnemonics.
    - (xi) Ladder diagram listing, complete with description headings, comments for each rung, and mnemonics for each element.
    - (xii) Data table listing, identifying all preset values and their service.
    - (xiii) Written description of the program(s).

#### E68.7 Drawings of Record

- (a) Submit control ladder drawings and PLC programs for the instrumentation system.

#### E68.8 Coordination of Work

- (a) Cooperate and coordinate with other trades on the project.
- (b) Make suitable arrangements with other trades to make provision for the control and instrumentation work and be responsible for the assurance that such provisions are satisfactory for the control and instrumentation work.

- (c) Check drawings and specifications of other trades for conflict and coordination with the control and instrumentation trade. If any conflicts are found, obtain a ruling from the Contract Administrator before proceeding.

#### E68.9 Record Documentation

- (a) As work progresses, record on one (1) set of contract drawings, any change to conduit layout as well as any approved changes and deviations from the original contract and/or working drawings. At completion of Work, submit to the Contract Administrator.
- (b) In addition to the record contract drawings, submit record documentation for inclusion in the Maintenance Manuals.
- (c) Provide record PLC programming hard copy and back-ups (2 copies) on compatible CD ROM to the Contract Administrator.
- (d) All software development packages and manufacturer's development manuals shall be turned over to the Contract Administrator.
- (e) No final contract payment shall be made until all record documentation has been accepted by the Contract Administrator.

#### E68.10 Warranty

- (a) Warranty system assembly, installation, hardware, software, and communications operations for all parts and labour for a period of one year from date of Total Completion.

#### E68.11 Materials

- (a) All materials shall be new and the best of their respective kind.
- (b) All materials shall bear the approval of the Canadian Standards Association (CSA).
- (c) All materials shall be suitable for full operation within non-hazardous environments (EEMAC 12) as indicated.
- (d) See subsequent clauses for specific equipment and instrument specifications.

#### E68.12 Power Supply

- (a) Provide all necessary power supplies for controls and instruments.
- (b) Power wiring to field devices shall be #12 AWG.

#### E68.13 Control Wiring

- (a) Unless specified otherwise, all conductors for control wiring shall be copper with RW90, X-link insulation, 300 volts.
- (b) Neutral conductors shall be white, grounding conductors shall be green, DC conductors shall be blue and AC conductors shall be red.
- (c) Instrumentation wiring for analog signals shall be individually shielded - multipair cable #16 AWG (7x16) tinned copper.
- (d) Control wiring for level and pressure switches shall be #14 THHN Black.
- (e) Where dimensional details are required work with the applicable structural and architectural drawings.
- (f) The Contractor is responsible for correcting any work completed contrary to the intent of the drawings and specification and shall bear all costs for correcting same.

#### E68.14 Conduit, Wiring and Cable

- (a) Supply and install all conduit, wiring, control and instrumentation cables for the control, instrumentation and low line voltage control for building services.
- (b) Conduit and wiring for power, lighting, miscellaneous electrical systems and power supplies to control instrumentation and building service panels including other components requiring line voltage power supply shall be supplied and installed as specified.

#### E68.15 Installation

- (a) Install and interconnect all process control system equipment and components as indicated.
- (b) Install all equipment in accordance with the manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.
- (c) Provide all labour and all necessary equipment including timbers, scaffolding, tools and rigging materials for installation of the equipment.
- (d) Contractor shall be responsible for coordinating all mechanical, electrical and other works for the equipment being installed.
- (e) Installation shall meet the minimum standards set forth by Standards and Practices for Instrumentation, Tenth Edition - 1989.
- (f) Use trained personnel to install systems and controls as per approved shop drawings and in accordance with manufacturer's recommendations.
- (g) Follow building lines with all piping and electrical wiring runs. Utilize proper separation and wiring techniques.

#### E68.16 Testing

- (a) Thoroughly test all control equipment, components, and systems for proper operation and report in writing to the satisfaction of the Contract Administrator.
- (b) Tests shall include:
  - (i) Complete operational test including interlocks, functions, features, options, etc., for all instrumentation, PLC, and HMI control operations.
  - (ii) Operation of alarm initiating devices.
  - (iii) Calibration of all instruments.
- (c) Supply all necessary test equipment and personnel to completely test the entire instrumentation and process control system.

#### E68.17 Start-Up and Commissioning

- (a) Upon completion of the installation, the Contractor shall be responsible for testing to determine correct system operation and sequences as intended in the Contract. Process Instruments such as flow meters shall be checked for operation prior to process start-up, by manipulating operating controls like set points, auto-manual selectors, etc. Status and alarm contacts to be checked by manipulation or jumpering at the sensing element.
- (b) Results of tests are to be logged by the Contractor and submitted to the Contract Administrator. Any apparent defects shall be reported and corrected.
- (c) When preliminary checks have been completed and process equipment is operating or ready to operate, individual systems shall be calibrated in accordance with the latest ISA recommendation. After calibrations the system shall be placed in operation in conjunction with the Contract Administrator and/or the City's designated operating personnel.
- (d) In general, the start-up and commissioning shall be in accordance with these provisions.

#### E68.18 Spare Parts

- (a) The Contractor shall provide the following spare parts:
  - (i) Two (2) plug-in control relays of each type used complete with base.
  - (ii) Two (2) plug-in time delays of each type used complete with base.
  - (iii) Twenty (20) fuses of each type used.
  - (iv) Ten (10) indicating lights of each type used.
  - (v) Two (2) fuse holders of each type used.
  - (vi) One (1) push button of each type used.
  - (vii) One (1) selector switch of each type used.



## **E69. CONTROL PANELS**

### **E69.1 Scope**

- (a) This section covers the supply and installation of all field located motor control stations and control panels.

### **E69.2 Quality Assurance**

- (a) Control equipment to CSA C22.2 No. 14-M1987.

### **E69.3 Submittals**

- (a) Submit shop drawings in accordance with these provisions and include schematic, wiring diagrams, and mounting information.

### **E69.4 Operator Control Stations**

- (a) All enclosures and devices shall be rated EEMAC 12 in non-hazardous environments or EEMAC 3R outdoor environments, unless otherwise noted.

### **E69.5 Pushbuttons**

- (a) Heavy duty oiltight, operator flush, black, with 1-NO and 1-NC contacts rated at 10 A, 120 VAC, labels as indicated. Stop pushbuttons colored red, provision for padlocking in depressed position.
- (b) Acceptable manufacturer shall be Telmecanique, Allen-Bradley.

### **E69.6 Indicating Lights**

- (a) Heavy duty Oiltight, push to test transformer type, lens color as indicated, supply voltage: 120 V (ac), labels as indicated.
- (b) Acceptable manufacturer shall be Telmecanique, Allen-Bradley.

### **E69.7 Selector Switches**

- (a) 2 or 3 position as required, labelled as indicated heavy duty oiltight, operators as indicated, contact arrangement as indicated, rated 120 V (ac), 10 A.
- (b) Acceptable manufacturer shall be Telmecanique, Allen-Bradley.

### **E69.8 General**

- (a) 2 or 3 position as required, labelled as indicated heavy duty oiltight, operators as indicated, contact arrangement as indicated, rated 120 V (ac), 10 A.
- (b) Acceptable manufacturer shall be Telmecanique, Allen-Bradley.

### **E69.9 Construction**

- (a) Minimum EEMAC 12 construction for all panels unless otherwise specified.
- (b) Unless otherwise specified fabricate floor mounted panels, indicated, of high grade, cold rolled smooth sheet metal steel no thinner than 3 mm thick with all doors and edges neatly turned and finished smoothly. Visible welding seams will not be accepted.
- (c) Construct rigid panels and racks with an angle iron or channel supporting frame, suitably braced and stiffened to prevent any deformation during shipping or installation, and provide a surface free from dents, warping or other deformation. Provide a four-sided channel iron mounting base with front recess.
- (d) Provide flush fitting, gasketed doors hung on piano type hinges with three point latches and locking-type handles (CSA Type 12 construction).
- (e) Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

- (f) Use rear connected fittings to hold equipment and instrument cases on the panel, but where not possible; any front fixing required shall be only by means of chrome-plated, brass or stainless steel machine screws.
- (g) Panel surfaces shall be thoroughly cleaned and degreased before painting. One primer coat shall be covered by two finished paint coats.
- (h) The surface finish shall be free of runs, drops, ridges, waves and laps. The paints shall be applied in such manner as to provide an even film covering corners and crevices. The interior finish shall be white and the exterior finished will be selected after award of the contract.
- (i) Panel Accessories: a metal pocket, 250 mm wide x 150 mm high x 25 mm deep, to hold pertinent drawings and manuals on the lower half of the inside door.

#### E69.10 Internal Works

- (a) Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120-volt supply.
- (b) Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments. Conductors shall be extra flexible stranded copper of gauges sufficient to carry the required currents, and shall in no case be smaller than #16 AWG extra flexible.
- (c) Wire connections to all relays and instruments shall be made using easily removable good quality mechanical clips.
- (d) Identify all wiring by means of plastic slip-on type markers. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, and where practical, contained in plastic wiring channels with covers.
- (e) Provide Weidmuller terminal blocks #SAK 2.5, T7 Carrier & EK 2.5N Grounding, tubular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufactured jumpers and marking tape.
- (f) Mount all internally mounted equipment on a hinged sub-chassis or mount on a rack and arrange for ease of access and removal when necessary.
- (g) Arrange all terminal blocks in the panel in groups such that all low level signals such as 4-20 mA DC are located in one area, followed by contact closure type signals (limit switches, etc.), that do not subsequently energize starters, etc. but are for status indication, and the remainder that contain powered circuits, 120 volt, 50 Hz, are to be arranged in such a manner and location so as to prevent interference into the low level signal.
- (h) Submit proposed terminal block layout and identification scheme for review prior to manufacture.
- (i) Provide suitable spaces around the terminal blocks for incoming and outgoing conductors or cable assemblies.
- (j) Provide plastic cable troughs equal to Panduit complete with snap-on covers for containing the cables. Cables are not to be bunched and tied, but laid in.

#### E69.11 Panel Manufacturer

- (a) Panel assembly, subcomponents and all internal components shall be CSA approved. Cabinet construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory, and Department of Labour regulations and has CSA approval as manufacturer for all components of the Work including control panels, MCCs, service entrance, etc. Local approvals for panel construction including CSA will not be accepted.
- (b) Acceptable panel manufacturer shall be Manco Control Systems Inc., Celco Controls.

#### E69.12 Alternate Panel Manufacturer

- (a) Bid Opportunity shall be based on the panel manufacturer specified. Alternate approvals.
- (b) Proposed alternate panel manufacturer must submit package at time of Bid Submission for review and evaluation by the Contract Administrator containing the following information and material:
  - (i) Separate requests for approval as equal for all monitoring and control equipment (including system software) to be used not listed as approved in this specification. Provide complete technical data including manufacturer make and model number to allow for a thorough review of the system and equipment being proposed.
  - (ii) List of five (5) recent water and/or sewage treatment plant projects successfully completed by the firm as a panel manufacturer.
  - (iii) List of references from satisfied clients, Contractors and Project Administrators attesting to the firms product quality and performance in addition to the firms reputation, service, professionalism, and ability to meet deadlines.
  - (iv) Complete listing of all in house personnel to be working directly on the project indicating experience working with the proposed equipment and control system of this type and experience working specifically on water and sewage treatment plant control systems. Detail years of relevant experience complete with listing of specific projects.
  - (v) Documentation confirming full CSA approval as manufacturer for all components of the Work (e.g. control panels, MCCs, service entrance, etc.).

#### E69.13 Supply Fans SF-1 and SF-2 Starter Panels

- (a) Provide supply fan SF-1 starter panel as indicated complete with the following:
  - (i) Surface mounted EEMAC 12 enclosure.
  - (ii) Hinged lockable door.
  - (iii) Lamacoid identification nameplates on all components.
  - (iv) Terminal strips (identified) for all wiring.
  - (v) F.R. HP, 1Ø, 120V, 1 speed starter for supply fan SF-1.
  - (vi) Relays, OMRON LY4N-120AC, complete with PTF14A-E bases.
  - (vii) Push to test LED type pilot lights, selector switches, pushbuttons, Telemecanique XB2B series.
- (b) Provide supply fan SF-2 starter panel as indicated complete with the following:
  - (i) Surface mounted EEMAC 12 enclosure.
  - (ii) Hinged lockable door.
  - (iii) Lamacoid identification nameplates on all components.
  - (iv) Terminal strips (identified) for all wiring.
  - (v) F.R. HP, 1Ø, 120V, 2 speed starter for supply fan SF-2.
  - (vi) Relays, OMRON LY4N-120AC, complete with PTF14A-E bases.
  - (vii) Push to test LED type pilot lights, selector switches, pushbuttons, Telemecanique XB2B series.
- (c) Panel finish shall be white epoxy paint for interior and ASA61 light grey enamel for exterior.

#### E69.14 Spare Parts

- (a) Provide one spare pushbutton, pilot light and selector switch for each type of switches and color of lights supplied.

#### E69.15 Installation

- (a) Install pushbutton stations, control and relay panels, control devices as indicated and interconnect as indicated.

#### E69.16 Tests

- (a) Perform tests in accordance with these provisions.
- (b) Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.
- (c) Upon completion of sectional test, undertake group testing.
- (d) Check out complete system for operational sequencing.
- (e) Submit one copy of test results to the Contract Administrator.

#### E69.17 Start-Up and Commissioning

- (a) Perform all panel start-up and commissioning in accordance with these provisions.

### **E70. PROGRAMMABLE LOGIC CONTROLLER**

#### E70.1 Scope

- (a) This section covers the supply and installation of the programmable controller.

#### E70.2 Submittals

- (a) Submit shop drawings in accordance with these provisions and include details on all CPU functions, programming, flow charts, operator menus, control sequences, schematics, component dimensions, data storage quantity, data storage speed, data storage back-ups, and program storage back-ups.

#### E70.3 Effluent Sampling Facility PLC

- (a) Effluent Sampling Facility PLC system shall be as shown on the drawings and include:
  - (i) Central processing unit (CPU) including power supply
  - (ii) I/O modules: discrete input, discrete output, analog input and analog output
  - (iii) Remote monitoring hardware
  - (iv) All necessary supporting hardware, e.g. PLC backplane, terminal strips, etc.
  - (v) PLC programming
- (b) Environmental conditions
  - (i) Temperature ratings:
    - Storage temperature: -40 to 85°C
    - Operating temperature: 0 to 60°C
  - (ii) Humidity: 0 to 93% non-condensing
  - (iii) Altitude: 2000 metres full operation
  - (iv) Vibration and shock:
    - Shock (half sine wave):  $\nabla$ 15g peak, 11 msec, 3 pulses/axis
    - Vibration: 10 to 57 Hz @ 0.075 mm d.a 57 to 150 Hz @ 1G
    - Free fall: 1m
  - (v) RFI and EMF Protection:
    - RFI/EMF susceptibility: 27 to 500 Mhz: 10 V/m
    - Electrostatic discharge: 8 kV/ 4 kV contact
    - Surge withstand: IEC 801-5 2000 V, shield to ground
- (c) Central Processing Unit (CPU):
  - (i) General:
    - The CPU shall consist of rack-mounted sub-assemblies (modules) which solve application logic, store the application program, store numerical values related to the logic, and interface to the I/O modules.

- The CPU shall provide local diagnostic information via LED indicators and relay contact outputs. All indicators shall be marked as to its respective function.
  - A dry contact shall provide for remote PLC failure alarm indication. The CPU shall come complete with all necessary software to provide for this alarm function.
  - Power back-up for one year via lithium battery.
- (ii) Communication Networking:
- One Modbus RTU interface port for connection via twisted pair.
- (iii) Program Storage:
- 8K words of program memory.
  - PLC program storage medium shall be solid state RAM. RAM memory shall have battery back-up capability of retaining all stored program data through a continuous power outage for 12 months under worst case conditions. Capability shall exist to remove battery from RAM module without interrupting system power.
  - Removable EEPROM card for non-volatile RAM memory back-up (loads on power-up) and program portability.
  - Total 256K of memory
  - 0.3ms/k to 1.4ms/k scan time.
  - Time-of-day clock.
  - Watchdog timer.
- (iv) Programming Technique:
- The programming format shall be traditional relay ladder logic/function block.
  - Acceptable manufacturer shall be Rockwell Automation No. 1763-L16AWA (MicroLogix 1100 series).
- (d) Input/Output (I/O) Modules:
- (i) General:
- All I/O inputs shall be individually fused.
  - All I/O modules shall be of the rack-mounted plug-in type modular design. Each I/O module shall be keyed to prevent module insertion into the wrong rack slot.
  - LED indicators adjacent to each I/O point, along with identification label.
  - All user wiring to the I/O modules shall be through a heavy duty terminal strip. Removable, push-in type terminal strip shall allow for module replacement without disturbing field wiring. Pressure type screw terminals shall be used to provide fast, secure wire connections.
  - Malfunction of an I/O module shall not affect the operation of the remaining I/O modules or the CPU.
  - CPU shall retain status of all I/O points of a failed I/O module.
  - Isolation shall be provided between all internal logic and external power circuits. Isolation shall meet minimum specification of 1500V RMS.
- (ii) Discrete Inputs:
- No. of modules: As required
  - Description: 115 VAC Isolated Input Module
  - Number of points: 8
  - Operating voltage: 79-132VAC @ 60Hz
  - Points per group: Isolated
  - Acceptable manufacturer shall be Rockwell Automation No. 1762-IA8.
- (iii) Analog Inputs:
- No. of modules: As required

- Description: Analog Input Module (Uni-Polar)
- No. of channels: 4
- Operating current: 4 to 20 mA
- Isolation: 1000 VAC Channel to Bus
- Accuracy: 0.05% of full scale current
- Acceptable manufacturer shall be Rockwell Automation No. 1762-IF4.

#### E70.4 Installation

- (a) Mount and install PLC and associated equipment in control panel as indicated on the drawings and as specified in these provisions.
- (b) Complete PLC and control system installation, testing, start-up and commissioning shall be as specified in these provisions.
- (c) Supply copy of MicroLogix software to Electrical and Instrumentation personal at the SEWPCC.

### E71. INSTRUMENTATION

#### E71.1 Scope

- (a) This section specifies the supply installation, field testing, and placing into operation of flow, temperature and other instruments of control and instrumentation.

#### E71.2 Submittals

- (a) Submit shop drawings in accordance with these provisions.

#### E71.3 Instruments

- (a) Provide each instrument with mechanisms that are corrosion resistant.
- (b) Provide each instrument with mechanisms enclosed in a dustproof and a moistureproof case.
- (c) Provide all indicator and gauge dials finished in permanent white with black graduations and figures.
- (d) Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge voltages, which may occur in the circuits from any source in the power supply.
- (e) Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, e.g., horizontal, vertical or sloped position.
- (f) The Contractor shall provide all power supplies. Provide each instrument having a 115 volt supply with a receptacle and plug assembly. Receptacles and plug to be of "twist-lok," type.
- (g) Provide each instrument with a circuit breaker.
- (h) Integrating counters and elapsed time meters shall show the total quantity that has passed through the meter and shall not require the use of a multiplier other than cipher additions. The integrators shall have at least seven figures.
- (i) All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.
- (j) Unless otherwise indicated or specified, all signals shall be of the 4-20 mA type. This applies to both transmitting and receiving instruments.
- (k) All materials shall conform to the standards of the Canadian Standards Association (CSA).

#### E71.4 Flow Meter System:

- (a) Provide and install a scissors ring support brace for securing the velocity probe sensor in the pipe invert.
- (b) Flowrate accuracy of the system shall be within 2% of actual flowrate.
- (c) Velocity range shall be within plus or minus 9 m/s. Positive velocity will be in the normal direction of effluent flow, from east to west.
- (d) Velocity Bin Size: 50 to 30 mm, user selectable.
- (e) Water level measurement range: 48 mm to 2 m.
- (f) Water level accuracy: plus or minus 5 mm.
- (g) Electronics Unit shall meet the following requirements:
  - (i) Electronic unit configuration: Wall-mounted
  - (ii) Operating Temperature: -26 degrees C to +52 degrees C
  - (iii) Storage Temperature: -54 degrees C to +71 degrees C
  - (iv) Packaging: NEMA 4X
  - (v) Dimensions: Box: 445 mm x 375 mm x 170 mm
  - (vi) Weight : Not to exceed 11 kg
- (h) Sensor probe shall meet the following requirements :
  - (i) Operating Temperature: -5 degrees C to +35 degrees C
  - (ii) Housing Material: Urethane
  - (iii) Static Pressure: 250 psi nominal
  - (iv) Dimensions: 200 mm x 75 mm x 40 mm
  - (v) Weight : Not to exceed 1.5 kg
- (i) Sensor Signal Cable shall meet the following requirements:
  - (i) Operating Temperature: -40 degrees C to +52 degrees C
  - (ii) Physical: Polyethylene jacket
  - (iii) Length: Up to 45 m without splices
  - (iv) Minimum bend radius: 250 mm
  - (v) Outer diameter: 13 mm nominal
- (j) Data Type:
  - (i) Q, V, D,: Discharge, average velocity, depth
  - (ii) Velocity: Velocity profile data (relative to acoustic beam directions) per beam and bin
  - (iii) Echo intensity: Echo intensity data (relative to backscatter intensity) per beam and bin
  - (iv) Data Quality: Profile data quality indicators (correlation magnitude, %-good) per beam and bin
  - (v) Temperature: Transducer temperature output, range: -7 degrees C to +52 degrees C
  - (vi) Sound speed: One output for speed of sound data
  - (vii) Leader: Output of general leader information (time, data, record number, etc.) and for vertical beam data
- (k) Data Storage and I/O shall meet the following requirements:
  - (i) Data storage capacity: 32 MB standard, up to 440 MB optional
  - (ii) Data I/O interface: RS-232 standard
- (l) Power features shall meet the following requirements:
  - (i) Internal battery voltage: 24 VDC nominal
  - (ii) Internal battery capacity: 26 Ah at 24 degrees C – alkaline. Battery life equivalent to 22 weeks at 15 minute sampling intervals

- (iii) External DC: 12 to 36 VDC; 10 VDC absolute minimum; 36 VDC absolute maximum
    - (iv) Software: WinADM Software for Windows98, 2000, NT, XP
  - (m) Flow metering system shall be as manufactured by FlowShark by ADS; or other approved equal meeting the specification requirements.
- E71.5 Commissioning Testing of Flow Meter System Accuracy:
  - (a) Submit documentation for conformance with specified requirements.
- E71.6 Flow Switch
  - (a) Provide sample water flow switch as indicated. Acceptable manufacturer shall be Greyline Model DFS-II. Supply sensor with 10 metres shielded cable.
- E71.7 Building Flood Switches
  - (a) Provide building flood switches as indicated. Acceptable manufacturer shall be Sorinc Series 711.
- E71.8 Temperature Switches
  - (a) Provide building low temperature switches as indicated. Acceptable manufacturer shall be Honeywell No. T631A.
- E71.9 Installation
  - (a) Coordinate the work of this Section with the installation of the equipment specified in the relevant Sections in these provisions and shown on the drawings.
  - (b) Perform all work in compliance with the relevant sections.
- E71.10 Field Instrument Monitoring
  - (a) "Mounting" shall mean the positioning and fastening with proper brackets in the position required.
  - (b) All equipment shall be mounted in accordance with manufacturer's recommendations.
  - (c) Locations of all field instruments are subject to modification by the Contract Administrator who reserves the right to move any item up to 3 meters from the position shown, without change to the contract price, provided notice is given before the related work has commenced.
  - (d) Exact locations of all field instruments shall be site determined by the Contractor to the satisfaction of the Contract Administrator to ensure proper operation of the device.
  - (e) Employ any and all means of trade, skill, and workmanship to install all field instruments to the satisfaction of the Contract Administrator.
- E71.11 Commissioning
  - (a) Instrument manufacturer's qualified field service representative shall be onsite as required to perform instrument calibration, testing and commissioning and to instruct City's representative in all aspects of instrument operation and maintenance.

## **E72. STAINLESS STEEL KNIFE GATE**

### **E72.1 Description**

#### **E72.1.1 General**

- (a) This Specification shall cover the supply, delivery, installation and testing of stainless steel knife gate, wall thimbles, stems, wall brackets and accessories.

#### **E72.1.2 General Design:**

- (a) Specification Standard: MSS-SP-81



- (b) Type: bonneted with non-rising stem with stop nut, flange back with standard bottom closure.
- (c) Rating: 150 psi
- (d) Flanges: drilled and tapped to ANSI B16.5
- (e) Mounting: Type F wall thimble.
- (f) Seating Head: Maximum design seating head for the knife gate will be from centreline of the gate to the energy grade line (Appendix B) or top of the gate chamber, whichever is greater.
- (g) Operating nut: 50 mm x 50 mm square operating nut for attachment of an electric portable drill for opening. Operator to be in a standard watermain valve box cast into the roof of the chamber marked with an "S".
- (h) Operator shall turn counter clock wise to open.

#### E72.1.3 Materials

- (a) Body: Stainless Steel A 276 Type 316
- (b) Gate: Stainless Steel A 276 Type 316
- (c) Bonnet: Stainless Steel A 276 Type 316
- (d) Bonnet Flange and Stiffeners: Carbon Steel
- (e) Yoke: Ductile Iron A536 Grade 65-45-12
- (f) Seat: Rubber (EPDM)
- (g) Steam: Stainless Steel A 276 Type 316
- (h) Packing: Teflon
- (i) Wall Thimble ASTM A48 Cast Iron, Class 30
- (j) Fasteners & Anchors ASTM A276 Type 316 Stainless Steel
- (k) Stem Couplings ASTM A276 Type 304 Stainless Steel

#### E72.1.4 Shop Drawings

- (a) Submit shop drawings of knife gate, wall thimbles, stems, wall brackets and accessories in accordance with E4 of this specification.

#### E72.1.5 Operating and Maintenance Manuals

- (a) Provide five (5) copies of all the manufacturer's brochures and technical literature detailing correct installation procedure and recommended operating and maintenance instructions. Manuals shall be bound with the project title and gate description identified on the front cover. Final payment for knife gate in accordance with E6.

#### E72.1.6 Construction Methods

- (a) Installation
  - a) Install knife gate, wall thimbles, operator, stems, wall brackets and accessories as shown on the drawings and in accordance with the manufacturer's recommendations.
  - b) Make arrangements to have a qualified field representative of the knife gate supplier/manufacturer inspect the installation during and after completion and provide a Certificate of Satisfactory Installation to the Contract Administrator.

#### E72.2 Field Testing

- a) Perform leakage tests in the Contract Administrator's presence once knife gate has been installed to ensure compliance with the allowable leakage rate.
- b) The Contractor may use the stop logs to prevent water from draining from the chamber only after the stop logs have been tested and those test results accepted by the Contract Administrator. Water used for the test may be obtained from the effluent flow through the existing outfall. Any additional water required to ensure an adequate head on the gate will be imported by the Contractor at the Contractor's expense.

- c) If a gate fails the field leakage test, the Contractor shall undertake adjustments, replacements or other modifications recommended by the knife gate supplier/manufacturer's field representative and repeat the test. The sequence shall be repeated until the gate passes the allowable leakage rate.

**E72.3 Measurement and Payment**

- (a) Knife Gate will be measured for payment on a unit basis and paid for at the Contract Unit Price for "Knife Gate". Number of units to be paid for will be the total number of knife gates supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.

**E73. REMOVAL OF EXISTING CULVERT**

E73.1 The Contractor shall remove the existing 1050 mm culvert located west of the UV building by excavating the flood protection berm, removing the culvert and all bedding and other granular material, and replacing the disturbed berm. Replacement of the disturbed berm shall meet the requirements of E10.

E73.2 The Contractor shall return the salvaged culvert to the City. The culvert shall be placed at the location designated by the City within the SEWPCC grounds.

E73.3 The Contractor shall be responsible for any damage to the culvert by replacing the damaged culvert with a new culvert of the same length and diameter.

**E73.4 Measurement and Payment**

- (a) Removal of the existing culvert will be measured for payment on a lump sum basis and paid for at the lump sum Contract Unit Price for "Removal of Existing Culvert". Unit to be paid for will be the total number of culverts removed, delivered to the City, and flood protection berm replaced to the above condition and accepted and measured by the Contract Administrator.