



**RETURN BIDS TO:**

**RETOURNER LES SOUMISSIONS À:**

Public Works and Government Services

Canada

ATB Place North Tower

10025 Jasper Ave./10025 ave. Jaspe

5th floor/5e étage

Edmonton

Alberta

T5J 1S6

Bid Fax: (780) 497-3510

**INVITATION TO TENDER**

**APPEL D'OFFRES**

**Tender To: Public Works and Government Services  
Canada**

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

**Soumission aux: Travaux Publics et Services  
Gouvernementaux Canada**

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici et sur toute feuille ci-annexée, au(x) prix indiqué(s).

**Comments - Commentaires**

**Vendor/Firm Name and Address**

**Raison sociale et adresse du**

**fournisseur/de l'entrepreneur**

**Issuing Office - Bureau de distribution**

Public Works and Government Services Canada

ATB Place North Tower

10025 Jasper Ave./10025 ave Jaspe

5th floor/5e étage

Edmonton

Alberta

T5J 1S6

<b>Title - Sujet</b> Bow Heat Recovery	
<b>Solicitation No. - N° de l'invitation</b> E0208-162581/A	<b>Date</b> 2016-04-29
<b>Client Reference No. - N° de référence du client</b> CSC E0208-162581	<b>GETS Ref. No. - N° de réf. de SEAG</b> PW-\$PWU-107-10751
<b>File No. - N° de dossier</b> PWU-6-39012 (107)	<b>CCC No./N° CCC - FMS No./N° VME</b>
<b>Solicitation Closes - L'invitation prend fin</b> <b>at - à 02:00 PM</b> <b>on - le 2016-05-20</b>	
<b>Time Zone</b> Fuseau horaire Mountain Daylight Saving Time MDT	
<b>F.O.B. - F.A.B.</b>	
<b>Plant-Usine:</b> <input type="checkbox"/> <b>Destination:</b> <input type="checkbox"/> <b>Other-Autre:</b> <input type="checkbox"/>	
<b>Address Enquiries to: - Adresser toutes questions à:</b> Anthony, Mary	<b>Buyer Id - Id de l'acheteur</b> pwu107
<b>Telephone No. - N° de téléphone</b> (780) 237-7582 ( )	<b>FAX No. - N° de FAX</b> (780) 497-3510
<b>Destination - of Goods, Services, and Construction:</b> <b>Destination - des biens, services et construction:</b> Correctional Service Canada Regional Psychiatric Centre Central Avenue N Saskatoon, SK S7K 3X5 CANADA	

**Instructions: See Herein**

**Instructions: Voir aux présentes**

<b>Delivery Required - Livraison exigée</b> See Herein	<b>Delivery Offered - Livraison proposée</b>
<b>Vendor/Firm Name and Address</b> <b>Raison sociale et adresse du fournisseur/de l'entrepreneur</b>	
<b>Telephone No. - N° de téléphone</b> <b>Facsimile No. - N° de télécopieur</b>	
<b>Name and title of person authorized to sign on behalf of Vendor/Firm</b> <b>(type or print)</b> <b>Nom et titre de la personne autorisée à signer au nom du fournisseur/</b> <b>de l'entrepreneur (taper ou écrire en caractères d'imprimerie)</b>	
<b>Signature</b>	<b>Date</b>

## INVITATION TO TENDER

### IMPORTANT NOTICE TO BIDDERS

#### **SUPPORT THE USE OF APPRENTICES**

Through Canada's Economic Action Plan 2013, the Government of Canada proposes to support the employment of apprentices in federal construction and maintenance projects. Refer to SI10.

#### **INTEGRITY PROVISIONS - BID**

Important changes have been made to the Integrity Provisions - Bid as of 2016-04-04. See GI01, Integrity Provision-Bid of R2710T of the General Instructions for more information.

#### **LISTING of SUBCONTRACTORS**

As per GI07 of R2710T you should provide using Annex C at Bid closing a list of Subcontractors that have 20% or more of the tendered price value.

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### R2710T GENERAL INSTRUCTIONS - CONSTRUCTION SERVICES - BID SECURITY REQUIREMENTS (GI) (2016-04-04)

The following GI's are included by reference and are available at the following Web Site <https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual/5/R>

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Id de l'acheteur - Buyer ID : PWU107

N° de réf. du client - Client Ref. No.

File No. - N° du dossier

N° CCC / CCC No./ N° VME - FMS

**APPENDIX 1 - INTEGRITY PROVISIONS – LIST OF NAMES**

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## **SPECIAL INSTRUCTIONS TO BIDDERS (SI)**

### **SI01 BID DOCUMENTS**

1. The following are the bid documents:

- a. Invitation to Tender - Page 1;
- b. Special Instructions to Bidders;
- c. General Instructions - Construction Services - Bid Security Requirements R2710T (2016-04-04)
- d. Clauses & Conditions identified in "Contract Documents";
- e. Drawings and Specifications;
- f. Bid and Acceptance Form and related Appendix(s); and
- g. Any amendment issued prior to solicitation closing.

Submission of a bid constitutes acknowledgement that the Bidder has read and agrees to be bound by these documents.

2. General Instructions - Construction Services - Bid Security Requirements R2710T is incorporated by reference and is set out in the Standard Acquisition Clauses and Conditions (SACC) Manual, issued by Public Works and Government Services Canada (PWGSC). The SACC Manual is available on the PWGSC Web site:  
<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual/5/R>

### **SI02 ENQUIRIES DURING THE SOLICITATION PERIOD**

1. Enquiries regarding this bid must be submitted in writing to the Contracting Officer named on the Invitation to Tender - Page 1 as early as possible within the solicitation period. Except for the approval of alternative materials as described in GI15 of R2710T, enquiries should be received no later than five (5) calendar days prior to the date set for solicitation closing to allow sufficient time to provide a response. Enquiries received after that time may not result in an answer being provided.
2. To ensure consistency and quality of the information provided to Bidders, the Contracting Officer shall examine the content of the enquiry and shall decide whether or not to issue an amendment.
3. All enquiries and other communications related to this bid sent throughout the solicitation period are to be directed ONLY to the Contracting Officer named on the Invitation to Tender - Page 1. Failure to comply with this requirement may result in the bid being declared non-responsive.

### **SI03 OPTIONAL SITE VISIT**

There will be a site visit on May 16, 2016 at 1:30 pm. Interested bidders are to meet at:

Regional Psychiatric Centre  
2520 Central Avenue North  
Saskatoon, SK S7K 3X5

The entrance gate is a separate building. All visitors must report and sign-in prior to entering the facility.

<https://www.google.ca/maps/place/Regional+Psychiatric+Centre/@52.1616805,-106.5972471,14.3z/data=!4m2!3m1!1s0x0:0x4ba2938cc64b03b>

### **SI04 REVISION OF BID**

A bid may be revised by letter or facsimile in accordance with GI10 of R2710T. The facsimile number for receipt of revisions is (780) 497-3510.

**SI05 BID RESULTS**

1. A public bid opening will be held in the office designated on the Front Page "Invitation to Tender" for the receipt of bids shortly after the time set for solicitation closing.
2. Following solicitation closing, bid results may be obtained by calling Mary at (780) 237-7582 or via e-mail at: mary.anthony@pwgsc-tpsgc.gc.ca

**SI06 INSUFFICIENT FUNDING**

In the event that the lowest compliant bid exceeds the amount of funding allocated for the Work, Canada in its sole discretion may

- a. cancel the solicitation; or
- b. obtain additional funding and award the Contract to the Bidder submitting the lowest compliant bid; and/or
- c. negotiate a reduction in the bid price and/or scope of work of not more than 15% with the Bidder submitting the lowest compliant bid. Should an agreement satisfactory to Canada not be reached, Canada shall exercise option (a) or (b).

**SI07 BID VALIDITY PERIOD**

1. Canada reserves the right to seek an extension to the bid validity period prescribed in BA04 of the Bid and Acceptance Form. Upon notification in writing from Canada, Bidders shall have the option to either accept or reject the proposed extension.
2. If the extension referred to in paragraph 1. of SI08 is accepted, in writing, by all those who submitted bids, then Canada shall continue immediately with the evaluation of the bids and its approvals processes.
3. If the extension referred to in paragraph 1. of SI08 is not accepted in writing by all those who submitted bids then Canada shall, at its sole discretion, either
  - a. continue to evaluate the bids of those who have accepted the proposed extension and seek the necessary approvals; or
  - b. cancel the invitation to tender.
4. The provisions expressed herein do not in any manner limit Canada's rights in law or under GI11 of R2710T.

**SI08 CONSTRUCTION DOCUMENTS**

The successful Contractor will be provided with one paper copy of the sealed and signed drawings, the specifications and the amendments upon acceptance of the offer. Additional copies, up to a maximum 5, will be provided free of charge upon request by the Contractor. Obtaining more copies shall be the responsibility of the Contractor including costs.

**SI09 PUBLIC WORKS AND GOVERNMENT SERVICES CANADA APPRENTICE PROCUREMENT INITIATIVE**

1. To encourage employers to participate in apprenticeship training, Contractors bidding on construction and maintenance contracts by Public Works and Government Services Canada (PWGSC) are being asked to sign a voluntary certification, signaling their commitment to hire and train apprentices.
2. Canada is facing skills shortages across various sectors and regions, especially in the skilled trades. Equipping Canadians with skills and training is a shared responsibility. In Economic Action Plan (EAP) 2013, the Government of Canada made a commitment to support the use of apprentices in federal construction and maintenance contracts. Contractors have an important role in supporting apprentices through hiring and training and are encouraged to certify that they are providing opportunities to apprentices as part of doing business with the Government of Canada.

3. Through the Economic Action Plan 2013 and support for training programs, the Government of Canada is encouraging apprenticeships and careers in the skilled trades. In addition, the government offers a tax credit to employers to encourage them to hire apprentices. Information on this tax measure administered by the Canada Revenue Agency can be found at: [www.cra-arc.gc.ca](http://www.cra-arc.gc.ca). Employers are also encouraged to find out what additional information and supports are available from their respective provincial or territorial jurisdiction.
4. Signed certifications (Appendix 3) will be used to better understand contractor use of apprentices on Government of Canada maintenance and construction contracts and may inform future policy and program development.
5. The Contractor hereby certifies the following:

In order to help meet demand for skilled trades people, the Contractor agrees to use, and require its subcontractors to use, reasonable commercial efforts to hire and train registered apprentices, to strive to fully utilize allowable apprenticeship ratios \* and to respect any hiring requirements prescribed by provincial or territorial statutes

The Contractor hereby consents to this information being collected and held by PWGSC, and Employment and Social Development Canada to support work to gather data on the hiring and training of apprentices in federal construction and maintenance contracts.

To support this initiative, a voluntary certification signaling the Contractor's commitment to hire and train apprentices is available at Appendix 3.

If you accept fill out and sign Appendix 3.

*\* The journeyperson-apprentice ratio is defined as the number of qualified/certified journeypersons that an employer must employ in a designated trade or occupation in order to be eligible to register an apprentice as determined by provincial/territorial (P/T) legislation, regulation, policy directive or by law issued by the responsible authority or agency.*

## SI10 WEB SITES

The connection to some of the Web sites in the solicitation documents is established by the use of hyperlinks. The following is a list of the addresses of the Web sites:

Treasury Board Appendix L, Acceptable Bonding Companies  
<http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=14494&section=text#appl>

Buy and Sell <https://www.achatsetventes-buyandsell.gc.ca>

Canadian economic sanctions <http://www.international.gc.ca/sanctions/index.aspx?lang=eng>

Contractor Performance Evaluation Report (Form PWGSC-TPSGC 2913)  
<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/2913.pdf>

Bid Bond (form PWGSC-TPSGC 504) <http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/504.pdf>

Performance Bond (form PWGSC-TPSGC 505) <http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/505.pdf>

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Labour and Material Payment Bond (form PWGWSC-TPSGC 506)  
<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/506.pdf>

Standard Acquisition Clauses and Conditions (SACC) Manual  
<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual/5/R>

PWGSC, Industrial Security Services <http://ssi-iss.tpsgc-pwgsc.gc.ca/index-eng.html>

PWGSC, Code of Conduct and Certifications  
<http://www.tpsgc-pwgsc.gc.ca/app-acq/cndt-cndct/contexte-context-eng.html>

Construction and Consultant Services Contract Administration Forms Real Property Contracting  
<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/formulaires-forms-eng.html>

Declaration Form  
<http://www.tpsgc-pwgsc.gc.ca/ci-if/formulaire-form-eng.html>



## **SUPPLEMENTARY CONDITIONS (SC)**

### **SC01 INDUSTRIAL SECURITY RELATED REQUIREMENTS, DOCUMENT SAFEGUARDING**

There is no document security requirement applicable to this Contract.

### **SC02 INSURANCE TERMS**

#### **1) Insurance Contracts**

- (a) The Contractor must, at the Contractor's expense, obtain and maintain insurance contracts in accordance with the requirements of the Certificate of Insurance. Coverage must be placed with an Insurer licensed to carry out business in Canada.
- (b) Compliance with the insurance requirements does not release the Contractor from or reduce its liability under the Contract. The Contractor is responsible for deciding if additional insurance coverage is necessary to fulfill its obligation under the Contract and to ensure compliance with any applicable law. Any additional insurance coverage is at the Contractor's expense, and for its own benefit and protection.

#### **2) Period of Insurance**

- (a) The policies required in the Certificate of Insurance must be in force from the date of contract award and be maintained throughout the duration of the Contract.
- (b) The Contractor must be responsible to provide and maintain coverage for Products/Completed Operations hazards on its Commercial General Liability insurance policy, for a period of six (6) years beyond the date of the Certificate of Substantial Performance.

#### **3) Proof of Insurance**

- (a) Before commencement of the Work, and no later than thirty (30) days after acceptance of its bid, the Contractor must deposit with Canada a Certificate of Insurance on the form attached herein.
- (b) Upon request by Canada, the Contractor must provide originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the Certificate of Insurance.

#### **4) Insurance Proceeds**

In the event of a claim, the Contractor must, without delay, do such things and execute such documents as are necessary to effect payment of the proceeds.

#### **5) Deductible**

The payment of monies up to the deductible amount made in satisfaction of a claim must be borne by the Contractor.

## CONTRACT DOCUMENTS (CD)

1. The following are the contract documents:

- a. Contract Page when signed by Canada;
- b. Duly completed Bid and Acceptance Form and any Appendices attached thereto;
- c. Drawings and Specifications;
- d. General Conditions and clauses
  - GC1 General Provisions – Construction Services R2810D (2016-04-04);
  - GC2 Administration of the Contract- R2820D (2016-01-28);
  - GC3 Execution and Control of the Work R2830D (2015-02-25);
  - GC4 Protective Measures R2840D (2008-05-12);
  - GC5 Terms of Payment R2850D (2016-01-28);
  - GC6 Delays and Changes in the Work R2860D (2016-01-28);
  - GC7 Default, Suspension or Termination of Contract R2870D (2008-05-12);
  - GC8 Dispute Resolution R2880D (2016-01-28);
  - GC9 Contract Security R2890D (2014-06-26);
  - GC10 Insurance R2900D (2008-05-12);
  - Allowable Costs for Contract Changes Under GC6.4.1 R2950D (2015-02-25);
  - Supplementary Conditions
- e. Any amendment issued or any allowable bid revision received before the date and time set for solicitation closing;
- f. Any amendment incorporated by mutual agreement between Canada and the Contractor before acceptance of the bid; and
- g. Any amendment or variation of the contract documents that is made in accordance with the General Conditions.

2. The documents identified by title, number and date above are incorporated by reference and are set out in the Standard Acquisition Clauses and Conditions (SACC) Manual, issued by Public Works and Government Services Canada (PWGSC). The SACC Manual is available on the PWGSC Web site:  
<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>

3. The language of the contract documents is the language of the Bid and Acceptance Form submitted.

## BID AND ACCEPTANCE FORM (BA)

### BA01 IDENTIFICATION

Bow Heat Recovery System  
Correctional Service Canada Regional Psychiatric Centre  
Saskatoon, Saskatchewan  
Project #: R.072342.001

### BA02 BUSINESS NAME AND ADDRESS OF BIDDER

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_

Procurement Business Number (PBN): \_\_\_\_\_

E-mail address: \_\_\_\_\_

### BA03 THE OFFER

The Bidder offers to Canada to perform and complete the Work for the above named project in accordance with the Bid Documents for the Total Bid Amount of

\$\_\_\_\_\_excluding applicable tax(es).  
(amount in numbers)

### BA04 BID VALIDITY PERIOD

The bid shall not be withdrawn for a period of thirty (30) days following the date of solicitation closing.

### BA05 ACCEPTANCE AND CONTRACT

Upon acceptance of the Contractor's offer by Canada, a binding Contract shall be formed between Canada and the Contractor. The documents forming the Contract shall be the contract documents identified in Contract Documents (CD).

### BA06 CONSTRUCTION TIME

The Contractor shall perform and complete the Work within forty (40) weeks from the date of notification of acceptance of the offer.

### BA07 BID SECURITY

The Bidder is enclosing bid security with its bid in accordance with GI08 - Bid Security Requirements of R2710T - General Instructions - Construction Services - Bid Security Requirements.

### BA08 SIGNATURE

\_\_\_\_\_  
Name and title of person authorized to sign on behalf of Bidder (Type or print)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

Contact e-mail address \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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## **APPENDIX 3 – DEPARTMENTAL REPRESENTATIVE’S AUTHORITY**

### **TO BE PROVIDED AT CONTRACT AWARD.**

#### Contracting Authority is :

Name : \_\_\_\_\_

Title : \_\_\_\_\_

Department : \_\_\_\_\_

Division : \_\_\_\_\_

Telephone : \_\_\_\_ - \_\_\_\_ - \_\_\_\_\_

e-mail : \_\_\_\_\_

#### Technical Authority is :

Name : \_\_\_\_\_

Title : \_\_\_\_\_

Department : \_\_\_\_\_

Division : \_\_\_\_\_

Telephone : \_\_\_\_ - \_\_\_\_ - \_\_\_\_\_

e-mail : \_\_\_\_\_

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Id de l'acheteur - Buyer ID : PWU107

N° de réf. du client - Client Ref. No.

File No. - N° du dossier

N° CCC / CCC No./ N° VME - FMS

## **ANNEX - A - CERTIFICATE OF INSURANCE** (Not required at solicitation closing)

See attached

**ANNEX B - VOLUNTARY REPORT FOR APPRENTICES EMPLOYED DURING THE CONTRACT (Sample)**

*This report is not required at bid deposit)*

The Contractor should compile and maintain records on the number of apprentices and their trade that were hired to work on the contract.

The Contractor should provide this data in accordance with the format below. If no apprentices were hired during the contract period, the Contractor should still provide a "nil" report.

The data should be submitted six months after the Contract award or at the end of the Contract, whichever comes first to the Contracting Authority.

Number of apprentices hired	Trade

(Add rows as needed)



**ANNEX C - LISTING OF SUBCONTRACTORS**

- 1) In accordance with GI07 - Listing of Subcontractors and Suppliers of R2710T- General Instructions - Construction Services - Bid Security Requirements, the Bidder should provide a list of Subcontractors with his Bid.
- 2) The Bidder should submit the list of Subcontractors and for any portion of the Work valued at 20% or greater of the submitted Bid Price.

	Subcontractor	Division	Estimated value of work
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			



Travaux publics et  
Services gouvernementaux  
Canada

Public Works and  
Government Services  
Canada

# CERTIFICATE OF INSURANCE

Page 1 of 2

<b>Description and Location of Work</b>  <b>Bow Heat Recovery System</b> <b>Correctional Service Canada Regional Psychiatric Centre, Saskatoon, SK</b>  <b>Description:</b> Add a new air handling unit and heat recovery system to the existing Bow Heat Recovery units located at the Correctional Service Canada Regional Psychiatric Centre located in Saskatoon, Saskatchewan.	<b>Contract No.</b> <b>E0208-162581</b>
	<b>R.072342.001</b>

Name of Insurer, Broker or Agent	Address (No., Street)	City	Province	Postal Code
Name of Insured (Contractor)	Address (No., Street)	City	Province	Postal Code
Additional Insured <b>Her Majesty the Queen in Right of Canada as represented by the Minister of Public Works and Government Services</b>				

Type of Insurance	Insurer Name and Policy Number	Inception Date D / M / Y	Expiry Date D / M / Y	Limits of Liability		
<b>Commercial General Liability</b> <b>Umbrella/Excess Liability</b>				Per Occurrence	Annual General Aggregate	Completed Operations Aggregate
				\$	\$	\$
<b>Builder's Risk / Installation Floater</b>				\$		

I certify that the above policies were issued by insurers in the course of their Insurance business in Canada, are currently in force and include the applicable insurance coverage's stated on page 2 of this Certificate of Insurance, including advance notice of cancellation / reduction in coverage.

Name of person authorized to sign on behalf of Insurer(s) (Officer, Agent, Broker)

Telephone number

Signature

Date D / M / Y

**General**

The insurance policies required on page 1 of the Certificate of Insurance must be in force and must include the insurance coverage listed under the corresponding type of insurance on this page.

The policies must insure the Contractor and must include Her Majesty the Queen in Right of Canada as represented by the Minister of Public Works and Government Services as an additional Insured.

The insurance policies must be endorsed to provide Canada with not less than thirty (30) days notice in writing in advance of a cancellation of insurance or any reduction in coverage.

Without increasing the limit of liability, the policies must protect all insured parties to the full extent of coverage provided. Further, the policies must apply to each Insured in the same manner and to the same extent as if a separate policy had been issued to each.

**Commercial General Liability**

The insurance coverage provided must not be substantially less than that provided by the latest edition of IBC Form 2100.

The policy must either include or be endorsed to include coverage for the following exposures or hazards if the Work is subject thereto:

- (a) Blasting.
- (b) Pile driving and caisson work.
- (c) Underpinning.
- (d) Removal or weakening of support of any structure or land whether such support be natural or otherwise if the work is performed by the insured contractor.

The policy must have the following minimum limits:

- (a) **\$5,000,000** Each Occurrence Limit;
- (b) **\$10,000,000** General Aggregate Limit per policy year if the policy contains a General Aggregate; and
- (c) **\$5,000,000** Products/Completed Operations Aggregate Limit.

Umbrella or excess liability insurance may be used to achieve the required limits.

**Builder's Risk / Installation Floater**

The insurance coverage provided must not be less than that provided by the latest edition of IBC Forms 4042 and 4047.

The policy must permit use and occupancy of any of the projects, or any part thereof, where such use and occupancy is for the purposes for which a project is intended upon completion.

The policy may exclude or be endorsed to exclude coverage for loss or damage caused by asbestos, fungi or spores, cyber and terrorism.

The policy must have a limit that is **not less than the sum of the contract value** plus the declared value (if any) set forth in the contract documents of all material and equipment supplied by Canada at the site of the project to be incorporated into and form part of the finished Work. If the value of the Work is changed, the policy must be changed to reflect the revised contract value.

The policy must provide that the proceeds thereof are payable to Canada or as Canada may direct in accordance with GC10.2, "Insurance Proceeds" (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual/5/R/R2900D/2>).



Public Works and  
Government Services  
Canada

Travaux publics et  
Services gouvernementaux  
Canada

Canada



## SPECIFICATION

Project No. R.072342.001  
CSC Psychiatric Centre Bow Heat Recovery  
Saskatoon, Saskatchewan  
Issued for 100% – 02 October 2015  
Solicitation No.



[www.pwgsc-tpsgc.gc.ca](http://www.pwgsc-tpsgc.gc.ca)



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**END OF TABLE**

**Part 1 General**

**1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract for PWGSC, Project No. R.072342.001 comprises of adding new air handling unit and heat recovery system to the existing Bow Heat Recovery units, located at Correctional Services Canada (CSC) Regional Psychiatric Centre, Saskatoon Saskatchewan.

**1.2 CONTRACT METHOD**

- .1 Construct Work under stipulated price contract.

**1.3 WORK BY OTHERS**

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

**1.4 WORK SEQUENCE**

- .1 Construct Work in stages to accommodate for continuous public usage of the site during construction. Do not close off public usage of the facilities until use of one stage of Work will provide alternate usage.
- .2 Contractor to coordinate with Departmental Representative to devise strategy enabling Occupants 24 hour access to their space.
- .3 Co-ordinate Progress Schedule and co-ordinate with Occupancy during construction.
- .4 Maintain fire access/control.

**1.5 CONTRACTOR USE OF PREMISES**

- .1 Unrestricted use of designated site until Substantial Performance.
- .2 Limit use of premises for Work, for storage, for access, to allow:
  - .1 Work by other contractors.
- .3 Co-ordinate use of premises under direction of Departmental Representative.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.



- .7 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

#### **1.6 OCCUPANCY**

- .1 Occupants will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Departmental Representative in scheduling operations to minimize conflict and to facilitate Occupants usage.

#### **1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations, occupants and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

#### **1.8 EXISTING SERVICES**

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hour notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance.
- .3 Provide alternative routes for personnel traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.
- .10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

#### **1.9 DOCUMENTS REQUIRED**

- .1 Maintain at job site, one copy each document as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.

- .4 Reviewed Shop Drawings.
- .5 List of Outstanding Shop Drawings.
- .6 Change Orders.
- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Building Permit
- .12 Other documents as specified.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1 General**

**1.1 ACCESS AND EGRESS**

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

**1.2 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Use only elevators in existing in building for moving workers and material.
  - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
  - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Closures: protect work temporarily until permanent enclosures are completed.

**1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

**1.4 EXISTING SERVICES**

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for personnel traffic.

**1.5 SPECIAL REQUIREMENTS**

- .1 Carry out noise generating Work Monday to Friday from 09:00 to 16:00 hours.
- .2 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart.

- .3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .4 Keep within limits of work and avenues of ingress and egress.
- .5 Deliver materials outside of peak traffic hours 17:00 to 07:00 and 13:00 to 15:00 unless otherwise approved by Departmental Representative.

**1.6 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions. Smoking is not permitted.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 ADMINISTRATIVE**

- .1 Schedule and administer project meetings throughout the progress of the work.
- .2 Departmental Representative to prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Departmental Representative, Sub-consultant and Sub-contractors.
- .4 Provide physical space and make arrangements for meetings.
- .5 Departmental Representative to record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .6 Departmental Representative to reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and affected parties not in attendance.
- .7 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.2 PRECONSTRUCTION MEETING**

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative and senior representatives of the Sub-Consultant, Contractors, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Schedule of Work: in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
  - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .5 Delivery schedule of specified equipment.
  - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
  - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .8 Owner provided products.

- .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs (GC).
- .13 Appointment of inspection and testing agencies or firms.
- .14 Insurances, transcript of policies.
- .15 Appointment of safety coordinator.
- .16 Review of health and safety procedures. Provide proof for notice to the local authority.

### 1.3 PROGRESS MEETINGS

- .1 During course of Work schedule progress meetings bi-weekly. Prior to project completion, meetings more often to facilitate project completion and take over.
- .2 Contractor, major Subcontractors involved in Work Departmental Representative are to be in attendance.
- .3 Notify parties minimum 5 days prior to meetings.
- .4 Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Construction Safety.
  - .11 Maintenance of quality standards.
  - .12 Review proposed changes and reflect on construction schedule and on completion date.
  - .13 Other business.

## Part 2 Products

### 2.1 NOT USED

- .1 Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

.1            Section .

**1.2                DEFINITIONS**

- .1            Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2            Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3            Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4            Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5            Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6            Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7            Milestone: significant event in project, usually completion of major deliverable.
- .8            Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9            Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

**1.3                REQUIREMENTS**

- .1            Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2            Plan to complete Work in accordance with prescribed milestones and time frame.
- .3            Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4            Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.



**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative 10 within working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

**1.5 PROJECT MILESTONES**

- .1 Project milestones form interim targets for Project Schedule.
  - .1 Mechanical, and electrical work completed within 120 working days of Award of Contract date.
  - .2 Interim Certificate (Substantial Completion) within 150 working days of Award of Contract date.

**1.6 MASTER PLAN**

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Departmental Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

**1.7 PROJECT SCHEDULE**

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.
  - .4 Mobilization.
  - .5 Excavation.
  - .6 Lighting.
  - .7 Electrical.
  - .8 Piping.
  - .9 Controls.
  - .10 Heating, Ventilating, and Air Conditioning.
  - .11 Fire Systems.
  - .12 Testing and Commissioning.
  - .13 Supplied equipment long delivery items.

.14 Engineer supplied equipment required dates.

## **1.8 PROJECT SCHEDULE REPORTING**

- .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

## **1.9 PROJECT MEETINGS**

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1 General**

**1.1 ADMINISTRATIVE**

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 10 working days for Departmental Representative's review of each submission.

- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .9 After Departmental Representative's review, distribute copies.
- .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

- .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that the Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
  - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that

pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

**1.3 SAMPLES**

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

**1.4 MOCK-UPS**

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of Saskatchewan
  - .1 Occupational Health and Safety Act, 1993, S.S. - Updated 2012.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit electronic copies of Contractor's authorized representative's work site health and safety inspection reports to authority having jurisdiction, weekly and to Departmental Representative.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

**1.3 FILING OF NOTICE**

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.
- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award. Contractor to submit written acknowledgement to CSST along with Ouverture de Chantier Notice.

- .3 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

#### **1.4 SAFETY ASSESSMENT**

- .1 Perform site specific safety hazard assessment related to project.

#### **1.5 MEETINGS**

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

#### **1.6 REGULATORY REQUIREMENTS**

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

#### **1.7 GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

#### **1.8 RESPONSIBILITY**

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Contractor shall be the Principal Contractor as described in the Quebec Act Respecting Health and Safety code for the Construction for only their scope and areas of work as defined and described this project specification.
- .4 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

#### **1.9 COMPLIANCE REQUIREMENTS**

- .1 Comply with R.S.Q., c. S-2.1, an Act respecting Health and Safety, and c. S-2.1, r.4 Safety Code for the Construction Industry.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

#### **1.10 UNFORSEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.



- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

#### **1.11 HEALTH AND SAFETY CO-ORDINATOR**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
  - .1 Have working knowledge of occupational safety and health regulations.
  - .2 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

#### **1.12 POSTING OF DOCUMENTS**

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

#### **1.13 CORRECTION OF NON-COMPLIANCE**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

#### **1.14 POWDER ACTUATED DEVICES**

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

#### **1.15 WORK STOPPAGE**

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

### **Part 2 Products**

#### **2.1 NOT USED**

- .1 Not used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not used.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES AND CODES**

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2010 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

**1.2 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions and municipal by-laws. No smoking inside the building or within designated perimeter of no smoking zone of the building.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 INSPECTION**

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

**1.2 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by the Contractor for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by the Contractor.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

**1.3 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

**1.4 PROCEDURES**

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

#### **1.5 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

#### **1.6 REPORTS**

- .1 Submit electronic copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested and manufacturer or fabricator of material being inspected or tested.

#### **1.7 TESTS AND MIX DESIGNS**

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

#### **1.8 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative as specified in specific sections.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 In some instances, Mock-ups may remain as part of Work. Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

**1.9 MILL TESTS**

- .1 Submit mill test certificates as required of specification Sections.

**1.10 EQUIPMENT AND SYSTEMS**

Submit adjustment and balancing reports for mechanical, electrical and building equipment systems as required.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

**1.3 INSTALLATION AND REMOVAL**

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

**1.4 WATER SUPPLY**

- .1 Departmental Representative will provide continuous supply of potable water for construction use.
- .2 Departmental Representative will pay for utility charges at prevailing rates.

**1.5 TEMPORARY HEATING AND VENTILATION**

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of Work.
  - .2 Protect Work and products against dampness and cold.
  - .3 Prevent moisture condensation on surfaces.
  - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
  - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, to not to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Departmental Representative DCC Representative.
- .8 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside.
- .9 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

#### **1.6 TEMPORARY POWER AND LIGHT**

- .1 Departmental Representative for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 240 volts 30 amps.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
- .3 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Departmental Representative DCC Representative.
- .4 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .5 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative DCC Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract.

#### **1.7 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary telephone, fax, data hook up, line(s) and equipment necessary for own use.



**1.8 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
- .2 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

**1.2 INSTALLATION AND REMOVAL**

- .1 Indicate use of supplemental or other staging area.
- .2 Provide construction facilities in order to execute work expeditiously.
- .3 Remove from site all such work after use.

**1.3 SCAFFOLDING**

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, wing staging, platforms and temporary stairs.

**1.4 ELEVATORS**

- .1 Designated existing permanent elevators may be used by construction personnel. All tools materials and equipment to be transported by freight elevators. Co-ordinate use with Departmental Representative.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

**1.5 SITE STORAGE/LOADING**

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

**1.6 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

**1.7 SECURITY**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

**1.8 OFFICES**

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

**1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

**1.10 SANITARY FACILITIES**

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Building's washroom facilities may be used on approval of Departmental Representative.

**1.11 CONSTRUCTION SIGNAGE**

- .1 No other signs or advertisements, other than warning signs, are permitted on site. Directional signage as agreed by the Departmental Representative.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

**1.12 CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to the most current version of reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.2 QUALITY**

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.
- .7 Acceptable Product/Materials;
  - .1 Acceptable Products/Materials means, those items named and specified by manufacturers' reference, meet the specification in all respects and are acceptable to Departmental Representative. Refer to Part 2 of this Section.
  - .2 No Substitution. All products listed as No Substitution in various sections are to be supplied as specified.

### **1.3 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .5 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .6 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

### **1.4 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

### **1.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

### **1.6 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

**1.7 CO-ORDINATION**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

**1.8 CONCEALMENT**

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

**1.9 REMEDIAL WORK**

- .1 Refer to Section 01 73 00 - Execution Requirements.
- .2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

**1.10 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

**1.11 FASTENINGS**

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

**1.12 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.13 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

**1.14 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Work of Owner or separate contractor.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work, and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on Work of Owner or separate contractor.
  - .7 Written permission of affected separate contractor.
  - .8 Date and time work will be executed.

**1.2 MATERIALS**

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

**1.3 PREPARATION**

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

**1.4 EXECUTION**

- .1 Fit several parts together, to integrate with other Work.
- .2 Uncover Work to install ill-timed Work.
- .3 Remove and replace defective and non-conforming Work.
- .4 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

- .5 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .6 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .7 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .8 Restore work with new products in accordance with requirements of Contract Documents.
- .9 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .10 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.
- .11 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .12 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

**1.2 FINAL CLEANING**

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1            WASTE MANAGEMENT GOALS**

- .1    Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's waste management goal.
- .2    Minimize amount of non-hazardous solid waste generated by project and accomplish maximum source reduction, reuse and recycling of solid waste.
- .3    Protect environment and prevent environmental pollution damage.

**1.2            REFERENCES**

- .1    Definitions:
  - .1    Class III: non-hazardous waste - construction renovation and demolition waste.
  - .2    Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
  - .3    Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
  - .4    Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
  - .5    Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
    - .1    Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
    - .2    Returning reusable items including pallets or unused products to vendors.
  - .6    Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
  - .7    Separate Condition: refers to waste sorted into individual types.
  - .8    Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.
  - .9    Waste Reduction Plan: Departmental Representative and General Contractor to discuss and coordinate template for worksheet. Contractor will ultimately be required to provide timely and appropriate reports.

**1.3            STORAGE, HANDLING AND PROTECTION**

- .1    Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2    Unless specified otherwise, materials for removal becomes Contractor's property.
- .3    Protect, stockpile, store and catalogue salvaged items.

- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed and salvaged materials from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .7 Separate and store materials produced during project in designated areas.
- .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Obtain waybills, receipts and/or scale tickets for separated materials removed from site.
  - .4 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

#### **1.4 DISPOSAL OF WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil and paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.
  - .5 Reused or recycled waste destination.
- .4 Remove materials on-site as Work progresses.

#### **1.5 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance as work progresses.

#### **1.6 SCHEDULING**

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

### **Part 2 Products**

#### **2.1 NOT USED**

- .1 Not Used.

**Part 3            Execution**

**3.1                APPLICATION**

- .1        Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

**3.2                CLEANING**

- .1        Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1            Leave Work area clean at end of each day.
- .2        Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3        Waste Management: separate waste materials for reuse and recycling in accordance with this Section.
  - .1            Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

Approved: 2009-06-30

**Part 1 General**

**1.1 INSPECTION AND DECLARATION**

- .1 Contractor's Inspection: Contractor and Sub-contractors: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
  - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
  - .2 Request Departmental Representative Inspection.
- .2 Departmental Representative Inspection: Departmental Representative and Contractor will perform inspection of Work and identify obvious defects and deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificates that following have been performed:
  - .1 Work has been completed and inspected for compliance with Contract Documents.
  - .2 Defects have been corrected and deficiencies completed.
  - .3 Equipment and systems have been tested, adjusted, balanced and fully operational.
  - .4 Certificates required by Boiler Inspection Branch, Fire Commissioner, Utility companies have been submitted.
  - .5 Operation of systems have been demonstrated to Departmental Representative's personnel.
- .4 Final Inspection: When items noted above are completed, request final inspection of Work by Departmental Representative and Contractor. If Work is deemed incomplete according Departmental Representative, complete outstanding items and request re-inspection.
- .5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- .6 Commencement of Lien and Warranty Periods: date of Departmental Representative's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .7 Final Payment: When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

**1.2 FINAL CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.



- .2 Remove waste, surplus materials, excess materials, rubbish, tools and equipment and construction facilities from site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Copy will be returned after final inspection, with Departmental Representative's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.
- .6 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work. Ensure spare parts are new, undamaged or defective.
- .7 Provide evidence, if requested, for type, source and quality of products supplied.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

**1.2 FORMAT**

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

**1.3 CONTENTS – EACH VOLUME**

- .1 Table of Contents for Each Volume: provide title of project;

- .1 Date of submission; names.
- .2 Addresses, and telephone numbers of Departmental Representatives and Contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
  - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
  - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
  - .5 Typewritten Text: as required to supplement product data.
    - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
  - .6 Training: refer to Section 01 79 00 - Demonstration and Training.

#### **1.4 AS -BUILT DOCUMENTS AND SAMPLES**

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

#### **1.5 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.

- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .3 Field changes of dimension and detail.
  - .4 Changes made by change orders.
  - .5 Details not on original Contract Drawings.
  - .6 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

## **1.6 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics and limiting conditions.
  - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.

- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control .
- .15 Additional requirements: as specified in individual specification sections.

#### **1.7 MATERIALS AND FINISHES**

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

#### **1.8 SPARE PARTS**

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Departmental Representative.
  - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

#### **1.9 MAINTENANCE MATERIALS:**

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Departmental Representative.
  - .2 Include approved listings in Maintenance Manual.

- .5 Obtain receipt for delivered products and submit prior to final payment.

#### **1.10 SPECIAL TOOLS**

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Departmental Representative.
  - .2 Include approved listings in Maintenance Manual.

#### **1.11 DELIVERY, STORAGE AND HANDLING**

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

#### **1.12 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.

- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include HVAC balancing, pumps, motors, transformers, commissioned systems such as fire protection, alarm systems, sprinkler systems, lightning protection systems.
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
  - .5 Procedure and status of tagging of equipment covered by extended warranties.
  - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

**1.13 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 ADMINISTRATIVE REQUIREMENTS**

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance interim completion.
- .2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3 Preparation:
  - .1 Verify conditions for demonstration and instructions comply with requirements.
  - .2 Verify designated personnel are present.
  - .3 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
  - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
  - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:
  - .1 Section 23 05 01 – Common Work Results for HVAC: 4 hours of instruction for Heat Recovery System and Equipment.
  - .2 Section 23 05 01 – Common Work Results for HVAC: 4 hours of instruction for Building Management System and Equipment.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

**1.3 QUALITY ASSURANCE**

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
  - .1 Instruct Owner's personnel.
  - .2 Provide written report that demonstration and instructions have been completed.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

**1.2 GENERAL**

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

### **1.3 COMMISSIONING OVERVIEW**

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 Departmental Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O M training has been completed.

### **1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

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

### **1.5 PRE-CX REVIEW**

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, and systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.

- .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative and Consultant for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative Consultant in writing of discrepancies and deficiencies on finished works.

#### **1.6 CONFLICTS**

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

#### **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.
    - .2 Draft Cx documentation.
    - .3 Preliminary Cx schedule.
  - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
  - .4 Provide additional documentation relating to Cx process required by Departmental Representative

#### **1.8 COMMISSIONING DOCUMENTATION**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

#### **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.

- .2 Verification of reported results.
- .3 Repairs, retesting, re-commissioning, re-verification.
- .4 Training.

#### **1.10 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings: 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Contractor who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

#### **1.11 STARTING AND TESTING**

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

#### **1.12 WITNESSING OF STARTING AND TESTING**

- .1 Provide 14 days' notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

#### **1.13 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.

- .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

#### 1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.

.3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.

.1 Rejected equipment to be remove from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

#### **1.15 START-UP DOCUMENTATION**

.1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

#### **1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

#### **1.17 TEST RESULTS**

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

#### **1.18 START OF COMMISSIONING**

.1 Notify Departmental Representative at least 21 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

#### **1.19 INSTRUMENTS / EQUIPMENT**

.1 Submit to Departmental Representative for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.



- .2 Provide the following equipment as required:
  - .1 2-way radios.
  - .2 Ladders.
  - .3 Equipment as required to complete work.

#### **1.20 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under actual accepted simulated operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

#### **1.21 WITNESSING COMMISSIONING**

- .1 Departmental Representative to witness activities and verify results.

#### **1.22 AUTHORITIES HAVING JURISDICTION**

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

#### **1.23 COMMISSIONING CONSTRAINTS**

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

#### **1.24 EXTRAPOLATION OF RESULTS**

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

#### **1.25 EXTENT OF VERIFICATION**

- .1 Elsewhere:

- .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

**1.26 REPEAT VERIFICATIONS**

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
  - .1 Verification of reported results fail to receive Departmental Representative's approval.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Departmental Representative deems Contractor's request for second verification was premature.

**1.27 SUNDRY CHECKS AND ADJUSTMENTS**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

**1.28 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

**1.29 COMPLETION OF COMMISSIONING**

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

**1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

**1.31            TRAINING**

- .1        In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

**1.32            MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

- .1        Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

**1.33            OCCUPANCY**

- .1        Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

**1.34            INSTALLED INSTRUMENTATION**

- .1        Use instruments installed under Contract for TAB and PV if:
  - .1            Accuracy complies with these specifications.
  - .2            Calibration certificates have been deposited with Departmental Representative.
- .2        Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

**1.35            PERFORMANCE VERIFICATION TOLERANCES**

- .1        Application tolerances:
  - .1            Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2        Instrument accuracy tolerances:
  - .1            To be of higher order of magnitude than equipment or system being tested.
- .3        Measurement tolerances during verification:
  - .1            Unless otherwise specified actual values to be within +/- 2 % of recorded values.

**1.36            OWNER'S PERFORMANCE TESTING**

- .1        Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

**Part 2           Products**

**2.1            NOT USED**

- .1        Not Used.

**Part 3           Execution**

**3.1            NOT USED**

- .1        Not Used.

**END OF SECTION**

Approved: 2006-03-31

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

**1.2 REFERENCES**

- .1 American Water Works Association (AWWA)
- .2 Public Works and Government Services Canada (PWGSC)
  - .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
- .3 Underwriters' Laboratories of Canada (ULC)

**1.3 GENERAL**

- .1 Provide a fully functional System:
  - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .2 Facility user and O M personnel have been fully trained in aspects of installed systems.
  - .3 Optimized life cycle costs.
  - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
  - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3 Sets out deliverables relating to O M, process and administration of Cx.
  - .4 Describes process of verification of how built works meet Owner/Investor's design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
  - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1 Overview of Cx.
    - .2 General description of elements that make up Cx Plan.
    - .3 Process and methodology for successful Cx.

- .4 Acronyms:
  - .1 Cx - Commissioning.
  - .2 BMM - Building Management Manual.
  - .3 EMCS - Energy Monitoring and Control Systems.
  - .4 MSDS - Material Safety Data Sheets.
  - .5 PI - Product Information.
  - .6 PV - Performance Verification.
  - .7 TAB - Testing, Adjusting and Balancing.
  - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

#### **1.4 DEVELOPMENT OF 100% CX PLAN**

- .1 Cx Plan to be 95% completed before added into Project Specifications.
- .2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
  - .1 Approved shop drawings and product data.
  - .2 Approved changes to contract.
  - .3 Contractor's project schedule.
  - .4 Cx schedule.
  - .5 Contractor's, sub-contractor's, suppliers' requirements.
  - .6 Project construction team's and Cx team's requirements.
- .3 Submit completed Cx Plan to Departmental Representative and obtain written approval.

#### **1.5 REFINEMENT OF CX PLAN**

- .1 During construction phase, revise, refine and update Cx Plan to include:
  - .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
- .2 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

#### **1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM**

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:

- .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
- .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
  - .1 Review of Cx documentation from operational perspective.
  - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
  - .3 Protection of health, safety and comfort of occupants and O M personnel.
  - .4 Monitoring of Cx activities, training, development of Cx documentation.
  - .5 Work closely with members of Cx Team.
- .3 Contractor is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing, certifying accuracy of reported results.
  - .4 Witnessing and certifying TAB and other tests.
  - .5 Developing BMM.
  - .6 Ensuring implementation of final Cx Plan.
  - .7 Performing verification of performance of installed systems and equipment.
  - .8 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test reports.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## 1.7

### CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:

- .1 Equipment and systems except as noted.
- .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
  - .1 To include performance verification.
- .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
- .4 Specialist Cx agency:
  - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
- .5 Client: responsible for intrusion and access security systems.
- .6 Ensure that Cx participant:
  - .1 Could complete work within scheduled time frame.
  - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
    - .1 Modify ventilation rates to meet changes in off-gassing.
    - .2 Changes to heating or cooling loads beyond scope of EMCS.
    - .3 Changes to EMCS control strategies beyond level of training provided to O M personnel.
    - .4 Redistribution of electrical services.
    - .5 Modifications of fire alarm systems.
    - .6 Modifications to voice communications systems.
- .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

## **1.8 RISK ASSESSMENT**

- .1 The Building is an active facility, as such the shut-down of systems has to be coordinated.

## **1.9 EXTENT OF CX**

- .1 Cx Structural and Architectural Systems:
- .2 Commission mechanical systems and associated equipment:
  - .1
  - .2 HVAC and exhaust systems:
    - .1 HVAC systems.
  - .3 Fire and life safety systems:
  - .4 EMCS:
    - .1 Building management System



- .3 Commission electrical systems and equipment:
  - .1 Low voltage below 750 V:
    - .1 Low voltage equipment.
    - .2 Low voltage distribution systems.
  - .2 Lighting systems:
    - .1 Lighting equipment.
    - .2 Distribution systems.
    - .3 Emergency lighting systems, including battery packs.

#### **1.10 DELIVERABLES RELATING TO O M PERSPECTIVES**

- .1 General requirements:
  - .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.
  - .5 WHMIS information.
  - .6 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

#### **1.11 DELIVERABLES RELATING TO THE CX PROCESS**

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
  - .1 Cx Specifications.
  - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
  - .3 Completed installation checklists (ICL).
  - .4 Completed product information (PI) report forms.
  - .5 Completed performance verification (PV) report forms.

- .6 Results of Performance Verification Tests and Inspections.
- .7 Description of Cx activities and documentation.
- .8 Description of Cx of integrated systems and documentation.
- .9 Tests performed by Owner/User.
- .10 Training Plans.
- .11 Cx Reports.
- .12 Prescribed activities during warranty period.
- .4 Consultant to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

#### **1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Items listed in this Cx Plan include the following:
  - .1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
  - .2 Consultant to use approved check lists.
  - .3 Consultant will monitor of these pre-start-up inspections.
  - .4 Include completed documentation with Cx report.
  - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Departmental Representative and does not form part of Cx specifications.
  - .6 Departmental Representative will monitor some of these inspections and tests.
  - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
  - .1 HVAC equipment and systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 At this time, complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
    - .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.
  - .2 EMCS:
    - .1 EMCS trending to be available as supporting documentation for performance verification.
    - .2 Perform point-by-point testing in parallel with start-up.
    - .3 Carry out point-by-point verification.
    - .4 Demonstrate performance of systems, to be witnessed by Departmental Representative prior to start of 30 day Final Acceptance Test period.

- .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
- .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .3 Pre-Cx activities - LIFE SAFETY SYSTEMS
  - .1 Include equipment and systems identified above.
    - .1 .
  - .2 Reports of test results to be witnessed and certified by Departmental Representative before verification.
- .4 Pre-Cx activities - ELECTRICAL:
  - .1 Low voltage distribution systems under 750 V:
    - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
  - .2 Lighting systems:
    - .1 Emergency lighting systems:
      - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.
  - .3 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. Departmental Representative has witnessed and certified report, demonstrate devices and zones to Departmental Representative.

#### **1.13 START-UP**

- .1 Start up components, equipment and systems.
- .2 Departmental Representative to monitor some of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .3 Performance Verification (PV):
  - .1 Approved Cx Agent to perform.
    - .1 Repeat when necessary until results are acceptable to Departmental Representative.
  - .2 Use procedures modified generic procedures to suit project requirements.
  - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
  - .4 Departmental Representative to approve completed PV reports and provide to Consultant.
  - .5 Departmental Representative reserves right to verify up to 30% of reported results at random.
  - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

**1.14 CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Perform Cx by specified Cx agency using procedures developed by Contractor and approved by Departmental Representative.
- .2 Departmental Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Departmental Representative to witness, certify reported results of, Cx activities and forward Consultant.
- .5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

**1.15 INSTALLATION CHECK LISTS (ICL)**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

**1.16 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

**1.17 PERFORMANCE VERIFICATION (PV) REPORT**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

**1.18 DELIVERABLES RELATING TO ADMINISTRATION OF CX**

- .1 General:
  - .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

**1.19 CX SCHEDULES**

- .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
    - .3 Cx agents' credentials: 60 days before start of Cx.
    - .4 Cx procedures: 2 months after award of contract.
    - .5 Cx Report format: 2 months after contract award.
    - .6 Discussion of heating/cooling loads for Cx: 2 months before start-up.
    - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

- .8 Notification of intention to start TAB: 21 days before start of TAB.
- .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
- .10 Notification of intention to start Cx: 14 days before start of Cx.
- .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
- .12 Identification of deferred Cx.
- .13 Implementation of training plans.
- .14 Cx reports: immediately upon successful completion of Cx.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
- .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

#### **1.20 CX REPORTS**

- .1 Submit reports of tests, witnessed and certified by Departmental Representative to Consultant who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Consultant.

#### **1.21 ACTIVITIES DURING WARRANTY PERIOD**

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Fine tuning of HVAC systems.
  - .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.
  - .3 Full-scale emergency evacuation exercises.

#### **1.22 TESTS TO BE PERFORMED BY OWNER/USER**

- .1 None is anticipated on this project.

#### **1.23 TRAINING PLANS**

- .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

#### **1.24 FINAL SETTINGS**

- .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

**1.25 PAYMENTS FOR CX**

- .1 To be included in Contractors Base Bid.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

.1 Section Includes:

- .1 Commissioning forms to be completed for equipment, system and integrated system.

**1.2 INSTALLATION/START-UP CHECK LISTS**

.1 Include the following data:

- .1 Product manufacturer's installation instructions and recommended checks.
  - .2 Special procedures as specified in relevant technical sections.
  - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

**1.3 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.

**1.4 PERFORMANCE VERIFICATION (PV) FORMS**

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's DCC Representative's Consultant's approval.

#### **1.5 SAMPLES OF COMMISSIONING FORMS**

- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

#### **1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS**

- .1 When additional forms are required, but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
  - .1 Additional commissioning forms to be in same format as provided by Departmental Representative

#### **1.7 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Departmental Representative with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51 - Building Management Manual (BMM).



**1.8 LANGUAGE**

- .1 To suit the language profile of the awarded contract.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 This Section specifies roles and responsibilities of Commissioning Training.

**1.2 TRAINEES**

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

**1.3 INSTRUCTORS**

- .1 Consultant will provide:
  - .1 Descriptions of systems.
  - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
  - .1 Start-Up, operation, shut-down of equipment, components and systems.
  - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
  - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
  - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

**1.4 TRAINING OBJECTIVES**

- .1 Training to be detailed and duration to ensure:
  - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
  - .2 Effective on-going inspection, measurements of system performance.
  - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
  - .4 Ability to update documentation.
  - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

**1.5 TRAINING MATERIALS**

- .1 Instructors to be responsible for content and quality.

- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.
  - .2 Operating Manual.
  - .3 Maintenance Manual.
  - .4 Management Manual.
  - .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Property Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.6 SCHEDULING**

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be 4 hours in length.
- .3 Training to be completed prior to acceptance of facility.

## **1.7 RESPONSIBILITIES**

- .1 Be responsible for:
  - .1 Implementation of training activities,
  - .2 Coordination among instructors,
  - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

## **1.8 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.

- .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 Inter-Action among systems during integrated operation.
- .10 Review of O M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

#### **1.9 VIDEO-BASED TRAINING**

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.
- .2 On-Site training videos:
  - .1 Videotape training sessions for use during future training.
  - .2 To be performed after systems are fully commissioned.
  - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

#### **Part 2 Products**

##### **2.1 NOT USED**

- .1 Not Used.

#### **Part 3 Execution**

##### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

Approved: 2005-09-30

**Part 1            General**

**1.1            SUMMARY**

- .1    Section Includes:
  - .1       This section is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.
- .2    Acronyms:
  - .1       BMM - Building Management Manual.
  - .2       Cx - Commissioning.
  - .3       HVAC - Heating, Ventilation and Air Conditioning.
  - .4       PI - Product Information.
  - .5       PV - Performance Verification.
  - .6       TAB - Testing, Adjusting and Balancing.
  - .7       WHMIS - Workplace Hazardous Materials Information System.

**1.2            GENERAL REQUIREMENTS**

- .1    Standard letter size paper 216 mm x 279 mm.
- .2    Methodology used to facilitate updating.
- .3    Drawings, diagrams and schematics to be professionally developed.
- .4    Electronic copy of data to be in a format accepted and approved by Departmental Representative.

**1.3            APPROVALS**

- .1    Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

**1.4            GENERAL INFORMATION**

- .1    Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:
  - .1       Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.
  - .2       Summary of mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
    - .1           Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
  - .3       Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.

- .4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM..
- .5 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
- .6 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
- .7 Operating and maintenance manual - Section 3.2 of BMM.
- .8 Final commissioning plan as actually implemented.
- .9 Completed commissioning checklists.
- .10 Commissioning test procedures employed.
- .11 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.
- .12 Commissioning reports.

#### **1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL**

- .1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.
- .2 Departmental Representative to review and approve format and organization within 12 weeks of award of contract.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.
- .7 Approved project shop-drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.
- .11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- .12 Maintenance program supporting information including:
  - .1 Recommended maintenance procedures and schedule.
  - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

#### **1.6 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES**

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:

- .1 General:
    - .1 Finalized commissioning plan.
    - .2 WHMIS information manual.
    - .3 Approved "as-built" drawings and specifications.
    - .4 Procedures used during commissioning.
    - .5 Cross-Reference to specification sections.
  - .2 Mechanical:
    - .1 Installation permits, inspection certificates.
    - .2 Ducting leakage test reports.
    - .3 TAB and PV reports.
    - .4 Copies of posted instructions.
  - .3 Electrical:
    - .1 Installation permits, inspection certificates.
    - .2 TAB and PV reports.
    - .3 Electrical work log book.
    - .4 Charts and schedules.
    - .5 Locations of cables and components.
    - .6 Copies of posted instructions.
  - .2 Assist Departmental Representative with preparation of BMM.
- 1.7 LANGUAGE**
- .1 The Manual Shall be in English.
- 1.8 USE OF CURRENT TECHNOLOGY**
- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
  - .2 Obtain Departmental Representative's approval before starting Work.
- Part 2 Products**
- 2.1 NOT USED**
- .1 Not used.
- Part 3 Execution**
- 3.1 NOT USED**
- .1 Not used.

**END OF SECTION**



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**END OF TABLE**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 21 13 13 – Wet Pipe Sprinkler Systems.

**1.2 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .3 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Engineer before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .4 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.
  - .2 Make changes as required and re-submit as directed by Engineer.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Maintain neat record of changes on a set of prints during construction.
  - .2 Submit to Engineer minimum five (5) working days before Substantial Completion.
  - .3 Contractor shall certify and check the accuracy of each drawing.
  - .4 Record additional changes and submit final record drawings at Total Performance.
- .9 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for Sprinkler System, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Engineer for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for Sprinkler System using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### **1.4 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 Spare sprinklers and tools in accordance with NFPA 13.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- .1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
- .2 Do verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

### **PART 3 EXECUTION**

#### **3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

#### **3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

#### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

- .1        Testing to be witness by Authority Having Jurisdiction.
- .2        Manufacturer's Field Services:
  - .1        Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2        Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3        Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.4            DEMONSTRATION**

- .1        Engineer Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2        Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3        Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4        Instruction duration time requirements as specified in appropriate sections.
- .5        Engineer will record these demonstrations on video tape for future reference.

### **3.5            PROTECTION**

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

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 05 – Common Work Results for Fire Suppression.

**1.2 REFERENCES**

- .1 National Fire Prevention Association (NFPA)
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems, latest edition.
  - .2 NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province where work is taking place.
  - .2 Indicate:
    - .1 Materials.
    - .2 Finishes.
    - .3 Method of anchorage
    - .4 Number of anchors.
    - .5 Supports.
    - .6 Reinforcement.
    - .7 Assembly details.
    - .8 Accessories.
- .4 Samples:
  - .1 Submit samples of following:
    - .1 Each type of sprinkler head.
    - .2 Signs.
- .5 Test reports:
  - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

- .6 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.
- .8 Field Quality Control Submittals:
  - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
- .2 Manufacturer's Catalog Data, including specific model, type, and size for: Pipe and fittings.
  - .1 Valves, including gate, check, and globe.
  - .2 Sprinkler heads.
  - .3 Pipe hangers and supports.
  - .4 Mechanical couplings.
- .3 Drawings:
  - .1 Sprinkler heads and piping system layout.
    - .1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings".
    - .2 Show data essential for proper installation of each system.
    - .3 Show details, plan view, elevations, and sections of systems supply and piping.
    - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings.
- .4 Design Data:
  - .1 Calculations of sprinkler system design.
  - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports: Preliminary tests on piping system.
- .6 Records:
  - .1 As-built drawings of each system.
    - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
    - .2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.

- .7 Operation and Maintenance Manuals:
  - .1 Provide hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

## **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company or person specializing in wet sprinkler systems with documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
  - .1 Store materials indoors in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 PRODUCTS**

### **2.1 DESIGN REQUIREMENTS**

- .1 A professional Engineer licensed to practice in Saskatchewan is required to perform and seal the design.



- .2 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13 latest edition, by pipe schedules for light hazard occupancy or hydraulic calculations for uniform distribution of water over design area.
- .3 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .4 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings. Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Location of Sprinkler Heads:
  - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for light hazard occupancy 20.9m<sup>2</sup> per head].
  - .2 Uniformly space sprinklers on branch.
- .7 Water Distribution:
  - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
  - .2 Discharge from individual heads in hydraulically most remote area to be 100 % of specified density.
- .8 Density of Application of Water:
  - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
  - .2 Application to horizontal surfaces below sprinklers shall be 0.38 lpm per m<sup>2</sup>.
- .9 Sprinkler Discharge Area:
  - .1 Area: hydraulically most remote 279 m<sup>2</sup> area as defined in NFPA 13.
- .10 Outside Hose Allowances:
  - .1 Include allowance in hydraulic calculations of 378 lpm for outside hose streams.
- .11 Friction Losses:
  - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- .12 Water Supply:
  - .1 Base hydraulic calculations on existing water supply reading on existing sprinkler system pressure gauges.

## **2.2 ABOVE GROUND PIPING SYSTEMS**

- .1 Provide fittings for changes in direction of piping and for connections.
  - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will not be permitted.
- .3 Conceal piping in areas with suspended ceiling and paint piping in areas exposed. Coordinate paint color with Architects and Owner.

## **2.3 PIPE, FITTINGS AND VALVES**

- .1 Pipe:
  - .1 Ferrous: to NFPA 13.
  - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
  - .1 Ferrous: screwed, welded, flanged or roll grooved.
    - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
  - .2 Copper tube: screwed, soldered, brazed, grooved.
  - .3 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
  - .4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
  - .5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
  - .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
  - .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
  - .8 Side outlet tees using rubber gasketed fittings are not permitted.
  - .9 Sprinkler pipe and fittings: metal.
- .3 Valves:
  - .1 ULC listed for fire protection service.
  - .2 Gate valves: open by counter-clockwise rotation.
  - .3 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.
  - .4 Provide gate valve in piping protecting elevator hoist ways, machine rooms, and machinery spaces.
- .4 Pipe hangers:

- .1 ULC listed for fire protection services in accordance with NFPA.

## **2.4 SPRINKLER HEADS**

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Head Type:
  - .1 Type A: upright bronze.
  - .2 Type B: pendent chrome link and lever type.
  - .3 Type C: pendent chrome glass bulb type.
  - .4 Type D: recessed pendent polished chrome glass bulb type with ring and cup.
  - .5 Type E: concealed polished chrome link and lever type.
  - .6 Type F: side wall polished chrome link and lever type.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
  - .1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.
  - .2 Provide polished stainless steel ceiling plates or chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings.
  - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
  - .4 Provide sprinkler heads as indicated.
  - .5 Deflector: not more than 75 mm below suspended ceilings.
  - .6 Ceiling plates: not more than 25 mm deep.
  - .7 Ceiling cups: not permitted.

## **2.5 PRESSURE GAUGES**

- .1 ULC listed and to Section 23 05 19 - Thermometers and Pressure Gauges - Piping Systems.

## **2.6 PIPE SLEEVES**

- .1 Provide pipe sleeves where piping passes through walls, floors.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
  - .1 Firmly pack space with mineral wool insulation.
  - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.

- .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
  - .1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.
  - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
  - .1 Provide 0.61 mm thick galvanized steel sheet.

## **2.7 ESCUTCHEON PLATES**

- .1 Provide one piece type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished stainless steel plates, chromium-plated finish on copper alloy plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

## **2.8 INSPECTOR'S TEST CONNECTION**

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

## **2.9 SIGNS**

- .1 Attach properly lettered and approved metal signs to each valve and alarm device to NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

# **PART 3 EXECUTION**

## **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

### **3.3 PIPE INSTALLATION**

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

### **3.4 DISINFECTION**

- .1 Disinfect new piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

### **3.5 FIELD PAINTING**

- .1 Clean, pre-treat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pre-treatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.

- .8 Provide primed surfaces with following:
  - .1 Piping in Finished Areas:
    - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
    - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
    - .3 Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.
  - .2 Piping in Unfinished Areas:
    - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
    - .2 Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands] spaced at maximum of 6 m intervals.

### 3.6 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
  - .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
  - .2 Test, inspect, and approve piping before covering or concealing.
  - .3 Preliminary Tests:
    - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
    - .2 Flush piping with potable water in accordance with NFPA 13.
    - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
    - .4 Test alarms and other devices.
    - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
  - .4 Formal Tests and Inspections:
    - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
    - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
    - .3 Repeat required tests as directed.
    - .4 Correct defects and make additional tests until systems comply with contract requirements. Furnish equipment, instruments, connecting devices, and personnel for tests.

- .5 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Site Tests:
  - .1 Testing to be witnessed by authority having jurisdiction.
  - .2 Develop, with Departmental Representative, detailed instructions for O & M of this installation.
- .4 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Low-emitting materials.

### **3.7 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section includes:

.1 Common work results for HVAC.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- .1 ASHRAE 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings
- .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)
- .3 Canadian Standards Association (CSA)
- .1 CAN/CSA-C22.2 No. 100, Motors and Generators
- .2 CAN/CSA-C747, Energy Efficiency for Single- and Three-Phase Small Motors
- .3 CAN/CSA-C390, Energy Efficiency Test Methods for Three-Phase Induction Motors
- .4 Underwriter's Laboratories of Canada (ULC)
- .5 SMACNA
- .1 HVAC Air Duct Leakage Test Manual
- .2 HVAC Duct Construction Standards – Metal and Flexible

**1.3 REGULATORY REQUIREMENTS**

- .1 Refer carefully to other parts of the specifications.
- .2 Conform to the requirements and recommendations of all local municipal, provincial and federal codes, by-laws and ordinances.
- .3 Do not reduce the quality of work specified and/or shown on the drawings because of the Regulatory requirements.

**1.4 APPLICABLE CODES AND STANDARDS**

- .1 In general and as applicable, the physical and chemical properties, the characteristics and the performance of items in this Division shall be as noted in the following:
- .1 Canadian Standards Association.
- .2 American National Standards Institute.
- .3 Provincial Building Code.
- .4 Civic Building By-Laws.



- .5 Civic Water Works By-Laws and Sewer By-Laws.  
.6 Provincial Fire Code.  
.7 Worker's Compensation Board Requirements.  
.8 American Society for Testing and Materials.  
.9 Canadian Government Specifications Board.  
.10 National Fire Protection Association.  
.11 Canadian Council of Ministers of the Environment Codes.  
.12 Underwriters' Laboratories of Canada.

## 1.5 LATEST EDITIONS

- .1 The latest edition of all codes and standards, of the date of tender submission, shall apply; except for specific editions referenced by overriding codes.

## 1.6 AUTHORITIES HAVING JURISDICTION (AHJ)

- .1 Comply with all requirements of Authorities with competent jurisdiction, AHJ, including authorized inspectors, without additional compensation.

## 1.7 PERMITS, FEES AND CERTIFICATES

- .1 In addition to the requirements in Division 01, obtain all required Certificates of Inspection for the work and deliver same to the Engineer before request for substantial performance. These include but are not limited to:
  - .1 Equipment start-up reports.
  - .2 Fire, smoke, and combination fire/smoke damper test reports.
- .2 Correct installed work as directed by the local Authorized Inspector of the Regulatory body without extra compensation.

## 1.8 CONSTRUCTION SCHEDULE

- .1 The following requirements are in addition to those specified elsewhere. All reports refer to the final successful report. Include other tasks requested by the Engineer.
- .2 Schedule individual HVAC tasks at no more than 4 weeks. Split larger tasks by floor or other approved means, to ensure individual tasks do not exceed the duration limit. Similarly, limit all tasks to maximum one-week duration during the last 6 weeks prior to Substantial Completion, and to Total Completion.

## 1.9 EQUIPMENT LIST

- .1 Compile a complete list of HVAC equipment and materials to be used on this project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.
- .2 Submit for review within ten (10) days after award of contract.

**1.10 SAFETY FEATURES**

- .1 Provide safety features on all equipment to ensure safe operation and maintenance including belt, coupling, and other guards, screened fan intakes and discharges where inadequate ductwork for protection, safety interlocks and labels.

**1.11 QUALITY OF MATERIALS**

- .1 Furnish new materials, apparatus or products required for the work, of first class quality, delivered, erected, connected up and finished in every detail.
- .2 The use of any or all materials is subject to the approval of the Engineer.
- .3 Unless otherwise specified, all products shall be CSA approved.
- .4 All fire protection materials and products shall be ULC approved.
- .5 If materials, apparatus or products are not CSA or ULC approved, obtain approval of the provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .6 Confirm colours with the Architect before ordering.

**1.12 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data for all products and equipment specified within Division 22 must be submitted to the Engineer for review.
- .3 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances (e.g. access door swing spaces).
- .4 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.

**1.13 SPECIFIED EQUIPMENT AVAILABILITY**

- .1 If specified equipment is not available (due to delays in delivery) at scheduled installation time an acceptable alternate shall be installed AT THE CONTRACTOR'S EXPENSE and replaced with the specified equipment when the specified equipment becomes available with no additional compensation.

**1.14 COORDINATION**

- .1 Coordinate design with other disciplines, taking into account all project requirements.
- .2 Coordinate installation with other trades. To avoid conflicts, early in the project discuss proposed routing of ductwork, piping and locations of equipment with other trades.

**1.15 ELECTRICAL WORK**

- .1 Refer also to Section 23 09 93 – Sequence of Operation for HVAC Controls.
- .2 Division 23 is responsible for the supply, physical installation, and operation of all electric motors, temperature and humidity controls systems, combustion controls systems, and other electrical devices and systems specified under its portion of the work. Bear full responsibility for factory installed wiring and equipment on packaged equipment, be responsible where detailed in equipment requirements for controlling devices such as, but not restricted to, pump and liquid level controls, multi-speed motor controllers, boiler controls, etc., which are necessarily integrally mounted on packaged equipment.
- .3 Submit detailed composite wiring diagrams for all control systems as specified and as required for the HVAC work for review by the Engineer. Distribute copies of reviewed drawings to the Electrical Division for their reference.
- .4 Provide all wiring in approved rigid conduit to suit temperature and moisture conditions of area through which wire is to run. All wiring is in accordance with the relevant Electrical Codes, and in no case smaller than #12 AWG. Comply fully with the electrical specifications for all electrical work.

**1.16 ELECTRICAL CHARACTERISTICS**

- .1 Check with the electrical trade and provide all mechanical items with correct electrical characteristics to suit the electrical work.
- .2 If correct characteristics are not available from the specified equipment manufacturer, contact the Engineer prior to the close of tenders.
- .3 At time of ordering HVAC equipment, confirm electrical characteristics with the electrical contractor, and ensure that they have been confirmed with the power authority.
- .4 No additional compensation will be paid for problems arising from incorrect electrical characteristics.

**1.17 PAINTING**

- .1 Refer to Section 09 91 00 – Painting.
- .2 All paint shall be top quality enamel or as approved by the Engineer, applied in strict accordance with the manufacturer's recommendations and the Engineer's instructions.

- .3 Prime and touch up marred finished paintwork to match original. Unmatched painting is not acceptable.
- .4 Finishes that have been damaged too extensively to be simply primed and touched up shall be restored to new condition and Engineer's satisfaction.
- .5 Be responsible for advising the painter as to the colors and identification of the piping, flow directions, etc.

#### **1.18 CUTTING, PATCHING, REPAIRING, MAKING GOOD**

- .1 In addition to the requirements in Division 01, each trade requiring such work shall be responsible for necessary cutting. Patching by appropriate trade. All work to be performed by experienced tradesmen.
- .2 Neatly perform cutting and patching work to blend smoothly with surrounding surfaces.
- .3 Patch and make good disturbed surfaces to match existing adjacent work. Leave finished, neat, to Engineer's approval.
- .4 Perform X-ray examination of wall and floors prior to making openings, where required to avoid damage to structural reinforcements and electrical conduits.

#### **1.19 TESTS**

- .1 In addition to the requirements in Division 01, carry out all tests hereinafter noted, as required by the regulatory agencies and as requested by the Engineer and furnish all labour and equipment required for such tests without extra compensation.
- .2 Before activating systems, recheck equipment, check all connections, set all controls for proper start-up, obtain necessary clearances from the electrical division, etc.
- .3 Submit to the Engineer, legible report for all tests conducted, within one week of the test.
- .4 Notify the Engineer at least two (2) working days ahead of all tests, so that the tests can be witnessed on a random basis.

#### **1.20 TRIAL USAGE**

- .1 Engineer may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

#### **1.21 CLEANING**

- .1 Refer to Section 01 74 11 – Cleaning.
- .2 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

**1.22 FUNCTIONAL TESTING**

- .1 Test all HVAC equipment, devices and systems. Test as required by the AHJ and Engineer, submitting comprehensive reports. Example forms are available from the Engineer.
- .2 Ensure all tests demonstrate compliance with the specified and manufacturers' shop drawing and catalogued performance, as well as compliance with applicable standards.

**1.23 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS**

- .1 In addition to the requirements in Division 01, supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Manufacturers, or expert suppliers, to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Engineer or Owner may record these demonstrations on videotape for future reference.
- .6 Submit training schedule and scope description to the Engineer for review and approval for each training topic. Training shall not commence until approval of training schedule and scope if given by the Engineer.

**1.24 SPARE PARTS**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals and as follows:
  - .1 One set of packing for each packed pump.
  - .2 One mechanical seal for each size and type of pump utilizing a mechanical seal.
  - .3 One casing joint gasket for each size and type of pump.
  - .4 One head gasket for each tube-in-shell heat exchanger.
  - .5 One plate gasket set for each plate-and-frame heat exchanger.
  - .6 One glass for each gauge glass.
  - .7 One set of filter media/cartridges, for each filter or filter bank in addition to final operating set.
  - .8 One set of belts for each piece of belt-driven equipment.

**1.25 SPECIAL TOOLS**

- .1 Provide one set of special tools required to service equipment in accordance with Section 01 78 00 - Closeout Submittals and as recommended by manufacturers.

- .2 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

#### **1.26 CLOSEOUT SUBMITTALS**

- .1 In addition to the requirements of Section 01 78 00 – Closeout Submittals, provide the following in the Operating and Maintenance Manuals. Edit all general data to specifically apply to this project. Pay particular attention to safety requirements.
- .2 Operation data provided by manufacturer, and to include:
  - .1 Control schematics for each system including environmental controls.
  - .2 Description of each system and its controls.
  - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
  - .4 Operation instruction for each system and each component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valve schedule and flow diagram.
  - .7 Colour coding chart.
- .3 Maintenance data provided by manufacturer, and shall include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task duration.
  - .3 Parts list including model numbers for replacement parts. Include contact name and phone number.

- .4 Performance data to include:
  - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified elsewhere.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Additional data:
  - .1 Prepare and insert additional material into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.
- .6 Submit for review by Engineer, and make final additions and adjustments as directed.

#### **1.27 RECORD DRAWINGS**

- .1 Maintain neat record of changes on a set of prints during construction.
- .2 Submit to Engineer a minimum of five (5) working days before Substantial Completion.
- .3 Contractor shall certify and check the accuracy of each drawing.
- .4 Record additional changes and submit final record drawings at Total Performance.

#### **1.28 SUBSTANTIAL COMPLETION / CERTIFICATION BY ENGINEER / LIFE SAFETY SUBMISSIONS**

- .1 Provide minimum notice of ten (10) working days to the Engineer prior to request to declare project substantially complete. Failure to do so may result in site review by Engineer being delayed.
- .2 In addition to the requirements of Division 01 submit the following (as applicable) a minimum of five (5) working days ahead of required proposed date of substantial completion (unless a longer period of time is dictated by Authorities Having Jurisdiction):
  - .1 All certificates and documentation required by Authorities Having Jurisdiction.
  - .2 Fire and smoke damper test reports.
  - .3 Smoke exhaust/management systems commissioning reports
  - .4 Equipment start-up reports.
  - .5 Control systems commissioning reports pertaining to equipment/systems required for life safety system operation (i.e. ventilation interlocks/unit operation, CO detection/exhaust systems, etc.).
  - .6 Test reports for backflow prevention devices with test taps.
  - .7 Written confirmation that propane system is approved by the utility and/or Authority Having Jurisdiction, and turned on.

- .8 Record ('As-Built') drawings.
- .9 Operation and Maintenance Manuals, complete with revisions as directed.
- .10 Written confirmation that all life safety and health systems are fully functional, including but not limited to ventilation, both supply and exhaust.
- .11 Written confirmation that all HVAC equipment is operational and under control, indicating exceptions and temporary controls/arrangements.
- .12 All other life safety and health reports and certificates.
- .3 Confirm, in writing, systems are ready for occupancy and use for intended purpose in every respect.
- .4 Before certification date submit detailed written confirmation of completion of deficient life safety work noted in the documentation listed above, including date completed.
- .5 Before certification date submit detailed written confirmation of completion of deficient non-life safety work, including that noted in Engineer reports, listing each deficient item. Submit schedule for completion of all deficient non-life safety work that will not be completed prior to the certification date, listing each deficient item for consideration.
- .6 These requirements apply to each phase of a phased project.

## **1.29 FAN CONNECTIONS**

- .1 Inlet and discharge conditions are critical to proper fan performance. Review proposed fan installations and ensure that proper conditions are provided; add straightening vanes or turning vanes where required.
- .2 In general, provide a minimum of three (3) wheel diameters of straight duct immediately upstream of the fan inlet.
- .3 Review special cases with the Engineer and TAB Contractor prior to installation.

## **PART 2 PRODUCTS**

### **2.1 MOTORS**

- .1 Motors to be high efficiency, in accordance with local Hydro company standards, the requirements of ASHRAE 90.1, and National Energy Code of Canada
- .2 Comply with all Canadian Electrical Code requirements, and in particular CSA C22.2 No. 100, c/w CSA label, unless otherwise specified.
- .3 Motors included in the scope of CAN/CSA-C747 shall have a nominal full-load efficiency not less than the minimum specified in that standard. Efficiency ratings of motors included in the scope of this standard shall be based on a statistically valid quality control procedure conforming to the standard. Nameplates shall list the nominal full-load motor efficiency.





- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed.

## **2.4 GUARDS**

- .1 Provide guards for all drives as specified and required by Authorities Having Jurisdiction.
- .2 Guards for belt drives (minimum requirements):
  - .1 Expanded galvanized metal screen welded to galvanized steel frame.
  - .2 Minimum 1.2 mm thick galvanized sheet metal tops and bottoms.
  - .3 Prime coat for painting.
  - .4 38 mm diameter holes on both shaft centres for insertion of tachometer.
  - .5 Allow movement of motors for adjusting belt tension.
- .3 Guards for flexible couplings (minimum requirements):
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Prime coat for painting.
- .4 Guards are to be readily removable to permit servicing of equipment.
- .5 Provide means to permit lubrication and use of test instruments with guards in place.
- .6 Ensure that all guards are securely fastened in place, sufficiently sturdy to provide the required safety and free of rattles and excess vibration.

## **2.5 FIRE SEPARATION REPAIR**

- .1 Refer to Section 07 84 00 – Firestopping.
- .2 Cooperate fully with other trades to ensure maintenance of the rating of fire separations that are penetrated, in strict compliance with the manufacturer's recommendations and requirements of the AHJ.

## **2.6 ACCESSIBILITY**

- .1 Refer to Section 10 90 00 – Miscellaneous Specialties for access door specification.
- .2 Be responsible for supplying and locating all access panels in the ceiling, wall, partitions, etc., where openings are necessary for the inspection, servicing and/or removal of equipment, valves and other items that require periodic access. Panel type to suit the construction of the ceilings, walls, partitions, etc., in which they are located. Determine the location subject to the approval of the Engineer. Access panels to be installed by trade experienced in work with surface in which the panel is to be installed.

- .3 Mark mechanical access points in accessible ceilings with distinctive but inconspicuous tags properly attached to the ceiling grid. Obtain sample approval before purchase and installation. Indicate on record drawings.
- .4 Accessibility shall be defined as:
  - .1 Ability to place both hands on equipment or device, with no duct, pipe or other equipment in the way.
  - .2 Must be accessible while standing on maximum 2400 mm high stepladder.
  - .3 Must be in plain view.
- .5 Mark mechanical access points in accessible ceilings with distinctive but inconspicuous tags properly attached to the ceiling grid. Obtain sample approval before purchase and installation. Indicate on record drawings.

## **2.7 SLEEVES AND PENETRATIONS**

- .1 Install sleeves for all piping passing through floors and walls.
- .2 Sleeves as specifically noted, or through structural walls shall be Schedule 40 steel. All other sleeves are 6 mm galvanized sheet steel.
- .3 Fit sleeves flush on either side of the wall through which they pass, extend sleeves through floors and terminate 50 mm above finished floor. Adjust as necessary to accommodate the requirements of through-penetration fire-stopping systems.
- .4 Where passing through walls, make sleeves a minimum 6 mm clear of the piping, through floors make sleeves a minimum of 20 mm clear of the piping. Pack for full depth with fiberglass insulation & finish with a lagging compound. Penetrations through fire separations shall be repaired to maintain rating.
- .5 Provide escutcheon plates with setscrews to completely cover openings for all exposed pipes passing through walls, subject to the approval of the Engineer. Provide chrome-plated plates in finished areas unless otherwise approved.
- .6 Be responsible for maintaining integrity of building envelope when making penetration to install equipment or devices. Enlist services of qualified trade to make openings in and/or repairs to building envelope.
- .7 Sleeving through steel beams shall be permitted only where approved by the Engineer in writing or where expressly indicated on the Contract Documents. Sleeves are NOT permitted in concrete beams.
- .8 Seal all sleeves to make watertight.

## **2.8 COUNTER FLASHINGS**

- .1 In addition to the requirements in Division 01, provide watertight, non-corroding, counter flashings for all penetrations of the building envelope, painted to match adjacent materials

after proper preparation and painting. Refer to drawings, including building drawings, for additional information.

- .2 Installation to allow for movement and accommodate high temperatures where necessary.
- .3 For short pipes, the flashing may overlap the end, in lieu of attachment to the pipe. Minimum 300 mm high above the roof, c/w water break above maximum water level on the roof, to negate wind effects.
- .4 All galvanized material to be 0.7 mm thick minimum.
- .5 In exposed locations, flashings must be aesthetically acceptable to the Engineer.
- .6 Co-ordinate with all other trades including roofer and metal wall panel installer.
- .7 For copper pipe use 0.82 mm sheet copper, soldered to pipe end c/w solder joints.
- .8 For galvanized ducts use galvanized sheet metal soldered to the duct and c/w soldered joints.
- .9 For cast iron and steel pipes at normal temperature, use manufactured stretch fit heavy neoprene flashings c/w galvanized protective layer.
- .10 For hot pipes clamp galvanized to the pipe with a temperature rated gasket and stainless steel worm gear clamp.
- .11 For aluminum and stainless steel, use the same materials for the flashing.
- .12 For manufactured hoods, fans and rooftop unit mounting, apply a low density neoprene gasket all around and fasten securely.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- .1 All Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Do not scale the Drawings. Consult the Architectural Drawings and details for exact locations of fixtures and equipment; where some are not definitely located, obtain this information from the Engineer.
- .2 Follow Drawings as closely as possible in laying out work and check Drawings of all other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. When headroom or space conditions appear inadequate, notify the Engineer before proceeding with the installation.
- .3 Make reasonable modifications in the layout as needed without extra compensation to prevent conflicts with work of other trades or for proper execution of the work. This shall include, but not necessarily be confined to, offsets in piping or ducts, transformation in

ductwork and relocation of ducts and piping up to 3.0 m either way on each item as required to suit on site job conditions.

- .4 Where variances occur between the Drawings and Specifications or within either document itself, include in the contract, the item or arrangement of better quality, greater quantity, and higher cost or clarify before tenders close. The final decision on the item and manner in which work is installed rests with the Engineer.
- .5 Provide, with all trades involved, marked-up drawings, when requested, of mechanical spaces indicating all dimensions for all installations prior to the work being done. Report any discrepancies to the Engineer. Any conflicts arising that may have been resolved by laying the work out in this manner will be resolved WITHOUT ADDITIONAL COMPENSATION.
- .6 Provide 48 hours minimum notice to Engineer and Owner of all work before it is concealed. Expose concealed work for inspection, upon request, when proper notice was not provided and pay all costs therefore, including making good other trades' work.

### **3.2 SURVEYS AND MEASUREMENTS**

- .1 Base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements shown on the Drawings at the site, and check the correctness of same as related to the work.
- .2 Notify the Engineer if any discrepancy is discovered between the actual measurements and those indicated which prevent following good practice or the intent of the Drawings & Specifications. Do not proceed with the work until receiving instructions from the Engineer.

### **3.3 CO-ORDINATION**

- .1 Give full co-operation to those doing work under other Divisions of the specifications and furnish in writing with copies to the Engineer any information necessary to permit the work of all Divisions to be installed satisfactorily and with least possible interference or delay.
- .2 Discuss work with other Divisions prior to installation. Confirm proposed locations for equipment installed by this Division will not interfere with work installed by others.
- .3 If work is installed before coordinating with other trades or so as to interfere with work of other trades, make necessary changes in the work to correct the conditions without extra compensation.
- .4 When requested, provide marked up drawings indicating required clearances for installation of plumbing equipment. Provide section drawings indicating location of other equipment not installed by Division 23, such as other equipment and piping,, cable trays, etc. Report any discrepancies to the Engineer.

### **3.4 ACCESSIBILITY**

- .1 Locate all equipment that must be serviced, operated or maintained in fully accessible positions, with minimum interference and maximum usable space. If required for better accessibility, furnish access doors for this purpose. Make deviations from Drawings to allow for good accessibility, obtaining prior approval for changes of magnitude.

### **3.5 SCAFFOLDING, RIGGING, HOISTING**

- .1 Unless otherwise specified, furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment apparatus furnished. Remove same from the premises when no longer required.
- .2 Take precautions not to overload the structure in any manner nor provide inadequate scaffolding and rigging so as to endanger the safety of personnel on the site whether under this Division's employ or otherwise.

### **3.6 CUTTING AND PATCHING**

- .1 Cutting shall be performed neatly by this trade. No hammering or other methods are permitted without approval of the Engineer and other trades affected. Utilize a rebar detector and stud finder to ensure cutting does not damage other elements.
- .2 Patching is to be done by the appropriate trade. Arrange and pay for all patching not specifically specified elsewhere in these specifications, including fire rated patching at fire separations.
- .3 Fill voids around pipes and ducts with fiberglass batt insulation and sheet metal closure strips. For fire separations, install fire stop material in accordance with manufacturer's details as required to meet the UL classification and to match separation rating. Ventilate adequately during curing. Provide adequate structural support in larger spaces. Install slightly above floors to provide positive drainage away from pipe or duct.
- .4 Provide a structural shop drawing stamped by a Professional Engineer showing all reinforcements required for openings through the structure. Allow for all costs of the reinforcement.

### **3.7 SUPPORTS**

- .1 Provide all necessary and recommended supports for all equipment furnished under this Division. Co-ordinate and facilitate all necessary and recommended foundations, pads, bases and piers provided under other Divisions for equipment furnished or installed under this Division.

### **3.8 WATERPROOFING**

- .1 Obtain approval for the installation method employed where any work pierces waterproofing concrete and waterproofing. Furnish all necessary grout rings sleeves, caulking, curbs, counter flashing and flashing required to make openings through roofs, walls, floors, etc., absolutely watertight. This applies to, but is not restricted to, roof

exhausters, relief vents, penthouses, ducts, grilles, pipes, etc. Work involving the roofing is done in conjunction with the roofing Division. Work passing through roofing is to be done in accordance with applicable C.R.C.A. "FL" Series details.

### **3.9 PROTECTION**

- .1 Protect the work and material of all other sections from damage and make good all damage thus caused, to the satisfaction of the Engineer.
- .2 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

### **3.10 CLEANING**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 All dirt, rubbish, or grease on walls, floors or fixtures for which this Division is responsible must be removed and the premises left in first class condition in every respect.
- .3 Perform cleaning operations in accordance with manufacturer's recommendations.
- .4 Clean all HVAC piping and equipment and leave in a condition to receive paint.
- .5 Clean the interior of all ductwork. Ducts 750 x 300 mm and larger shall be vacuumed by hand. Power vacuum ducts smaller than 750 x 300 mm through duct openings, etc.

### **3.11 EQUIPMENT START-UP**

- .1 HVAC contractor shall ensure that all electrical/HVAC components match and that it is safe to start-up HVAC equipment.
- .2 All support such as electrical contractor, controls contractor, etc., shall be arranged by the mechanical and all trades directly involved in equipment being started shall be present for start-up.

### **3.12 MANUFACTURERS' RECOMMENDATIONS**

- .1 Install, adjust, test, start-up, and maintain all equipment in strict accordance with the manufacturer's recommendations. If in conflict with the drawings and specifications, contact the Engineer for clarification.
- .2 Ensure that the manufacturer recommends the product for its intended use. If in doubt, contact the Engineer.

### **3.13 PERSONNEL PROTECTION**

- .1 In addition to the requirements in Division 01, provide visual warning signs and/or markers and mechanical protection devices for all mechanical items mounted below the minimum limits listed below and suspended more than 1500mm clear of the floor.





## **PART 1 GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:

.1 Material and installation of pipe work in general.

### **1.2 REFERENCES**

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
- .1 ANSI/ASME B24, Cast Copper Alloy Pipe Flanges and Flanged Fittings.
- .2 ANSI/ASME B39, Malleable Iron Threaded Pipe Unions.
- .3 ANSI/ASME B42, Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.
- .2 American Society for Testing and Materials (ASTM)
- .3 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.9 – Building Services Piping.
- .4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

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

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Installations shall include all devices, attachments, equipment, components and piping necessary to form a complete working system to code requirements.

### **2.2 VALVES**

- .1 Refer to the specific pipe specification sections for valve types.

- .2 All valves of one type (e.g. gate valves) must be of one manufacturer. Ensure that working pressure, size and manufacturer's name are cast or stamped into the body of each valve.
- .3 Use O. S. & Y. design on all valves 100 mm and larger unless specifically noted otherwise.
- .4 Provide valves with hand wheels accessible for operation.

## **2.3 STRAINERS**

- .1 Provide Y-type strainers where, indicated on the drawings and where specified herein, in piping system, full size of the connected piping ahead of each pump, control valve, meter, etc. Install bucket or basket strainers only where indicated on the drawings.
- .2 All strainers shall have the same end connections and working pressure as the attached piping is specified.
- .3 Use monel screens with a reinforced edge. Perforations shall be 0.8 mm for steam, 1.6 mm for condensate, 3.2 mm for chilled and hot water, and 3.2 mm ahead of pumps.
- .4 Provide 20 mm blow-off lines with ball valves, piped directly to drain on all strainers over 50 mm.

## **2.4 DIELECTRIC PIPE FITTINGS /UNIONS**

- .1 Dielectric fittings factory certified to withstand a minimum of 600 volts on a dry line with no flashover. Unions rated at 1.7 MPa conforming to ANSI B16.39. Flanged fittings rated at 1.2 MPa conforming to ANSI B16.24 (bronze) and B16.42 (iron).

## **2.5 PIPE SLEEVES AND SEALS**

- .1 Where piping penetrates below grade walls or floors:
  - .1 Seal: modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening complete with 316 stainless steel fasteners. Seal elements shall be sized and selected per manufacturer's recommendations and be suitable for the required fire-resistance rating and anticipated environmental conditions. Standard of acceptance: 'Link-Seal'.
  - .2 Sleeve: custom-sized molded HDPE sleeves matched to the mechanical seal dimensions complete with reinforcing ribs, end caps, and integrally formed hollow water stop having a minimum outside diameter 100 mm larger than the diameter of the sleeve itself and allowing 13 mm movement between wall forms to resist pour forces. Standard of acceptance: 'Century-Line'
- .2 Elsewhere: Schedule 40 black steel pipe sleeve.

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**PART 3 EXECUTION**

**3.1 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping is subject to movement.

**3.2 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

**3.3 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Provide air vents as required to assist in draining the piping.
- .5 Drain valves: Ball valves unless otherwise approved, NPS 3/4 minimum. Provide hose end male thread, cap and chain where not piped to drain

**3.4 AIR VENTS**

- .1 Install manual air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air vent.
- .3 Install drain piping to approved location and terminate where discharge is visible.

**3.5 DIELECTRIC COUPLINGS**

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.

- .4        Over NPS 2: Isolating flanges.

### **3.6                PIPEWORK INSTALLATION**

- .1        Install exposed piping, equipment, rectangular cleanouts and similar items approximately as shown, parallel or perpendicular to building lines and as close to the structure as possible.
- .2        Conceal all piping except where otherwise approved. Install concealed piping to minimize furring space, maximize headroom, and conserve space.
- .3        Exposed piping must be carefully installed to be pleasing to the eye and meet the Architect's requirements.
- .4        Install all pipe mounted control devices, such as control valves and wells.
- .5        Assemble piping using fittings manufactured to ANSI standards.
- .6        Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7        Use only eccentric reducing fittings at pipe size changes, installed with the piping in line at the top to ensure positive drainage and venting.
- .8        Use only long radius welding or soldered fittings in expansion loops, not screwed fittings.
- .9        American National Taper pipe thread must be used for all thread connections. Remove burrs and chips and ream or file the pipe ends out to size of bore.
- .10       Leave not more than 2 threads exposed on threaded joints when made up.
- .11       Screwed fittings jointed with Teflon tape.
- .12       Do not use
- .1        running nipples.
- .2        threaded protectors as couplings.
- .3        direct welded or screwed connections to valves, equipment or other apparatus.
- .13       Protect openings against entry of foreign material.
- .14       Ream pipes, remove scale and other foreign material before assembly.
- .15       Slope piping for positive drainage and venting.
- .16       Arrange piping to permit flushing.
- .17       Group piping, wherever possible.

- .18 Provide anchors and sway braces to Engineer's approval.
- .19 Provide for thermal expansion.
- .20 Provide for movement due to seismic events as required by the NBC and applicable NFPA standards.

### 3.7 EXPANSION OF PIPING

- .1 Install all piping systems with due regard and provision for expansion avoiding strain or damage to the building and equipment. Where pipe runs past building expansion joints, provide expansion compensation.
- .2 Only major expansion configurations and fittings have been detailed on the drawings. Provide all required additional compensators, loops and swing connections as specified herein, and in accordance with good trade practice.
- .3 Use swing connections with a minimum of 3 elbows (i.e. four fittings including the tee) where required. These swing connections are not always shown on the piping drawings for reasons of clarity; they must however, be installed. Where close tolerances do not permit the installation of a complete swing connection, consult the Engineer prior to the closing of tender.
- .4 Install expansion loops cold spring 50 percent of the calculated expansion. Use compensator type expansion joints with suitable pressure ratings for radiation piping where required. Install compensators with double guides on inlet and outlet with distances in accordance with manufacturer's instructions. Where not indicated, calculate compensator expansion equal to 38 mm per 30 m of run between the anchors.
- .5 Schedule for Expansion Loops:
  - .1 Maximum Distance between Anchors:
    - .1 Heating Hot Water; copper 30 m, steel 45 m.
  - .2 Loop Size Required:

Pipe Size NPS	Loop Size (m)
3/4	1.22
1	1.27
1-1/4	1.32
1-1/2	1.37
2	1.42
2-1/2	1.53
3	1.68
4	1.98
- .6 If the length between anchors is 50% of the maximum listed above, then the loop can be reduced to 67% of that listed.

- .7 Loops shall be located midway between guides.

### **3.8 PIPE GUIDES**

- .1 Provide alignment guides where required for proper operation of the system.

### **3.9 PIPE ANCHORS**

- .1 Provide substantial pipe anchors. Anchors shall be suitably attached to the structure and the pipe to prevent movement.

### **3.10 PIPE SLEEVES AND SEALS**

- .1 General: Install where pipes pass through masonry structures, concrete structures, beams, fire rated assemblies, and elsewhere as indicated. Be responsible for maintaining the integrity of the building envelope when making penetrations. Enlist the services of qualified trade(s) to make openings in, and/or repairs to, building envelope.
- .2 Sleeve Sizes:
  - .1 Walls and beams: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
  - .2 Floors: 20 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .3 Sleeve Installation:
  - .1 Concrete walls, masonry walls, beams, and concrete floors on grade: Terminate flush with finished surface.
  - .2 Other floors:
    - .1 Terminate 50 mm above finished floor.
    - .2 Adjust as necessary to accommodate the requirements of through-penetration fire-stopping systems.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .4 Sealing:
  - .1 Foundation walls and below grade floors: Fire retardant, waterproof, modular mechanical seal.
  - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
  - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.11 ESCUTCHEONS**

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.12 PREPARATION FOR FIRESTOPPING**

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

### **3.13 FLUSHING OUT OF PIPING SYSTEMS**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant sections of Division 23.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.14 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Engineer and Owner 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 23 where specified, otherwise test to requirements of ASME B31.9.
- .3 Test all piping, with the exception of atmospheric vents and sanitary piping, hydraulically to 1½ times the operating pressure but not less than 860 kPag.
- .4 Prove piping with less than 14 kPa pressure drop and no visible leakages for a period of 24 hours with a hydraulic test.
- .5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or test media.
- .6 Conduct tests in presence of Engineer or designate approved by the Engineer.
- .7 Pay costs for testing, repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.

- .8       Insulate or conceal work only after approval and certification of tests by Engineer. Test underground piping prior to backfilling.

**END OF SECTION**



## **PART 1 GENERAL**

### **1.1 SUMMARY**

.1 Section includes:

- .1 This section includes a list of manufacturers whose products are approved for installation in the work, provided the product chosen meets with the required design characteristics as particularly noted in the specifications and equipment schedules, and matches the design features of the item where a particular trade name and model is given, and suits the installation. Conform to space limitations on products, which are approved as equal in design characteristics. If the model or size selection is doubtful, contact the Consultant to ensure acceptability.

.2 Related Sections:

- .1 Everything in this Project Manual is a requirement for this Division. The following references constitute assistance to the Contractors. Refer to the Table of Contents for additional guidance.
- .1 Sections beginning with 23 05.

### **1.2 ALTERNATE MANUFACTURER APPROVAL**

- .1 The Drawings and Specifications are based upon manufacturers whose products are specified for installation in the work.
- .2 Any other manufacturers requesting "approved equal" status must request approval from the Consultant by letter stating specifically the items on which he wishes to quote and enclosing all necessary engineering data. Submit three (3) copies of all requests and a self addressed stamped envelope. Include the appropriate specification and/or drawing references. Requests should be made at least 14 days prior to closing of tenders, and an addendum may then be issued by the Consultant, prior to closing of tenders, listing any further Acceptable Manufacturers. Late requests may not be approved. Provide additional information requested by the Consultant to facilitate evaluation.
- .3 All fire suppression equipment shall be supplied from a manufacturer that has had an established local (Provincial) representative for a minimum of two (2) years, unless otherwise specified.
- .4 The Consultant may also take other factors into account.

### **1.3 CHANGES DUE TO USE OF DIFFERENT MANUFACTURERS**

- .1 Where the Contractor proposes to use an item of equipment other than that detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or of any other part of the mechanical, electrical or architectural layout, all such redesign and all new Drawings and details required shall, with the approval of the Consultant, be prepared by the Contractor at his own expense.

- .2 Where deviations are approved requiring a different quantity or arrangement of ductwork, piping, wiring, conduit and equipment from that indicated on the Drawings, this Division is responsible to furnish and install all such ductwork piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, without additional compensation.

## PART 2 PRODUCTS

### 2.1 HEATING, VENTILATION & AIR CONDITIONING ACCEPTABLE MANUFACTURERS LIST

Equipment	Acceptable Manufacturers
.1 Vibration Isolation	Amber/Booth, Mason, VAW Systems, Vibron
.2 Air Filters	AAF, Camfil Farr
.3 Belt Drive Vent Fans	CML Northern Blower, Greenheck, PennBarry, Twin City
.4 Hydronic Pumps	Armstrong, Bell & Gossett, Taco
.5 Diaphragm Expansion Tanks	Amtrol, Bell & Gossett, Expanflex, HG Spec
.6 Propylene Glycol	Dow, Union Carbide
.7 Packaged Glycol Fill Systems	Axiom, HG Spec, Armstong
.8 Chemical Treatment	GE Betz Canada, Perolin-Bird Archer
.9 Duct Sealer	Duro-Dyne, McGill Airseal
.10 Flexible Ductwork	Flexmaster, Thermaflex
.11 Fire Dampers	Greenheck, Nailor, NCA, Price, Ruskin
.12 Flexible Duct Connector	Carlisle Hardcast, Duro Dyne, Dyn/Air
.13 Welding Fittings	Anvil, Comco, Crane
.14 Malleable Iron Fittings, Flanges, Flange Gaskets	Anvil, Crane, Mueller
.15 Mechanical Pipe Joints	Gruvlok, Star, Victaulic
.16 Pipe Hangers and Saddles	Anvil, Crane, Myatt
.17 Alignment Guides	Adsko, Anvil, Flexon, Fulton, Yarway
.18 Ball Valves	Apollo, Crane, Kitz, Toyo
.19 Drain Valves	Crane, Toyo
.20 Gate and Globe Valves - Rising Stem	Crane, Toyo, Velan
.21 Horizontal Check Valves – up to Ø50mm	Crane, Toyo, Velan
.22 Horizontal Check Valves – Ø64mm and larger	Check-Rite, Crane, Tyco, Velan

.23	Vertical Check Valves – up to Ø50mm	Val-Matic 1400S, Durabla WLC
.24	Vertical Check Valves – Ø64mm	Val-Matic 1400, Durabla C-1
.25	Vertical Check Valves – Ø75mm and larger	Val-Matic 1800, Durabla GLC
.26	Butterfly Valves	Bray, Keystone
.27	Balancing Valves - Manual	Armstrong, Danfoss, Griswold, Tour & Andersson
.28	Safety and Relief Valves	Cash-Acme, Conbraco, Consolidated, Kunkle
.29	Expansion Joints and Flexible Connections	Fulton, Hyspan, Senior Flexonics, Yarway, VAW
.30	Air Vents	Dole, Maid-O-Mist, Spirotherm
.31	Strainers	Armstrong, Spirax Sarco, Toyo, Watts
.32	Pressure Gauges and Thermometers	Ashcroft, H.O. Trerice, Winters
.33	Auxiliary Test Ports	Peterson Equipment “Pete’s Plug II”, Sisco, Watts
.34	Mechanical Insulation – Fiberglas	Knauf, Manson, Johns Manville, Owens Corning
.35	Mechanical Insulation – Flexible Cellular Polyolefin	Armaflex, Imcoa, Merryweather
.36	Mechanical Insulation – Fire Retardant Canvas	Fattal, Radley, Robson
.37	Electric Motors	Baldor, G.E., Leeson, Toshiba, Westinghouse

### PART 3 EXECUTION

.1 Not used.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:
  - .1 Materials and installation for thermometers and pressure gauges in piping systems.
- .2 Related sections:
  - .1 Everything in this Project Manual is a requirement for this Division. The following references constitute assistance to the Contractors. Refer to the Table of Contents for additional guidance.
    - .1 Sections beginning with 22 05.

### **1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
- .3 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

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

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.
- .2 Upgrade specified materials and construction as required to suit particular application.

### **2.2 DIRECT READING THERMOMETERS**

- .1 Thermometer characteristics:

- .1 To CAN/CGSB14.4.
- .2 Type - Industrial, variable angle, liquid filled.
- .3 Case - die cast aluminum with glass front.
- .4 Scale - 225 mm long V-shaped aluminum.
- .5 Face - non-reflective enamel white with black numerals.
- .6 Fill - blue liquid.
- .7 Accuracy - to 1% of full scale range.
- .8 Scale range - to suit particular application.
- .9 Dual scale: Celsius and Fahrenheit

## **2.3 THERMOMETER WELLS**

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass.

## **2.4 PRESSURE GAUGES**

- .1 Gauge characteristics:
  - .1 To ASME B40.100.
  - .2 Case - stainless steel with solid front and gasketted pressure relief back.
  - .3 Dial size - 112 mm diameter.
  - .4 Face - enamel white with black numerals.
  - .5 Pointer - black finished brass, adjustable micrometer type.
  - .6 Grade 2A, phosphor bronze Bourden tube constructed silver soldered to socket and tip.
  - .7 Movement - stainless steel rotary type with nickel silver shaft and pinion gear.
  - .8 Glycerin filled.
  - .9 Accuracy - to 0.5% of full scale range.
  - .10 Scale range - to suit particular application.
  - .11 Dual scale: psi and kPa.
- .2 Provide:
  - .1 Siphon for steam service.
  - .2 Snubber for pulsating operation.
  - .3 Isolation valve, ball type.

## **2.5 AUXILIARY TEST PORTS**

- .1 Instrument test ports for reading of temperature and pressure via insertion probe. NPT ¼ brass body with cap, self-sealing neoprene valve core. Length and construction to suit application.

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**PART 3 EXECUTION**

**3.1 GENERAL**

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Locate where average reading can be sensed.
- .3 Install between equipment and first fitting or valve.

**3.2 THERMOMETERS**

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in following locations:
  - .1 Inlet and outlet of water heaters.
  - .2 In other locations as indicated.
- .3 Use extensions where thermometers are installed through insulation.

**3.3 PRESSURE GAUGES**

- .1 Install in following locations:
  - .1 Main service entrances.
  - .2 Suction and discharge of pumps.
  - .3 Upstream and downstream of PRV's.
  - .4 Upstream and downstream of control valves.
  - .5 Inlet and outlet of liquid side of water heaters.
  - .6 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes elsewhere.
- .3 Use extensions where pressure gauges are installed through insulation.

**3.4 AUXILIARY TEST PORTS**

- .1 Install as required for balancing purposes, at locations requested by the TAB contractor or as directed by the Engineer.
- .2 Install within 150 mm of pressure and temperature sensors that are connected to the controls system, for sensor calibration purposes.

**3.5 NAMEPLATES**

- .1 Install engraved lamicaid nameplates as specified in Section 22 05 53 - Identification for Plumbing Piping and Equipment to identify medium being measured.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:

.1 Material and installation of hangers and supports for HVAC.

### **1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.9 – Building Services Piping.
- .2 American Society for Testing and Materials (ASTM)
- .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 Underwriter's Laboratories of Canada (ULC)

### **1.3 DESIGN REQUIREMENTS**

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.9 or MSS SP58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.
- .6 Where structural movement may cause deflection or strain on supports, design to allow for movement of a minimum of 75mm. Use slotted bolt connections, slip type joints or other means as approved by the Engineer.



- .7 In areas where radiant floor piping is located above, support piping and equipment from steel structure. Anchoring into steel deck and concrete above will not be permitted.

#### **1.4 PERFORMANCE REQUIREMENTS**

- .1 Design supports, platforms, catwalks, hangers to withstand seismic events as required by the NBC.

#### **1.5 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

#### **1.6 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ASME B31.9 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

#### **2.2 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.
  - .1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 9mm.
  - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL/ULC listed to MSS-SP69.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
  - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, ULC listed to MSS SP69.

- .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULC listed.
- .4 Upper attachment to concrete.
  - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed to MSS SP69.
- .5 Shop and field-fabricated assemblies.
  - .1 Trapeze hanger assemblies: steel, sized to suit load.
  - .2 Steel brackets: sized to suit load.
- .6 Hanger rods: threaded rod material to MSS SP58.
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Size based on the following schedule:
    - .1 10 mm rod for pipes up to 50 mm diameter.
    - .2 12 mm rod for 65 mm and 75 mm diameter.
    - .3 16 mm rod for 100 mm diameter.
    - .4 20 mm rod for 150 mm diameter.
    - .5 22 mm rod for 200 mm to 300 mm diameter.
- .7 Pipe attachments: material to MSS SP58.
  - .1 Attachments for steel piping: carbon steel, galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP69, ULC listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.
- .12 For refrigerant piping use a manufactured support system consisting of:
  - .1 U-shaped channel of gauge and size as recommended by manufacturer to support the load.

- .2 Thermoplastic elastomer cushion that surrounds piping and hinges open for easy insertion of piping.
- .3 Clamp with electro chromate finish that secures cushion to channel by means of shaped end tabs that fit into the U-shaped channel and a tightening bolt at the top.

### 2.3 WALL SUPPORT

- .1 For piping supported off wall, roof or floor, use a manufactured support system consisting of:
  - .1 U-shaped channel of gauge and size as recommended by manufacturer to support the load.
  - .2 Thermoplastic elastomer cushion that surrounds piping and hinges open for easy insertion of piping.
  - .3 Clamp with electro chromate finish that secures cushion to channel by means of shaped end tabs that fit into the U-shaped channel and a tightening bolt at the top.
- .2 Spacing shall be as recommended by manufacturer for load being supported.
- .3 For groups of piping that are arranged perpendicular to wall, install Unistrut to form a triangular angle bracket.

### 2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, ULC listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

### 2.5 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

### 2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot-peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot-peened, magnetic particle inspected, with +/- 5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.8 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 05 - Structural Steel for Buildings.
- .2 Submit calculations with shop drawings.

## **2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.10 PLATFORMS AND CATWALKS**

- .1 To Division 05 - Metal Fabrication.

## **2.11 HOUSE-KEEPING PADS**

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Division 03 - Cast-in-place Concrete.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to be to industry standards.
  - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Use adjustable ring type hangers for pipes up to 50 mm diameter.
- .6 Use adjustable clevis type hangers for pipes 65 mm to 75 mm.
- .7 Use adjustable swivel roller type for pipes 100 mm and over.
- .8 Use adjustable pipe rolls with pipe or washer spacers on exposed threaded stands for all piping supported from below.
- .9 Where groups of pipes are run together, fabricated trapeze hanger assemblies may be used with separate rolls for each pipe. Design shall be approved by the Engineer.
- .10 Use approved constant support type hangers where:
  - .1 vertical movement of pipework is 13 mm or more,
  - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .11 Use variable support spring hangers where:
  - .1 transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 variation in supporting effect does not exceed 25 % of total load.
- .12 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .13 Apply 2 coats of shop primer paint on all un-plated hanger hardware and supporting steel and leave in a condition to receive paint.

- .14 Hangers and support that extend below 2100 above finished floor shall be permanently covered with cushioning material minimum of 25mm thick, and painted yellow or wrapped with yellow plastic tape.

### 3.2 HANGER SPACING

- .1 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Unless specifically noted otherwise on the drawings, support all piping with hangers spaced as follows:
  - .1 2.1 m for piping - NPS 1-1/4 and smaller
  - .2 3.0 m for piping - NPS 1-1/2 to 2-1/2
  - .3 3.6 m for piping - NPS 3 to 12
  - .4 To MSS SP69 for piping - NPS 12 and larger
- .4 Flexible joint roll groove pipe: not less than one hanger at joints.
- .5 Within 300 mm of each elbow.

### 3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Do not support from other pipes and ducts.
- .5 Support vertical piping at its base by hangers placed as near as possible to the horizontal pipe to which it is connected.
- .6 Give all hangers and rods, etc. that are not galvanized, two heavy coats of primer paint before concealing.
- .7 Provide insulation protection shields or saddles for all insulated piping. Oversize pipe hangers and supports.
- .8 Cut hanger rods after final adjustment as follows:
  - .1 Trapeze hangers: maximum 38mm below bottom nut.
  - .2 Clevis hangers: minimum 6mm above clevis bolt/pin.
- .9 Rivet hangers to insulation shields.

**3.4                    HORIZONTAL MOVEMENT**

- .1        Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2        Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

**3.5                    FINAL ADJUSTMENT**

- .1        Adjust hangers and supports:
  - .1        Ensure that rod is vertical under operating conditions.
  - .2        Equalize loads.
- .2        Adjustable clevis:
  - .1        Tighten hanger load nut securely to ensure proper hanger performance.
  - .2        Tighten upper nut after adjustment.
- .3        C-clamps:
  - .1        Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4        Beam clamps:
  - .1        Hammer jaw firmly against underside of beam.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section includes:
  - .1 Mechanical identification of piping, ducts, accessories, and equipment.

**1.2 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 National Fire Protection Association
  - .1 NFPA 13, Installation of Sprinkler Systems.
  - .2 NFPA 14, Standpipe and Systems.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, other products specified in this section.

**1.4 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

**PART 2 PRODUCTS**

**2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.



## 2.2 SYSTEM NAMEPLATES

### .1 Colours:

- .1 Hazardous: red letters, white background.
- .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

### .2 Construction:

- .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

### .3 Sizes:

- .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.

### .4 Locations:

- .1 Terminal cabinets, control panels: Use size # 5.
- .2 Equipment in Mechanical Rooms: Use size # 9.

## 2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Engineer.

## **2.4 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Natural gas: to CSA/CGA B149.1 .
  - .2 Propane gas: to CSA/CGA B149.1.
  - .3 Sprinklers: to NFPA 13.
  - .4 Standpipe and hose systems: to NFPA 14.

## **2.5 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 All other pipes: Pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150oC and intermittent temperature of 200oC.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Engineer.
  - .2 Colours for legends, arrows: To following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE

	Red	WHITE	
.3	Background colour marking and legends for piping systems:		
	Contents	Background colour marking	Legend
	** Add design temperature		
	++ Add design temperature and pressure		
	Hot glycol heating supply	Yellow	HEATING SUPPLY
	Hot glycol heating return	Yellow	HEATING RETURN
	Make-up water	Yellow	MAKE-UP WTR
	Domestic hot water supply	Green	DOM. HW SUPPLY
	Dom. HWS recirculation	Green	DOM. HW CIRC
	Domestic cold water supply	Green	DOM. CWS
	Storm water	Green	STORM
	Sanitary	Green	SAN
	Plumbing vent	Green	SAN. VENT
	Refrigeration suction	Yellow	REF. SUCTION
	Refrigeration liquid	Yellow	REF. LIQUID
	Compressed air	Green	COMP. AIR

## 2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

## 2.7 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

## 2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

## 2.9 LANGUAGE

- .1 Identification to be in English.

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**PART 3 EXECUTION**

**3.1 TIMING**

- .1 Provide identification only after all painting specified Section 09 91 23 - Interior Painting has been completed.

**3.2 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

**3.3 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection
  - .1 Do not paint, insulate or cover in any way.

**3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.5 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Engineer. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section includes:
  - .1 Testing, adjusting and balancing HVAC systems and equipment.

**1.2 REFERENCES**

- .1 Associated Air Balance Council (AABC)
  - .1 AABC National Standards for Total System Balance
  - .2 AABC Test and Balance Procedures
- .2 National Environmental Balancing Bureau (NEBB)

**1.3 GENERAL**

- .1 TAB means to test, adjust and balance in accordance with requirements of Contract Documents and to do other work as specified.
- .2 TAB to be done by an independent AABC certified testing company. The TAB Company must be a firm specializing in such work, equipped with a full range of calibrated instruments, and experienced in adjustment and operation of mechanical systems.

**1.4 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Names of personnel proposed to perform TAB to be submitted and approved by Engineer within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

**1.5 PURPOSE OF TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, and evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

**1.6 EXCEPTIONS**

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

**1.7 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs, final adjustments and re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with affected systems.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

**1.8 INSTRUMENTS**

- .1 Prior to TAB, submit to Engineer list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Engineer, prior to start of TAB work on site.

**1.9 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to the Engineer, prior to commencement of TAB:
  - .1 A written description of approach to TAB for each system, written specifically for the project, outlining sequence and procedures for the work. Include relevant information including, but not limited to, location of main duct traverses, approach to optimizing system setpoints, concerns affecting other trades such as weather-stripping and penetration sealing, and possible limitations of specified equipment and design that may affect TAB. Identify deviations in methodology from referenced standards and commonly accepted industry practice.

**1.10 PRELIMINARY TAB REPORT**

- .1 Submit for review and approval by Engineer, prior to submission of formal TAB report:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed, if different from procedures submitted earlier.
  - .3 Calculations procedures.
  - .4 Preliminary measurements.

**1.11 TAB REPORT**

- .1 Format to be in accordance with referenced standard.

- .2 TAB report to show results in SI units and to include:
  - .1 System schematics.
  - .2 TAB data.
  - .3 Discussion of results, with focus on system where measurements deviated significantly from design values along with possible cause and/or recommendations for correcting problem.
- .3 Submit 6 copies of TAB Report to Engineer for verification and approval, in English, spiral or Cerlox bound with covers, complete with index tabs.

#### **1.12 VERIFICATION**

- .1 Reported results subject to verification by Engineer.
- .2 Provide manpower and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results to be at discretion of Engineer.
- .4 Bear costs to repeat TAB as required to satisfaction of Engineer.

#### **1.13 SETTINGS**

- .1 After TAB is completed to satisfaction of Engineer, return systems and equipment to final operation condition. Replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Markings shall not be covered in anyway and shall be permanent and not easily eradicated.
  - .1 Mark position of balancing dampers using permanent pen, indicating position of damper handle on duct or quadrant.
  - .2 Set memory stop function on calibrated balancing valves. If ball or globe valves have been used for TAB, install locking quadrant or other means of permanently identified TAB setpoint.

#### **1.14 COMPLETION OF TAB**

- .1 TAB to be considered complete when final TAB Report received and reported approved by Engineer in writing.

#### **1.15 INSTRUMENT TEST PORTS AND HOLES**

- .1 Coordinate test openings with Division 23.
- .2 Utilize permanent test ports where installed by Division 23.
- .3 Where permanent test ports are not installed, make openings as required to facilitate the TAB. Seal test port openings in ductwork using rubber plugs or material with similar properties, which are not easily removed. Hard or semi-flexible plugs such as nylon or



polyethylene will not be accepted. Submit samples for each side to the Engineer for approval prior to installation. Alternately, patch ductwork using sheet metal patch screwed to duct and seal with aluminium tape or duct sealant.

#### **1.16 DRIVE CHANGES FOR BELT DRIVEN EQUIPMENT**

- .1 Allow for drive changes on all belt driven equipment.
  - .1 Include sheaves and bushings for driver and driven equipment, belts and other equipment and tools necessary to make drive change.
  - .2 Include all manpower necessary to make drive change, including removal and reinstallation of guards.
  - .3 For belt driven equipment forming part of life safety systems, such as pressurization or smoke exhaust fans, allow for minimum of two drive changes for each piece of equipment where less than 5 pieces are installed, or if more than 5 are installed, allow for total of 10 drive changes.

#### **1.17 DESIGN INTENT APPLICABLE TO TAB WORK**

- .1 Arrange a meeting with the Engineer to review design intent for all systems prior to the start of TAB. Obtain all information relevant to TAB work prior, including, but not limited to minimum outside air volume flowrates, relative pressurization setpoints and locations, temperature, humidity setpoints.

#### **1.18 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **PART 2 PRODUCTS**

- .1 Not used.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- .1 Investigate all problems and resolve with the contractor's help, to ensure all values are within range. Obtain direction from the Engineer when necessary.
- .2 Perform coil testing, adjusting and balancing only when outside conditions are commensurate with design conditions for the given system.

#### **3.2 PRE-TAB REVIEW**

- .1 Review contract documents and submit documentation specified below in writing to the Engineer prior to the installation of any systems that will require TAB.

- .2 Arrange and attend a meeting with the Engineer and appropriate trades to review and discuss adequacy of provision for TAB and other aspects of design and installation pertinent to success of TAB. Meeting to occur at least 2 weeks before installation of any mechanical systems that will require TAB.
- .3 Review proposed location of sensors and test ports with other trades to confirm that locations are suitable for TAB equipment and will permit repeatable measurements to permit recalibration on HVAC controls sensors.
- .4 Review location of balancing dampers and control valves for adequacy with respect to successful TAB completion.
- .5 Confirm in writing to Engineer adequacy of provisions for TAB, noting any inadequacies that may require attention.
- .6 Review specified standards and report to Engineer in writing all proposed procedures that vary from standard.

### **3.3 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere.

### **3.4 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

### **3.5 START OF TAB**

- .1 Notify Engineer 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB. Application of weather-stripping, sealing, caulking.
  - .2 All pressure, leakage, other tests specified.
  - .3 All provisions for TAB installed and operational.
  - .4 Areas served by air system are clean and dust producing activities have been suspended.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Clean filters in place.

- .2 Duct systems and equipment, including inside of air handlers, clean.
- .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
- .4 Correct fan rotation.
- .5 Fire, smoke, volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 Grilles, register and diffusers installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed, open.
  - .5 Calibrated balancing valves installed, at factory settings.
  - .6 Chemical treatment systems complete, operational.

### **3.6 APPLICATION TOLERANCES**

- .1 All balancing to meet AABC requirements.
- .2 Do TAB to following tolerances of design values:
  - .1 Air systems: plus or minus 10% of the quantities shown on the drawings for each component, and to within 5% of design requirements for the overall system. Small systems below 250 l/s to be balanced within 20% or 20 l/s.
  - .2 Hydronic systems: plus or minus 10% of the quantities shown on the drawings for each component, and to within 5% of design requirements for the overall system.
- .3 Check all change orders and clarifications to ensure current information is utilized.

### **3.7 ACCURACY TOLERANCES**

- .1 Measured values to be accurate to within plus or minus 2 % of actual values.

### **3.8 VERIFICATION OF CONTROLS SYSTEMS**

- .1 TAB contractor shall assist in verification, demonstration and calibration of the HVAC controls systems, specified under Division 23.
- .2 Perform measurements at test ports to confirm calibration of controls sensors, including temperature, pressure, flow rate and humidity and report on measured versus sensed values.

### **3.9 AIR SYSTEMS**

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.

- .2 Do TAB of systems, equipment, components, controls specified in Division 23.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified by standards of AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, and controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, current draw, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1 Furnace discharge and return,
  - .2 HRV and ERV connections.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
- .8 Measure and report quantity of outside air at minimum and maximum airflow for each system having an outside air connection.

### **3.10 HYDRONIC SYSTEMS**

- .1 Definitions: for purposes of this section, to include hot glycol heating system..
- .2 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.
- .3 Do TAB of systems, equipment, components, controls specified in Division 23.
- .4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .5 Quality assurance: Perform TAB under direction of supervisor qualified by standards of AABC or NEBB.
- .6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rates, pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, current draw, noise, vibration.
- .7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of boiler, pumps, radiant floor manifolds and loops
  - .2 At controllers, controlled device.

- .8 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of primary and secondary loops (main, main branch, branch, sub-branch of all hydronic systems), inlet connection of make-up water.
- .9 Once actual operating points of hydronic systems are established, installing contractor under Division 23 shall have impellers trimmed to near operating conditions, unless otherwise directed by Engineer. Repeat measurement and final adjustment of pumps following trimming of impellers.
- .10 **FOR ALL PUMPS**
  - .1 Horsepower as determined by voltage and current measurements in all phases.
  - .2 Pressure difference and flow rate.
  - .3 All nameplate data.
  - .4 Verify pump rotation and shut off head.
  - .5 Pump curve with operating design and shut-off conditions shown.
- .11 **FOR MULTIPLE COIL UNITS**
  - .1 Adjust to equal temperature drop through each coil section.
- .12 **FOR CONTROL STATIONS**
  - .1 Set to ensure desired pressure or flow rating.
- .13 **FOR RADIATION**
  - .1 Adjust to equal temperature drop through each unit, but at least 0.06 l/min (1 U.S. gpm per unit). Acceptable flow meter may also be used.
  - .2 Measure temperatures with thermometers having 0.05°C (0.1°F) accuracy.
- .14 **FLOW METERS**
  - .1 Nameplate data
  - .2 Primary and converted readings for each condition.
  - .3 Description, including service and location.

### **3.11 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
  - .2 Measure and report on building pressure during different operating mode and at various quantities of outside air. Report measurements at different percentages of outside based on total system air volumes, in increment of 10%. Perform measurements when all systems are in normal operating modes.

- .3 Domestic water recirculation systems:
  - .1 Measure and adjust flows on domestic water recirculation loops.
  - .2 Perform TAB on pumps as per requirements for hydronic systems as above.

### **3.12 SCHEDULE**

- .1 Schedule the balancing to suit the progress of the work. Make every attempt to complete the work, or at least the affected local work, prior to occupancy or partial occupancy.
- .2 In phased projects, complete the work in each phase, as it is completed. Make final checks and corrections as required to all phases at the completion of the entire project.

### **3.13 FINAL ADJUSTMENT**

- .1 Allow for a final adjustment, as directed by the Engineer. Revise the reports accordingly.

### **3.14 POST- OCCUPANCY TAB**

- .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, noise levels, in occupied zone as directed by Engineer once building as occupied.
- .2 Participate in systems checks twice during Warranty Period – first visit approximately 3 months after acceptance and 2nd within 1 month of termination of Warranty Period.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SUMMARY**

.1 Section includes:

- .1 Material and installation of insulation of HVAC pipes and fittings, including well water piping.

### **1.2 REFERENCES**

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .1 ASHRAE Standard 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings

.2 American Society for Testing and Materials (ASTM)

- .1 ASTM B209, Specification for Aluminum and Aluminum Alloy Sheet and Plate
- .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .6 ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .7 ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation
- .8 ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- .9 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
- .10 C1427 Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Manufacturer's Trade Associations

- .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

- .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

### **1.3 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" – plumbing piping in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

### **1.4 QUALIFICATIONS**

- .1 Installer to be specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

### **1.5 DELIVERY, STORAGE AND HANDLING**

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

### **1.6 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide sample board with all types of insulation and proper labelling.

### **1.7 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **PART 2 PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102.



- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

## **2.2 INSULATION**

- .1 Provide and apply insulation in accordance with TIAC National Insulation Standards Specification 1501, Piping, and as herein specified:
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 oC mean temperature when tested in accordance with ASTM C335.
- .3 Type P-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to ASTM C547.
  - .2 Maximum "k" factor: 0.033 W/m°C to ASTM C547.
  - .3 Acceptable material: Knauff, Manville Micro-lok
- .4 Type P-2: Flexible Cellular Polyolefin.
  - .1 Insulation: ASTM C1427.
  - .2 Maximum "k" factor: 0.036 W/m°C at 24°C to ASTM C1427.
  - .3 Acceptable material: Imcoa Imcolok
- .5 Type P-3: Calcium Silicate.
  - .1 High temperature abuse resistant.
  - .2 ASTM C 411 to 649 C (1200 F).
- .6 Type P-4: Cellular Glass.
  - .1 Insulation to ASTM C552

## **2.3 INSULATION SECUREMENT**

- .1 Tape: Self-adhesive, fibreglass reinforced foil-white kraft paper lamination, 50 mm wide minimum.
- .2 Contact adhesive: low VOC, air-drying adhesive.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

## **2.4 VAPOUR RETARDER LAP ADHESIVE**

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

## **2.5 INDOOR VAPOUR RETARDER FINISH**

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

## **2.6 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Water based, fire retardant type, compatible with insulation.
- .2 Reinforcing fabric: polyester fibre with PVA finish.

## **2.7 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet with pre-formed shapes.
  - .2 Colour and finish: white, gloss.
  - .3 Service temperature range: -18oC to 66oC.
  - .4 Moisture vapour transmission: 0.02 perm.
  - .5 Thickness: 0.50 mm.
  - .6 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Canvas:
  - .1 220 gm/m2 fire resistant cotton, plain weave, to ASTM C921 and ULC listed.
  - .2 Lagging adhesive: inorganic, water-based fire-resistive lagging adhesive and coating, ULC listed.
- .3 Aluminium:
  - .1 Jacket: To ASTM B209, minimum H-14 temper with heat-laminated moisture barrier liner.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Stucco embossed.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .4 Stainless steel:
  - .1 Type: 304.
  - .2 Thickness: 0.25 mm.
  - .3 Finish: 4.7mm Corrugated, dull.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5mm thick die-shaped fitting covers with factory-attached protective liner.

- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .5 Laminate Foil Film:
  - .1 Five-ply laminate foil film consisting of 3 layers of aluminum foil, and 2 layers of polyester with factory-applied pressure sensitive acrylic adhesive.

## **2.8 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: At valves, primary flow measuring elements and flanges and unions at equipment. Apply to expansion joints only where permitted by the expansion joint manufacturer's recommendations.
- .2 Design: To permit periodic removal and replacement without damage to adjacent insulation. For expansion joints, design to permit full range of motion for expansion joint.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as for piping.
  - .2 Jacket: as scheduled.

## **2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS**

- .1 Silicones sealant:
  - .1 One part formulation, industrial grade, clear.

# **PART 3 EXECUTION**

## **3.1 PRE- INSTALLATION REQUIREMENT**

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

## **3.2 INSTALLATION - GENERAL**

- .1 Install in accordance with TIAC National Standards, following manufacturer's instructions and this specification. In case of conflict between TIAC National Standard's, manufacturer's instructions and this specification, this specification shall govern, unless otherwise directed by the Engineer.
- .2 Use two layers with staggered joints when required nominal insulation thickness exceeds 75 mm.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .4 Supports, Hangers:

- .1 Apply high compressive strength insulation, as indicated below, at oversized saddles where insulation shoes have not been provided.
  - .1 Hot piping: Calcium silicate or Perlite.
  - .2 Cold piping: cellular glass or high density foam.
  - .3 Wood blocks or plastic inserts are acceptable only where approved by the Engineer.
- .5 Insulate valves, valve bonnets, strainers, flanges and fittings unless otherwise specified to same requirements as associated piping.
- .6 Carry insulation through floors and walls on services above 121°C (250°F) or below room temperature.
- .7 Ensure adequate ventilation is provided upon initial heating of insulation, where manufacturer indicates that fumes and odors may be released.

### **3.3 INSTALLATION OF TYPE P-1 INSULATION (FIBREGLASS):**

- .1 Without integral jacket: mechanically fasten at 300mm centres.
- .2 With integral jacket: staple flap on 75mm centres.
- .3 Insulation with self-sealing lap seal integral to jacket requires no additional fastening.
- .4 Seal butt joints with self-sealing butt strips, minimum 50mm wide.

### **3.4 INSTALLATION OF TYPE P-2 INSULATION (ELASTOMERIC)**

- .1 Follow manufacturer's instructions.

### **3.5 JACKETS**

- .1 Canvas:
  - .1 Make jacket ready to receive painted finish by applying lagging adhesive and coating to entire surface.
- .2 Aluminum and Stainless Steel:
  - .1 Outdoor installations:
    - .1 Water-proof installation.
    - .2 Apply silicone sealant under longitudinal and circumferential lap joints. Further apply silicone sealant along seam of longitudinal and circumferential joints.
    - .3 Locate longitudinal joints in jacket at bottom of pipe.

### **3.6 HEAT TRACED PIPES**

- .1 Provide insulation oversized to accommodate the heat tracing without any gaps.

- .2 Confirm compatibility of insulation with the heat tracing before ordering.
- .3 Insulation and tracing to extend in through the outside wall.

### 3.7 SPECIFIC APPLICATIONS

- .1 Thickness:
  - .1 As listed in following table.
- .2 Runouts:
  - .1 Runouts up to 50mm to individual terminal units, not exceeding 3.7m in length, may have insulation thickness reduced to 13mm.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
- .3 Jackets:
  - .1 Type P-1 insulations:
    - .1 Exposed indoors:
      - .2 Pipe: Canvas.
      - .3 Valves and Fittings: PVC.
    - .2 Exposed in mechanical rooms:
      - .1 Pipe: Stainless steel.
      - .2 Valves and Fittings: Stainless steel.
    - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
    - .4 Outdoors:
      - .1 Inaccessible areas, such as roofs: Aluminum.
      - .2 Accessible areas: Stainless steel.
  - .5 On Type P-2 insulation:
    - .1 Indoors:
      - .1 No further finish required.
    - .2 Outdoors:
      - .1 PVC.

### 3.8 INSULATION SCHEDULE

Service	Sizes	Type	Thick	VB	Fittings
Refrig Suction Piping (indoors)	ALL	P-2	25mm	YES	YES
Refrig Hot Gas (indoors)	ALL	P-2	19mm	NO	NO
Refrig Suction Piping (outdoors)	ALL	P-2	25mm	YES	YES
Hydronic Heating Piping (incl. all piping over 40°C)	13-50mm	P-1	25mm	NO	YES
Hydronic Heating Piping (incl. all piping over 40°C)	63mm-up	P-1	38mm	NO	YES

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SUMMARY**

.1 Section Includes:

- .1 The supply and installation of miscellaneous speciality equipment related to hydronic systems.

### **1.2 REFERENCES**

.1 American Society of Mechanical Engineers (ASME).

- .1 ASME, Boiler and Pressure Vessel Code.

.2 American Society for Testing and Materials, (ASTM).

- .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
- .3 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
- .4 ASTM A536, Specification for Ductile Iron Castings.
- .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International).

- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

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

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following additional information:

- .1 CRN numbers, for equipment where registration is possible.

### **1.4 CLOSEOUT SUBMITTALS**

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **PART 2 PRODUCTS**

### **2.1 DIAPHRAGM TYPE EXPANSION TANK**

- .1 Vertical steel pressurized diaphragm type expansion tank. Tank design to ensure that fluid is contained to diaphragm, and does not contact steel tank. Diaphragm to be replaceable in the field.

- .2 Diaphragm: heavy duty EPDM, suitable for 115 degrees C operating temperature. Diaphragm to be suitable for use with treated hot water and hot glycol.
- .3 Working pressure: 860 kPa with ASME stamp and certification.
- .4 Air pre-charged to pressure indicated on schedule (initial fill pressure of system), with provision for field adjustment.
- .5 Base mount for vertical installation.
- .6 Supports: provide supports with hold down bolts and installation templates. Incorporate seismic restraint systems where required.

## **2.2 AUTOMATIC AIR VENT**

- .1 Install on each convector, fan coil, cabinet unit heater or radiant floor manifold.
- .2 Radiator vent: brass body and insert, NPS 1/8 connection, screw driver operated, with copper tube extensions.
- .3 Steel panel radiator vent: chrome plated, automatic type.
- .4 Standard float vent: brass body and NPS 1/8 connection and rated at 620 kPa working pressure.
- .5 Install float vent on heating and chilled water at system high points. Install isolation valve ahead of air vents, except on coils equipped with isolation valves.
- .6 On glycol, install key-operated air vents at all high points and as indicated.

## **2.3 AIR SEPARATOR - IN-LINE**

- .1 Working pressure: 860kPa.
- .2 Size: equal to pipe size at location installed.
- .3 Cast iron body, with line size inlet and outlet openings, bottom connection for line from expansion tank and connection at top for air vent.
- .4 Install at boiler discharge.

## **2.4 PIPE LINE STRAINER**

- .1 NPS 1/2 to 2, Class 125: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12, Class 125: cast iron body to ASTM A48, Class 30, flat faced flanged connections.
- .3 Blow down connection.



- .4 Screen: stainless steel with
  - .1 Up to 50mm: 0.79 mm perforations.
  - .2 64mm and 200mm: 1.6 mm
- .5 Working pressure: 860 kPa.

## **2.5 SUCTION DIFFUSER**

- .1 Body: cast iron.
- .2 Connections:
  - .1 NPS 2 and under: screwed.
  - .2 NPS 2 ½ and greater: flanged.
- .3 Strainer: low pressure drop screen with 4.7mm perforations, blowdown connection and built-in, disposable 16 mesh bronze strainer for start up.
- .4 Full length straightening vanes.
- .5 NPT ¼ gauge port.
- .6 Adjustable support leg.

## **2.6 GLYCOL MAKE UP SYSTEM**

- .1 Glycol auto fill unit complete with expansion tank from same manufacturer designed to control and provide expansion and maintain the glycol system pressure by providing glycol make up automatically upon a drop in system pressure for the following system parameters:
  - .1 System flow temperature of 82 C (180F)
  - .2 Maximum system pressure at unit of 172 kPa (25 psi)
- .2 Packaged glycol make up systems consisting of polyethylene tank with 25 litre mixing capacity (6.6 gal), pump, pressure reducing valve, controls complete with low level alarm, pressure gauge.

## **2.7 AUXILLIARY TEST PORTS**

- .1 Instrument test ports for reading of temperature and pressure via insertion probe. NPT ¼ brass body with cap, self-sealing neoprene valve core. Length to suit application.

## **2.8 FLEXIBLE CONNECTIONS**

- .1 Stainless steel hose with carbon steel braid, designed to absorb vibration and compensate for thermal expansion.
- .2 Minimum 1370 kPa working pressure at 120°C.

- .3 Flanged connections for NPT 2 ½ and greater, threaded nipple for NPT 2 and under.  
Minimum length of 225mm

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## **PART 3 EXECUTION**

### **3.1 GENERAL**

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

### **3.2 STRAINERS**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and ahead of control valves smaller than NPS 1 that are not full port (such as those equipped with characterizing discs).

### **3.3 AIR VENTS**

- .1 Install at high points of systems.
- .2 Install valve on automatic air vent inlet.

### **3.4 EXPANSION TANKS**

- .1 Adjust expansion tank pressure to suit design criteria.

### **3.5 PRESSURE SAFETY RELIEF VALVES**

- .1 Run discharge pipe to terminate above nearest drain for water system, and back to glycol fill tank on glycol systems.

### **3.6 SUCTION DIFFUSERS**

- .1 Install on inlet to pumps having suction size greater than 50mm.

**3.7 DIELECTRIC UNIONS**

- .1 Install at connection of dissimilar metals.
- .2 Metals that are adjacent on the galvanic scale may not require additional protection, subject to the approval of the Engineer.
- .3 Dielectric 'couplings' are not acceptable.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

.1 Section Includes:

- .1 Materials, equipment selection, installation and start up for hydronic system pumps.

**1.2 REFERENCES**

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

- .1 Standard 90.1-2001 Energy Standard for Buildings except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).

.3 Canadian Standards Association (CSA International).

- .1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers Association (NEMA).

- .1 NEMA MG 1, Motors and Generators.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit following additional information:

- .1 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .2 Submit product data of pump curves for review showing point of operation.
- .3 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

**1.4 SPARE PARTS**

.1 Furnish following spare parts: one (1) set of mechanical seals for each pump.

**1.5 CLOSEOUT SUBMITTALS**

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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**PART 2 PRODUCTS**

**2.1 EQUIPMENT**

- .1 Do component selection and sizing to: CAN/CSA-B214.

**2.2 VERTICAL IN-LINE CIRCULATORS**

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: bronze.
- .3 Shaft: alloy steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135 degrees C.
- .5 Coupling: close-coupled, rigid.
- .6 Motor: to NEMA, resilient mounted, drip proof, sleeve bearing, 1750 rpm.
- .7 Design pressure: 1210 kPa.
- .8 Features and performance: as scheduled. Scheduled characteristics govern where they conflict with the general requirements herein.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Do Work in accordance with CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks at inlet and outlet of pump and suction guide and/or strainer. Pipe to common pressure gauge.
- .8 Ensure adequate access is provided at each pump for maintenance and motor removal.

- .9 Allow for removal and trimming of each impeller, following preliminary TAB measurements, as directed by the Engineer. Reinstall impeller and restore pump to like new condition, including replacement of seals, gaskets and other devices as required.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section includes:
  - .1 Material and procedure for HVAC water system cleaning and treatment and associated systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME Boiler and Pressure Vessel Code, Section VII.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**PART 2 PRODUCTS**

**2.1 MANUFACTURER**

- .1 Equipment, chemicals, service by one supplier.

**2.2 CHEMICAL FEED PIPING**

- .1 Resistant to chemicals employed. Pressure rating: 860 kPa.

**2.3 CHEMICALS**

- .1 Initial cleanout:
  - .1 New systems: Pre-operation cleaner specifically formulated to remove rust, oil-based coatings, organic debris from metal in new systems. Provide neutralizer as required to bring pH to required levels.
- .2 Corrosion Inhibitor: Formulated to inhibit corrosion in multi-metal closed circulating systems that may be subject to air ingress contamination or trace acidic contaminants. Inhibitor to have high buffering capability to help maintain systems pH levels.
- .3 Provide quantity of chemicals as required by manufacturer, based on system volumes.



- .4 Provide a minimum of 22 L (5 gallons) or 1 year supply, which ever is greater, of corrosion inhibitor on site.

## **2.4 TEST EQUIPMENT**

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

### **3.2 CHEMICAL FEED PIPING AND EQUIPMENT**

- .1 Install crosses at all changes in direction. Install plugs in unused connections.
- .2 Install ball valves on inlet, outlet and drains for pot feeders and filters.
- .3 Pipe across pumps and pipe drain to nearest floor drain ensuring that the pot feeder is readily accessible, preferably approximately 760mm (30") above the floor.

### **3.3 CLEANING OF MECHANICAL SYSTEM**

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Engineer.
- .2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials.
- .3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

- .4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Remove and clean all strainers and reinstall.
  - .1 Hot water heating system: Refill with clean water and treat with corrosion inhibitors.
  - .2 Glycol systems: Refill with glycol solution of specified concentration. Refer to heat transfer fluid specification.
- .5 Confirm concentration both one day and one week later to confirm stable. If make-up problems occur, check twice again after correction.
- .6 Disposal of cleaning solutions to be approved by authority having jurisdiction.

### **3.4 LABELS**

- .1 For each system label, on or near the feeder, the required information including: system, required concentration, approximate system volume, required chemical and recommended test frequency. Confirm wording and installation location before producing or installing label. Refer to 'Identification' specifications

### **3.5 WATER TREATMENT SERVICES**

- .1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:
  - .1 Initial water analysis and treatment recommendations.
  - .2 Supervise the installation of equipment related to system water treatment.
  - .3 System start-up assistance.
  - .4 Operating staff training.
  - .5 Visit facility every 30 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
  - .6 Provide necessary recording charts and log sheets for one year operation.
  - .7 Provide necessary laboratory and technical assistance.
  - .8 Instructions and advice to operating staff to be clear, concise and in writing.

### **3.6 START-UP**

- .1 Start up water treatment systems in accordance with manufacturer's instructions.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SUMMARY**

.1 Section Includes:

- .1 Materials and installation of galvanized ductwork, joints and accessories.

### **1.2 REFERENCES**

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

- .1 ASHRAE Handbook – Fundamentals.

.2 American Society for Testing and Materials International (ASTM)

- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.  
.2 ASTM A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.3 Canadian Standards Association (CSA International)

- .1 CAN/ULC-S109M, Standard for Flame Tests of Flame-Resistant Fabrics and Films.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

- .1 HVAC Duct Construction Standards - Metal and Flexible.  
.2 HVAC Air Duct Leakage Test Manual.

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

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 CLOSEOUT SUBMITTALS**

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **PART 2 PRODUCTS**

### **2.1 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653/A653M, G90/Z275 zinc coating, with tolerances to ASTM A924/A924M.  
.2 Thickness, fabrication and reinforcement: to SMACNA HVAC Duct Construction Standards.

- .3 Joints: to SMACNA HVAC Duct Construction Standards.

## **2.2 PRESSURE CLASSIFICATION**

- .1 Pressure Class: to match maximum design external static pressure of fans systems.

## **2.3 DUCTWORK**

- .1 Construction - round and oval.
  - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA HVAC Duct Construction Standards.
  - .2 Transverse joints up to 900 mm: slip type with tape and sealants.
  - .3 Transverse joints over 900 mm: Vanstone flanges.
- .2 Construction - rectangular:
  - .1 Ducts: factory fabricated to SMACNA HVAC Duct Construction Standards.
  - .2 Transverse joints: to SMACNA HVAC Duct Construction Standards.

## **2.4 FITTINGS**

- .1 Fabrication: to SMACNA HVAC Duct Construction Standards.
- .2 Radiused elbows:
  - .1 Rectangular: smooth radius. Centreline radius: 1.5 times width of duct.
  - .2 Round and oval: smooth radius or five-piece (for 90 degrees) and three-piece (for 45 degrees). Centreline radius: 1.5 times duct diameter.
- .3 Mitred elbows:
  - .1 To 750 mm duct height in plane of turn: with single-thickness turning vanes.
  - .2 Over 750 mm duct height in plane of turn: with double-thickness turning vanes.
- .4 Branches:
  - .1 Rectangular main and branch: connection with 45 degree entry.
  - .2 Round main and branch: conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct.
- .5 Transitions:
  - .1 Diverging: 10 degrees maximum angle each side; 20 degrees maximum included angle for symmetrical fittings.
  - .2 Converging: 22.5 degrees maximum angle each side; 45 degrees maximum included angle for symmetrical fittings.
- .6 Offsets:
  - .1 Full radiused or mitred elbows: as specified above.
- .7 Obstruction deflectors: maintain full cross-sectional area of duct.

- .1 Maximum included angles: as for transitions.

## **2.5 SEALANT**

- .1 Sealant: oil resistant, water-based, polymer type flame resistant duct sealant.
- .2 Flame spread rating shall not exceed 25 and smoke developed classification shall not exceed 50.
- .3 Operational temperature range of minus 32 degree C to plus 93 degree C. Application temperature range of plus 4 degree C to plus 43 degree C.

## **2.6 REINFORCING TAPE**

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
- .2 Meets the flame-resistance requirements of CAN/ULC-S109M.

## **2.7 HANGERS AND SUPPORTS**

- .1 Hangers and Supports:
  - .1 Hanger configuration, design, and construction: to SMACNA HVAC Duct Construction Standards.
  - .2 Strap hangers: Maximum rectangular duct size supported by strap hanger: 500 mm on longest side.
    - .1 Straps of same material as duct but next sheet metal thickness heavier than duct.
    - .2 Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
    - .3 Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - .3 Band hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum round or oval duct size supported by strap hanger: 500mm diameter.
  - .4 Trapeze hangers and Riser Supports: ducts over 500 mm diameter or longest side, to SMACNA HVAC Duct Construction Standards.
    - .1 Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
    - .2 Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
    - .3 Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
  - .5 Hangers: galvanized steel angle with galvanized steel rods to SMACNA HVAC Duct Construction Standards.
  - .6 Upper hanger attachments:
    - .1 For concrete: manufactured concrete inserts.

- .2 For steel joist: manufactured joist clamps.
- .3 For steel beams: manufactured beam clamps.
- .7 Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standards unless directed otherwise by Engineer.
- .2 First class workmanship is required for fabrication and installation. Submit samples and/or detailed shop drawings of different types of fittings, joints, supports, sealants, etc, when requested by the Engineer.
- .3 Locate ductwork approximately as shown on drawings unless otherwise prevented by jobsite conditions. Carefully coordinate duct layouts with other services, particularly where exposed in occupied spaces. Conceal all ductwork unless otherwise directed and approved by the Engineer. Report all layout deviations to the Engineer for approval prior to installation.
- .4 Construct ducts in accordance with the dimensions shown on the drawings. Alter the duct dimensions, while maintaining the equivalent round duct diameter, where necessitated by jobsite conditions. Equivalent duct dimensions to be determined using ASHRAE Handbook duct design procedures.
- .5 Duct dimension shown on drawings are inside dimensions. If ducts are internally lined or insulated, increase duct size such that clear dimensions after application of lining/insulation are equal to those shown on drawings.
- .6 Adjust duct dimensions to suit standard control damper sizes.
- .7 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .8 Support risers at each floor penetration. Provide neoprene pads between riser supports and the building structure. On exposed ductwork, provide galvanized angle collars to conceal the above work on both sides of the floor penetration.
- .9 Lap all joints in the direction of air flow wherever possible.
- .10 Provide a smooth interior surface at all seams and joints.
- .11 Provide a straight collar, not less than 300 mm long, at the connection to each diffuser. Where this is not possible provide adjustable multi-blade type flow equalizing grid in the diffuser neck.

### **3.2 FITTINGS**

- .1 Fitting geometry to be in accordance with specifications and drawing details unless otherwise directed and approved by the Engineer.
- .2 Provide mitred elbows with turning vanes where jobsite conditions prevent installation of radiused elbows.

### **3.3 HANGERS**

- .1 Strap and band hangers: install in accordance with SMACNA HVAC Duct Construction Standards.
- .2 Angle hangers: install in accordance with SMACNA HVAC Duct Construction Standards, complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA HVAC Duct Construction Standards.
- .4 Do not break continuity of insulation vapour barrier with hangers or rods.

### **3.4 SEALING AND TAPING**

- .1 Apply sealant to outside of joint in accordance with SMACNA HVAC Duct Construction Standards and to manufacturer's recommendations.
- .2 Use reinforcing tape on all ducts with seal Class A; ducts with seal Class B or C and a pressure classification in excess of 500 Pa; and for larger gaps.
- .3 Bed reinforcing tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.
- .4 Seal all joints including, but not limited to, at coils, terminal units, grilles and diffusers.
- .5 Eliminate all audible noise caused by air leakage.

### **3.5 WATERTIGHT DUCT AND DRIP PANS**

- .1 Provide watertight duct for:
  - .1 Exhaust and relief air outlets.
  - .2 Outside air intakes.
  - .3 Minimum 3000 mm from duct mounted humidifier in all directions.
  - .4 Downstream of cooling coil or heat recovery coils.
  - .5 As directed by Engineer.
- .2 Provide watertight drip pan below:
  - .1 Open-ended intakes for roof mounted equipment and hoods where condensation may occur.
  - .2 Cold equipment not insulated including pumps and water meters.

- .3 As directed by Engineer.
- .3 Form bottom of horizontal duct or drip pan without longitudinal seams.
  - .1 Solder or weld joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.
- .4 Slope horizontal branch ductwork down towards hoods served.
  - .1 Slope header ducts down toward risers.
- .5 Fit base of riser with 150 mm deep drain sump and 25 mm drain, with deep seal trap and trap primer, discharging to open funnel or hub drain.
- .6 Drip pan to be 75 mm wider all around ductwork or equipment served and complete with 75 mm deep drain sump. Elevated drip pans to be provided with 25 mm drain discharging to open funnel or hub drain. Provide sufficient clearance above drip pan to facilitate access and to permit unimpeded airflow to equipment or intake above.
- .7 Provide angle iron supports under sumps and drip pans adequate to support weight when full.
- .8 Install drip pans level to maximize holding capacity.
- .9 Fill sumps and drip pans with water to demonstrate strength, level and waterproof, when requested by Engineer.

### **3.6 LEAKAGE TESTS**

- .1 Conduct tests in accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
- .3 Coordinate testing requirements with the TAB contractor who will perform leakage tests. Provide temporary caps and make duct modifications required to conduct the tests.
- .4 Do leakage tests in sections.
- .5 Leakage testing shall include HVAC equipment and terminal units. Where sections include equipment and terminal units, do not perform leakage testing until final connections have been made.
- .6 Conduct trial leakage tests to demonstrate workmanship.
- .7 Do not install additional ductwork until trial tests have been passed.
- .8 Complete testing before installation of insulation or concealment Work.
- .9 Give seven days' advance notice for testing.



**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

.1 Section Includes:

- .1 Materials and installation for duct accessories including flexible connections, access doors, turning vanes, balancing dampers, pressure gauges and thermometers.

**1.2 REFERENCES**

.1 Air Movement & Control Association International Inc.

- .1 AMCA Standard 500-D, Laboratory Methods of Testing Dampers for Rating.
- .2 AMCA Standard 511, Certified Ratings Program for Air Control Devices.

.2 Canadian Standards Association (CSA International)

- .1 CAN/ULC-S109M, Standard for Flame Tests of Flame-Resistant Fabrics and Films.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

- .1 HVAC Duct Construction Standards - Metal and Flexible.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.4 CLOSEOUT SUBMITTALS**

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**PART 2 PRODUCTS**

**2.1 GENERAL**

.1 Manufacture in accordance with SMACNA HVAC Duct Construction Standards.

.2 General: construction and air tightness suitable for duct air velocities and pressure class. The following are minimum requirements. Provide additional features where required to suit the Work.

**2.2 FLEXIBLE CONNECTIONS**

.1 Frame: 75 mm wide galvanized sheet metal frame, 0.7 mm thick, with fabric clenched by means of double locked seams.

- .2 Material:
  - .1 Indoor application: fire-resistant, self-extinguishing, neoprene-coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, 0.63 mm thick, and density of 1.02 kg/m<sup>2</sup>. Meets the flame-resistance requirements of CAN/ULC-109M.
  - .2 Outdoor application: fire-resistant, self-extinguishing, DuPont 'Durolon'-coated glass fabric, temperature rated at minus 40 degrees C to plus 120 degrees C, 0.61 mm thick, and density of 0.81 kg/m<sup>2</sup>.

## 2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: closed cell neoprene, continuous, between door and frame.
- .4 Hinges: steel, zinc-plated, piano type, 90 mm wide x 90 mm minimum length unless otherwise specified.
- .5 Sash Locks: steel, zinc-plated, cam type.
- .6 Handles: corrosion-resistant zinc-aluminum alloy, steel and sponge shaft washers, inside and outside handles, plain finish.
- .7 Hardware:
  - .1 Up to 300 mm on hinge (long) side: continuous piano hinge and one sash lock.
  - .2 301 to 600 mm on hinge (long) side: continuous piano hinge and two sash locks.
  - .3 601 to 900 mm on hinge (long) side: continuous piano hinge and minimum three sash locks.
  - .4 901 to 1500 mm on hinge (long) side: three piano hinges and three handles.

## 2.4 TURNING VANES

- .1 Factory or shop fabricated of same material as duct.
- .2 Single Thickness Vanes:
  - .1 Use for duct heights up to 750 mm in plane of turn.
  - .2 To 400 mm duct width in plane of turn: 51 mm radius with 19 mm trailing edge, 41 mm vane spacing.
  - .3 Over 400 mm duct width in plane of turn: 114 mm radius with 41 mm trailing edge, 83 mm vane spacing.
- .3 Double Thickness Vanes:

- .1 Use for duct heights over 750 mm in plane of turn.
- .2 To 400 mm duct width in plane of turn: 51 mm radius, 41 mm vane spacing.
- .3 Over 400 mm duct width in plane of turn: 114 mm radius, 83 mm vane spacing.
- .4 Vane Runners: embossed.

## **2.5 INSTRUMENT TEST PORTS**

- .1 Cast aluminum or zinc-plated steel to suit duct material.
- .2 Heavy duty leak-proof screw cap.
- .3 Inside diameter to allow insertion of pitot tubes and other testing instruments. Length to suit insulation thickness.
- .4 Neoprene mounting gasket, flat or curved to suit duct profile.

## **2.6 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed-blade configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 150 mm.
- .4 Maximum blade length: 1200 mm. Use multi-sectional dampers for applications exceeding 1200 mm.
- .5 Bearings: pin in bronze bushings or self-lubricating nylon.
- .6 Linkage: shaft extension to accommodate insulation thickness with locking quadrant.
- .7 Channel frame of same material as adjacent duct, complete with angle stop.
- .8 Vibration-free operation.

## **2.7 VOLUME EXTRACTORS**

- .1 Factory manufactured of material compatible with duct.
- .2 Zinc-plated cold rolled steel blades and frame.
- .3 Gang-operated curved parallel blades, 25 mm blade spacing.
- .4 Controls both air flow rate and direction, pivots from full open to fully closed with blades overlapping for tight shut-off.
- .5 Key-operated mechanism for adjustment through grille face; otherwise adjusting rod with external set screw lock.

- .6 Vibration-free operation.

## **2.8 BAFFLES FOR MIXED AIR PLENUMS**

- .1 Hinged baffles with chains.
- .2 Corrosion resistant construction reinforced to prevent vibration and buckling.

## **2.9 DUCT PRESSURE GAUGES**

- .1 Magnahelic, pressure or differential pressure, with 121 mm bezel, red-tipped pointer with stops, accuracy + 2 % of full scale.
- .2 Photohelic, pressure or differential pressure, with 140 mm dial, red-tipped pointer with stops, accuracy + 2 % of full scale, complete with electromechanical high limit relay with external adjustment knobs for remote monitoring by building automation system.
- .3 Select range to provide all normal readings in the mid 50 percent of full scale.

## **2.10 DUCT THERMOMETERS**

- .1 Ducts less than 600 mm maximum dimension:
  - .1 Variable angle type with 175 mm case for locations up to 2,100 mm above the floor; 225 mm case for higher installations.
  - .2 Stem length to be 300 mm, except for ducts under 300 mm in width.
- .2 Larger ducts:
  - .1 Dial type with 2,400 mm long averaging element, element holder, and single hub duct flange.
- .3 Select range to provide all normal readings in the mid 50 percent of full scale.

# **PART 3 EXECUTION**

## **3.1 INSTALLATION**

- .1 Install air duct accessories in accordance with recommendations of SMACNA HVAC Duct Construction Standards and manufacturer's instructions.
- .2 Provide adequate access for service, adjustment, replacement of all accessories.
- .3 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
  - .2 Length of connection: 150 mm maximum.

- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 When fan is running:
  - .1 Ducting on sides of flexible connection to be in alignment.
  - .2 Ensure slack material in flexible connection.
  - .3 Material does not protrude into the duct.
- .4 Access Doors:
  - .1 Size:
    - .1 One-hand or viewing access: 200 x 125 mm minimum.
    - .2 One-hand and viewing access: 300 x 150 mm minimum.
    - .3 Two-hands and viewing access: 450 x 250 mm minimum.
    - .4 Head and shoulders access: 525 x 350 mm minimum.
    - .5 Body entry: 625 x 350 mm minimum.
    - .6 Body entry plus ladder: 625 x 425 mm minimum.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Duct coils – both sides.
    - .6 Base of every duct riser.
    - .7 To allow access for inspection and cleaning; before and after each change in direction, 15 m maximum spacing.
- .5 Instrument Test Ports:
  - .1 Number and arrangement to be determined by the TAB contractor.
  - .2 Locate to permit easy manipulation of instruments and accurate readings.
  - .3 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhaust fans.
      - .2 Inlets and outlets of other fan systems.
      - .3 Main and sub-main ducts.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 In mixed air applications in locations as approved by Engineer
      - .3 At inlet and outlet of coils.
      - .4 Downstream of junctions of two converging air streams of different temperatures.
- .6 Turning Vanes:

- .1 Construct vane edges to project tangents parallel to duct sides. Where inlet and outlet duct widths are not equal, or angle of turn is not 90 degrees, modify vane shape to comply with this requirement; submit shop drawing prior to fabrication.
- .2 Locations:
  - .1 Mitred elbows.
- .7 Balancing Dampers:
  - .1 Install quadrant handles parallel to damper blade(s).
  - .2 Splitter dampers shall be used only where approved by the Engineer.
  - .3 Where damper throttling produces excessive noise provide two dampers, duct baffle, volume extractor, or similar device to reduce noise to an acceptable level.
  - .4 Install as close as practical to main duct but at least two duct widths downstream of branch take-off. Where this is not possible use a volume extractor.
  - .5 Locations:
    - .1 Supply, return and exhaust systems: in each branch duct.
    - .2 Runouts to grilles, registers and diffusers: single blade damper regardless of whether dampers are specified as part of the air outlet assembly.
  - .6 All dampers to be vibration-free.
  - .7 Ensure damper operators are observable and accessible.
- .8 Volume Extractors:
  - .1 Volume extractor size to match dimensions of branch duct served.
  - .2 Where main duct height exceeds branch duct height provide top and bottom baffles for proper performance in accordance with the manufacturer's instructions.
  - .3 Locations:
    - .1 Diffusers and registers with short (less than two duct widths) straight branch ducts connected to main supply ducts.
- .9 Baffles for Mixed Air Plenums:
  - .1 Install where poor mixing will occur.
- .10 Duct Pressure Gauges:
  - .1 Provide a Magnahelic gauge at the discharge of each fan rated at over 472 l/s air flow rate.
  - .2 Provide a Photohelic gauge at each filter location.
  - .3 Locate where there is a minimum of turbulence.
- .11 Duct Thermometers:
  - .1 Provide one at the following locations in each air handling system:
    - .1 Outside air intake.
    - .2 Mixed air section outlet.
    - .3 Coil inlet and outlet.

- .2 Arrange averaging elements carefully to provide good duct coverage and compensate for temperature stratification.
- .3 Locate downstream of mixing locations for accurate readings.
- .4 Adjust case to facilitate reading from the floor.
- .5 Use remote mounted type where required.

**END OF SECTION**



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**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 This Section covers items common to Sections of Division 26, 27 and 28. These sections supplement requirements of Division 1.

**1.2 REFERENCES**

- .1 Definitions:
  - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
  - .1 CSA Group
    - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
    - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
  - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
    - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature, data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .4 If changes are required, notify Departmental Representative and Consultant of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.

- .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees: in accordance with General Conditions of contract.
- .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative and Consultant.
- .5 Manufacturer's Field Reports: submit to Departmental Representative and Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect equipment from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English and French.
- .4 Use one nameplate for both languages.

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

### **2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

### **2.4 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of Departmental Representative.
- .2 Porcelain Enamel signs, minimum size 175 x 250 mm.

### **2.5 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### **2.6 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates as follows:

- .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.

- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Wording on nameplates to be approved by Departmental Representative and Consultant prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. " as directed by Departmental Representative.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.

## 2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

## 2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	

Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

#### **3.2 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

#### **3.3 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

#### **3.4 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe or plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

#### **3.5 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

#### **3.6 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

### **3.7 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.8 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Circuits originating from branch distribution panels.
  - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .3 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.9 SYSTEM STARTUP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

- .2 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.

**3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specifications for related work.

**1.2 REFERENCES**

- .1 CSA International
  - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

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**Part 2 Products**

**2.1 MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper aluminum conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 and NEMA to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
  - .2 Clamp for stranded copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for TECK cable as required to: CAN/CSA-C22.2 No.18.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors cables and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
  - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2 and NEMA.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

Approved: 2008-12-31

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specifications for related work.

**1.2 PRODUCT DATA**

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

**Part 2 Products**

**2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE Jacketted.

**2.2 TECK 90 CABLE**

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Cross-linked polyethylene XLPE.
  - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables.
  - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.

**2.3 CONTROL CABLES**

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:

- .1 Insulation: thermoplastic.
- .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: solid or stranded (as required) annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors
- .3 Type: 600 V stranded annealed copper conductors, sizes as indicated:
  - .1 Insulation: TWH butyl rubber insulation type RW90 (x-link)
  - .2 Shielding: non-magnetic tape conductors.

### **Part 3 Execution**

#### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

#### **3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

#### **3.3 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

#### **3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)**

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps and hangers.

**3.5 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specifications for related work.

**1.2 REFERENCES**

- .1 CSA Group
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
  - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from inspection authority and include it with maintenance manuals.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**



Approved: 2011-12-31

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specifications for related work.

**1.2 REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

- .2 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, copper conductors, size as indicated.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

#### **3.2 INSTALLATION GENERAL**

- .1 Install connectors in accordance with manufacturer's instructions.
- .2 Protect exposed grounding conductors from mechanical injury.
- .3 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .4 Soldered joints not permitted.
- .5 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

#### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, duct systems, frames of motors, starters, control panels, building steel work, distribution panels.

#### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

#### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

Approved: 2003-12-31

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Refer to all sections of the specifications for related work.

**Part 2            Products**

**2.1                SUPPORT CHANNELS**

- .1            U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended as required.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2            Secure equipment to poured concrete with expandable inserts.
- .3            Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4            Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5            Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6            Fasten exposed conduit or cables to building construction or support system using straps.
  - .1            One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2            Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3            Beam clamps to secure conduit to exposed steel work.
- .7            Suspended support systems.
  - .1            Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2            Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8            Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9            Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10          Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative and Consultant.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specifications for related work.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.

**Part 2 Products**

**2.1 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on turned edge covers.

**Part 3 Execution**

**3.1 JUNCTION AND PULL BOXES INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

**3.2 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name and voltage and phase or as indicated.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Refer to all sections of the specifications for related work.

**1.2               REFERENCES**

- .1       Canadian Standards Association (CSA International)
  - .1       CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

**1.4               DELIVERY, STORAGE AND HANDLING**

- .1       Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

**Part 2            Products**

**2.1               OUTLET AND CONDUIT BOXES GENERAL**

- .1       Size boxes in accordance with CSA C22.1.
- .2       102 mm square or larger outlet boxes as required.
- .3       Blank cover plates for boxes without wiring devices.

**2.2               GALVANIZED STEEL OUTLET BOXES**

- .1       One-piece electro-galvanized construction.
- .2       Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

**2.3               CONDUIT BOXES**

- .1       Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

**2.4               FITTINGS - GENERAL**

- .1       Bushing and connectors with nylon insulated throats.
- .2       Knock-out fillers to prevent entry of debris.
- .3       Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4       Double locknuts and insulated bushings on sheet metal boxes.



**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Support boxes independently of connecting conduits.
- .2        Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3        For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4        Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5        Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6        Identify systems for outlet boxes as required.

**END OF SECTION**

Approved: 2006-12-31

## **Part 1            General**

### **1.1            RELATED REQUIREMENTS**

- .1        Refer to all sections of the specifications for related work.

### **1.2            REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2        CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
  - .3        CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4        CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
  - .5        CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
  - .6        CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

### **1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1        Submit cable manufacturing data.
- .3        Quality assurance submittals:
  - .1        Test reports: submit certified test reports.
  - .2        Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3        Instructions: submit manufacturer's installation instructions.

## **Part 2            Products**

### **2.1            CONDUITS**

- .1        Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

### **2.2            CONDUIT FASTENINGS**

- .1        One hole steel straps to secure surface conduits 50 mm and smaller.
  - .1        Two hole steel straps for conduits larger than 50 mm.
- .2        Beam clamps to secure conduits to exposed steel work.
- .3        Threaded rods, 6 mm diameter, to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.  
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## **2.4 FISH CORD**

- .1 Polypropylene.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Surface mount conduits.
- .4 Minimum conduit size for lighting and power circuits: 19 mm.
- .5 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .6 Mechanically bend steel conduit over 19 mm diameter.
- .7 Install fish cord in empty conduits.
- .8 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.

### **3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels, as required.
- .5 Do not pass conduits through structural members except as indicated.

- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

Approved: 2011-06-30

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specifications for related work.

**1.2 REFERENCES**

- .1 CSA International
  - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
  - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

---

**Part 2            Products**

**2.1            RECEPTACLES**

- .1    Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1      Grey urea moulded housing.
  - .2      Suitable for No. 10 AWG for back and side wiring.
  - .3      Break-off links for use as split receptacles.
  - .4      Eight back wired entrances, four side wiring screws.
  - .5      Triple wipe contacts and rivetted grounding contacts.

**2.2            COVER PLATES**

- .1    Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2    Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3    Stainless steel, vertically brushed, 1 mm thick cover plates cover plates, for wiring devices mounted in flush-mounted outlet box.

**2.3            SOURCE QUALITY CONTROL**

- .1    Cover plates from one manufacturer throughout project.

**Part 3           Execution**

**3.1            EXAMINATION**

- .1    Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
  - .1      Visually inspect substrate in presence of Departmental Representative.
  - .2      Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3      Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2            INSTALLATION**

- .1    Receptacles:
  - .1      Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2      Mount receptacles at height as indicated.
  - .3      Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .2    Cover plates:

- .1 Install suitable common cover plates where wiring devices are grouped.
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1            Refer to all sections of the specifications for related work.

**1.2            REFERENCES**

- .1            CSA Group
  - .1            CAN/CSA-C22.2 No.4-04(R2009 ), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Product Data:
  - .1            Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4            DELIVERY, STORAGE AND HANDLING**

- .1            Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
  - .1            Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2            Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
  - .3            Replace defective or damaged materials with new.

**Part 2            Products**

**2.1            DISCONNECT SWITCHES**

- .1            Non-fusible, Horsepower rated disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4 size as indicated.
- .2            Provision for padlocking in on-off switch position by 3 locks.
- .3            Mechanically interlocked door to prevent opening when handle in ON position.
- .4            Quick-make, quick-break action.
- .5            ON-OFF switch position indication on switch enclosure cover.



**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**



## APPENDIX A

### SAMPLE COMMISIONING FORMS

Project No. R.072342.001  
CSC Psychiatric Centre Bow Heat Recovery  
Saskatoon, Saskatchewan  
Issued for 100% – 02 October 2015  
Solicitation No.



# AIR HANDLING UNIT

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

### NAMEPLATE

MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

### SUPPLEMENTAL INFORMATION

--	--

### SYSTEM COMPONENTS

SYSTEM /EQUIPMENT DATA	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SERIAL NO.			

SUPPLY FAN INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SERIAL NO.			
FAN CFM			
FAN RPM			
FAN ESP/TSP			
BELT SIZE/QUANTITY			

SUPPLY FAN MOTOR INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MOTOR MANUFACTURER			
MODEL NO.			
SERIAL NO.			
HORSEPOWER/VOLTAGE/NO. OF PHASES/FULL LOAD AMPS			
INSULATION CLASS			
FRAME SIZE			
RPM			

RETURN FAN INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SERIAL NO.			
FAN CFM			
FAN RPM			
FAN ESP/TSP			
BELT SIZE/QUANTITY			

# AIR HANDLING UNIT

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

RETURN FAN MOTOR INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MOTOR MANUFACTURER			
MODEL NO.			
SERIAL NO.			
HORSEPOWER/VOLTAGE/NO. OF PHASES/FULL LOAD AMPS			
INSULATION CLASS			
FRAME SIZE			
RPM			

EXHAUST FAN INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SERIAL NO.			
FAN CFM			
FAN RPM			
FAN ESP/TSP			
BELT SIZE/QUANTITY			

EXHAUST FAN MOTOR INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MOTOR MANUFACTURER			
MODEL NO.			
SERIAL NO.			
HORSEPOWER/VOLTAGE/NO. OF PHASES/FULL LOAD AMPS			
INSULATION CLASS			
FRAME SIZE			
RPM			

ENERGY RECOVERY DEVICE	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SERIAL NO.			
AIRFLOW			
PRESSURE DROP			
EAT/LAT			

VFD INFO	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			

# AIR HANDLING UNIT

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

HP RATING			
-----------	--	--	--

COILS	SPECIFIED	SHOP DRAWINGS	INSTALLED
MODEL NO.			
EAT/LAT			
EWL/LWT			
FINS PER INCH			
NUMBER OF ROWS			
GPM			

FILTER	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
AIR VOLUME			
STATIC PRESSURE DROP			
TYPE/EFFICIENCY			
SIZE/QTY			
FACE VELOCITY			

HUMIDIFIER SECTION	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
TYPE			
LBS/HOUR			
VOLTAGE/AMPS			

DAMPERS	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
BLADE TYPE			
BLADE INSULATION			

EVALUATION			
AIR HANDLING CABINET AND GENERAL INSTALLATION	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
PERMANENT AND DURABLE NAMEPLATE LABELS AFFIXED TO UNIT			
CASING CONDITION GOOD: NO DENTS, DOOR GASKETS INSTALLED			
NO HOLES IN THE UNIT, I.E., MISSING SCREWS OR CAPS			
ACCESS DOORS CLOSE TIGHTLY, AND OPEN EASILY			
ACCESS DOORS OPEN ACCORDING TO THE PRESSURE IN CORRESPONDING SECTION AS REQUIRED			

# AIR HANDLING UNIT

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
 COMPANY: \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_  
 \_\_\_\_\_

CUSTOMER: PWGSC  
 PROJECT: R.015917.016  
 FILE NUMBER: 14097  
 DATE: \_\_\_\_\_ DD / MM / YYYY

VIEWING WINDOWS INSTALLED AS SPECIFIED			
MARINE VAPOR PROOF LIGHTS INSTALLED AS SPECIFIED			
SPECIFIED INSULATION PROPERLY ADHERED TO INTERIOR WALL			

<b>MOTORIZED DAMPER</b>	<b>VALUE</b>	<b>COMPLIES: Y / N</b>	<b>COMMENT REFERENCE NUMBER</b>
CORRECT BLADE ORIENTATION (PARALLEL/OPPOSED)			
DAMPER INSULATED AS REQUIRED			
CORRECT NON-ENERGIZED DAMPER POSITION			
DAMPERS CLOSE TIGHTLY			
DAMPER LINKAGES HAVE MINIMUM PLAY			
DAMPER STROKES 100% WITHOUT BINDING			
SPRING RETURN ACTION IS FUNCTIONAL			
DAMPER MODULATES CORRECTLY ACCORDING TO CONTROL SIGNAL			

<b>EXHAUST BACKDRAFT DAMPER</b>	<b>VALUE</b>	<b>COMPLIES: Y / N</b>	<b>COMMENT REFERENCE NUMBER</b>
DAMPER BLADES OPEN FREELY WITHOUT OBSTRUCTION			
BACKDRAFT DAMPER OPENS WHEN EXHAUST FAN IS OPERATIONAL			
THE BACKDRAFT DAMPER BLADES DO NOT RATTLE OR MAKE UNACCEPTABLE NOISE			

<b>AIR FILTRATION</b>	<b>VALUE</b>	<b>COMPLIES: Y / N</b>	<b>COMMENT REFERENCE NUMBER</b>
CORRECT FILTER TYPE(S) USED			
FILTERS INSTALLED IN CORRECT ORIENTATION			
CORRECT QUANTITY			
CORRECT SEALS INSTALLED BETWEEN DOOR AND FILTER TRACK			
NO GAPS BETWEEN FILTERS			
BLANK-OFF PLATES INSTALLED AS REQUIRED			

<b>ENERGY RECOVERY DEVICE</b>	<b>VALUE</b>	<b>COMPLIES: Y / N</b>	<b>COMMENT REFERENCE NUMBER</b>
NO BYPASS LEAKAGE PATH AROUND THE RECOVERY DEVICE			
VARIABLE SPEED DRIVE FOR ENERGY RECOVERY WHEEL			
PURGE INSTALLED IN CORRECT LOCATION			
FACE AND BYPASS DAMPERS FOR PLATE TYPE HEAT EXCHANGER OR HEAT PIPE AS SPECIFIED			
FACE AND BYPASS DAMPER IN NORMALLY OPEN ACROSS HEAT EXCHANGER AND CLOSE ON BYPASS			
THERMISTOR OR OTHER TYPE OF THERMAL OVERHEATING PROTECTION INTERLOCKED WITH MOTOR CONTROLS			

**AIR HANDLING UNIT**  
**Static Verification**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

EASILY ACCESSIBLE AND REMOVABLE			
MEASURED VOLTAGE : PHASE 1			
MEASURED VOLTAGE : PHASE 2			
MEASURED VOLTAGE : PHASE 3			
MEASURED AMPS : PHASE 1			
MEASURED AMPS : PHASE 2			
MEASURED AMPS : PHASE 3			

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

# AIR HANDLING UNIT

## Start-Up

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
 COMPANY: \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_  
 \_\_\_\_\_

CUSTOMER: PWGSC  
 PROJECT: R.015917.016  
 FILE NUMBER: 14097  
 DATE: \_\_\_\_\_ DD / MM / YYYY

### NAMEPLATE

MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

### EVALUATION

AIR HANDLING CABINET AND GENERAL INSTALLATION	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
AIR HANDLING CABINET AND GENERAL INSTALLATION			
CONNECTION BETWEEN DUCTS AND UNIT TIGHT AIRTIGHT			
SHIPPING BLOCKS REMOVED (IN PARTICULAR FAN SECTION)			
ALL CONSTRUCTION AND INSTALLATION DEBRIS CLEANED UP INSIDE UNIT			
UNIT INSTALLED ON ELEVATED AND LEVEL BASE AS SPECIFIED			
INSPECTION OF UNIT CASING: MINIMAL AIR LEAKAGE THROUGH DOORS AND JOINTS			
SUPPLY AND RETURN DUCTS CORRECTLY INSTALLED			
FLEXIBLE CONNECTIONS INSTALLED AS REQUIRED			
FLEXIBLE CONNECTIONS CONTAIN ADEQUATE SLACK			
NO TEARS IN FLEXIBLE CONNECTIONS			

ROOF CURB	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
ROOF CURB INSTALLED CORRECTLY ACCORDING TO PLANS AND SPECIFICATIONS			
ROOF CURB IS INSULATED AS REQUIRED			
CORRECT ROOF CURB HEIGHT ACCORDING TO APPROVED SHOP DRAWINGS			
UNIT SITS FLUSH ON ROOF CURB			
PROPER FLASHING AROUND THE CURB, I.E., CURB IS ADEQUATELY SEALED AND INTEGRATED TO ROOF STRUCTURE			
NO AIR LEAKAGE FROM THROUGH CURB			

FAN	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
FANS ROTATES FREELY			
FLEX CONNECTIONS INSTALLED CORRECTLY ACCORDING TO BLOWER PRESSURE (SUCTION/DISCHARGE)			
CORRECT TYPE OF VIBRATION ISOLATORS INSTALLED UNDERNEATH FAN/MOTOR BASE			
SPRING ISOLATION LOAD DISTRIBUTED EQUALLY			
PROPER FAN BELT TENSION AND DRIVE ALIGNMENT			
FAN BEARINGS ADEQUATELY LUBRICATED			
DRAIN PLUG IN FAN REMOVED			
FAN GUARDS PROVIDED WHERE NECESSARY			
CORRECT FAN ROTATION			



# AIR HANDLING UNIT

## Start-Up

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
 COMPANY: \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_  
 \_\_\_\_\_

CUSTOMER: PWGSC  
 PROJECT: R.015917.016  
 FILE NUMBER: 14097  
 DATE: \_\_\_\_\_ DD / MM / YYYY

NO UNUSUAL VIBRATION OR NOISE DURING SUPPLY FAN OPERATION			
ALIGNMENT IS CORRECT			
FAN CASING CLEANED			
INLET & OUTLET GUARDS INSTALLED			
DUCT AND FAN GEOMETRY CORRECT			
VIBRATION ISOLATORS INSTALLED AND ADJUSTED			
STARTERS & DISCONNECTS INSTALLED			
DISCONNECT LOCATION CORRECT			
INTERLOCKS INSTALLED			
THERMISTOR OR OTHER TYPE OF THERMAL OVERHEATING PROTECTION INTERLOCKED WITH MOTOR CONTROLS			
EASILY ACCESSIBLE AND REMOVABLE			
MEASURED VOLTAGE : PHASE 1			
MEASURED VOLTAGE : PHASE 2			
MEASURED VOLTAGE : PHASE 3			
MEASURED AMPS : PHASE 1			
MEASURED AMPS : PHASE 2			
MEASURED AMPS : PHASE 3			

COIL	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
CORRECT COUNTERFLOW SUPPLY/RETURN CONNECTIONS (SUPPLY ENTERING ON THE BOTTOM CIRCUIT LEAVING SIDE OF COIL AND RETURN LEAVING ON TOP CIRCUIT ON THE ENTERING SIDE OF COIL)			
CONTROL VALVE IS THE CORRECT TYPE, PROPERLY ORIENTED, AND IS ACCESSIBLE FOR MAINTENANCE			
ISOLATION AND BALANCING VALVES INSTALLED, CORRECT TYPE, PROPERLY ORIENTED, AND IS ACCESSIBLE FOR MAINTENANCE. DOES NOT OBSTRUCT COIL REMOVAL			
STEAM TRAPS ARE THE CORRECT TYPE, AND STRAINER IS INSTALLED. ISOLATION VALVES INSTALLED. UNIONS INSTALLED FOR SERVICE AND REPLACEMENT. STEAM TRAP MONITORS INSTALLED, IF APPLICABLE.			
AIR VENT LOCATED ON RETURN CONNECTION/DRAIN LOCATED ON THE SUPPLY CONNECTIONS			
VACUUM BREAKERS INSTALLED ON STEAM COILS			
CORRECT FIN TYPE AND SPACING			
FINS UNDAMAGED			
ACCESS ADEQUATE FOR COIL CLEANING AND INSPECTION			
ADEQUATE SPACE TO REMOVE COIL			
SUITABLE TRANSITIONS UPSTREAM AND DOWNSTREAM OF COIL			
COIL CORROSION RESISTANT COATING APPLIED AS REQUIRED			

# AIR HANDLING UNIT

## Start-Up

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

DX COIL	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
PROPER TRANSITION BETWEEN UPSTREAM AND DOWNSTREAM COMPONENTS			
THERMAL EXPANSION VALVE INSTALLED IN CORRECT LOCATION			
CORRECT SETTING FOR THERMAL EXPANSION VALVE INSTALLED IN CORRECT LOCATION			
CIRCUITING IS CORRECT			
EVAPORATOR COIL FINS UNDAMAGED			
CONDENSER COIL FINS UNDAMAGED			
COIL CORROSION RESISTANT COATING APPLIED AS REQUIRED			
CONDENSATE DRAIN PAN ADEQUATELY SLOPED			
ADEQUATE HEIGHT TO INSTALL DRAIN TRAP			
CONDENSATE PAN CLEAN & DRAINS PROPERLY			

HUMIDIFIER	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
PERMANENT AND DURABLE NAMEPLATE LABELS AFFIXED TO HUMIDIFIER			
CASING CONDITION GOOD			
CLEARANCE PROVIDED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS			
HUMIDIFIER PROPER SECURED TO STAND, AND STAND BOLTED TO FLOOR OR WALL			
HUMIDIFIER INSTALLED LEVEL			
WATER SUPPLY MANUAL SHUT-OFF VALVE PROVIDED			
INTERNAL DRAIN WATER COOLER INSTALLED AS PER LOCAL CODES			
ALL CONDENSATE RETURN LINES ARE CORRECTLY TRAPPED ACCORDING TO MANUFACTURER'S RECOMMENDATION.			
ALL HOSE CLAMPS TIGHTLY INSTALLED			
HIGH HUMIDITY CUT OUT SENSOR CORRECTLY LOCATED			
HUMIDITY SENSOR PROPERLY LOCATED			

ENERGY RECOVERY DEVICE	VALUE	COMPLIES: Y / N	COMMENT REFERENCE NUMBER
THERMISTOR OR OTHER TYPE OF THERMAL OVERHEATING PROTECTION INTERLOCKED WITH MOTOR CONTROLS			
EASILY ACCESSIBLE AND REMOVABLE			
MEASURED VOLTAGE : PHASE 1			
MEASURED VOLTAGE : PHASE 2			
MEASURED VOLTAGE : PHASE 3			
MEASURED AMPS : PHASE 1			
MEASURED AMPS : PHASE 2			
MEASURED AMPS : PHASE 3			

**AIR HANDLING UNIT**

**Start-Up**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**AIR HANDLING UNIT**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

**SHEET INTENTIONALLY LEFT BLANK FOR INDIVIDUAL TO POPULATE AS NEEDED**

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**BUILDING SYSTEM INTEGRATION**  
**Static Verification**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_

CUSTOMER: PWGSC

COMPANY: \_\_\_\_\_

PROJECT: R.015917.016

ADDRESS: \_\_\_\_\_

FILE NUMBER: 14097

\_\_\_\_\_

DATE: DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE	ALL RELATED EQUIPMENT AND SYSTEMS	LOCATION	

DESCRIPTION	RELATED SYSTEMS	POWER REQUIREMENTS	OPERATION TESTED & VERIFIED

GENERAL COMMENTS:

POSITION/TITLE	SIGNATURE	DATE

**BUILDING SYSTEM INTEGRATION**

**Start-Up**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

**SHEET INTENTIONALLY LEFT BLANK FOR INDIVIDUAL TO POPULATE AS NEEDED**

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

## Functional Performance Testing



NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_

DATE: DD / MM / YYYY

**SHEET INTENTIONALLY LEFT BLANK FOR INDIVIDUAL TO POPULATE AS NEEDED**

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

# CABLES, LOW-VOLTAGE, 600V MAX

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

NAMEPLATE				
OPERATING VOLTAGE			INSTALLED IN	
LENGTH			AGE	
SIZE			MANUFACTURER	
INSULATION TYPE			INSULATION THICKNESS	
# OF CONDUCTORS			CONDUCTOR MATERIAL	
RATED VOLTAGE			NUMBER OF SPLICES	
SYSTEM	<input type="checkbox"/> GROUNDED	<input type="checkbox"/> UNDERGROUNDED	CABLE TERMINATION POINT	
	<input type="checkbox"/> RESISTANCE GROUND		CONNECTED EQUIPMENT	
ISOLATED CABLE	<input type="checkbox"/> YES	<input type="checkbox"/> NO		<input type="checkbox"/> POT FUSES

DESCRIPTION	INSPECTED	N/A	COMMENTS
* CABLE DATA COMPARES WITH DRAWINGS & SPECIFICATIONS			
PHYSICAL DAMAGE ON EXPOSED SECTIONS			
COMPRESSION-APPLIED CONNECTORS			
CORRECT IDENTIFICATION & ARRANGEMENT			
CABLE JACKET & INSULATION			

\* ACCEPTANCE TESTING ONLY

### ELECTRICAL CONNECTIONS VERIFIED BY:

- ☐ CONNECTION TIGHTNESS  
☐ THERMOGRAPHIC SURVEY  
☐ MEASURED RESISTANCE

EQUIP. TEMPERATURE \_\_\_\_\_ °C

Indicates Temperature Corrected Reading to 20°C

INSULATION TESTS	<input type="checkbox"/> MEG-OHMS	<input type="checkbox"/> MICRO-AMPS	RESISTANCE TCF			
	KV	TIME (min)	PHASE A	PHASE B	PHASE C	NEUTRAL
PHASE-TO-GROUND						

BOLTED CONNECTION RESISTANCE	<input type="checkbox"/> MICRO-OHMS	<input type="checkbox"/> MILLI-OHMS	RESISTANCE TCF				
	FROM	TO	PHASE A	PHASE B	PHASE C	NEUTRAL	GROUND



**CABLES, LOW-VOLTAGE, 600V MAX**  
**Static Verification**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**CABLES, LOW-VOLTAGE, 600V MAX**  
**Start-Up**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

**SHEET INTENTIONALLY LEFT BLANK FOR INDIVIDUAL TO POPULATE AS NEEDED**

**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**CABLES, LOW-VOLTAGE, 600V MAX**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

# CONTROL POINTS

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CUSTOMER: PWGSC

PROJECT: R.015917.016

FILE NUMBER: 14097

DATE: \_\_\_\_\_ DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SIZE			
SERIAL NO.			

I/O Type	Point Name	Point Description	Device Installed	Point Verified	Point on OWS

### GENERAL COMMENTS:

POSITION/TITLE	SIGNATURE	DATE

**CONTROL POINTS**

**Start-Up**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**CONTROL POINTS**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

## Static Verification

NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

DATE: DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
SERIAL NO.			
TYPE			
I/O INTERFACE			
BATTERY BACKUP			

CONTROLLER INFORMATION	FIELD PANEL 1	FIELD PANEL 2	FIELD PANEL 3
MODEL NUMBER			
POINT CAPACITY			
POINTS USED			
SERIAL NUMBER			

STATIC VERIFICATION ACTIVITY	Y/N	COMMENTS	Y/N	COMMENTS	Y/N	COMMENTS
WIRING TERMINATED						
POWER CONNECTED						
EMERGENCY POWER						
WIRING IDENTIFICATION						
PANEL IDENTIFICATION						
PANEL DIRECTORY						
PANEL ACCESSIBLE						

GENERAL COMMENTS:	

<b>POSITION/TITLE</b>	<b>SIGNATURE</b>	<b>DATE</b>

# DDC FIELD CONTROL PANEL

## Startup

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

### NAMEPLATE

MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

STARTUP ACTIVITY	DDC PANEL 1		DDC PANEL 2		DDC PANEL 3	
	Y/N	COMMENTS	Y/N	COMMENTS	Y/N	COMMENTS
VERIFICATION COMPLETE						
POINTS LIST COMPLETE						
NETWORK CONNECTION COMPLETE						
CONTROL PROGRAM INSTALLED						
PANEL COMMUNICATING WITH OWS						
SENSORS CALIBRATED						
PANEL DRESSED						
DIRECTORY INSTALLED						
PANEL IDENTIFICATION INSTALLED						
PANEL CLEANED						

### GENERAL COMMENTS:

POSITION/TITLE	SIGNATURE	DATE



**DDC FIELD CONTROL PANEL**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**EXHAUST FANS**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

# EXPANSION TANK

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

EXPANSION TANK	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL NO.			
TYPE			
CRN NUMBER			
TOTAL VOLUME (L)			
ACCEPTANCE VOLUME (L)			
MAXIMUM OPERATING PRESSURE (KPA)			
MAXIMUM OPERATING TEMPERATURE (EC)			
FILL PRESSURE (KPA)			
PRV SET-POINT (KPA)			
LABELS			

EXPANSION TANK	STATUS	COMMENTS
INSTALLATION AND MOUNTING CORRECT		
SERVICE SPACE ADEQUATE		
PIPING SUPPORT AND LAYOUT		
ISOLATING VALVES INSTALLED		
RELIEF VALVE INSTALLED		
COMPRESSED AIR FILL SYSTEM INSTALLED		
PRESSURE GAUGE INSTALLED		
GAUGE GLASS INSTALLED		
BACKFLOW PREVENTER INSTALLED		
AIR SEPARATOR INSTALLED		
MAKEUP VALVE INSTALLED		
SYSTEM CONNECTION (SUCTION / DISCHARGE OF PUMPS)		
BACKFLOW PREVENTER INSTALLED, CERTIFIED AND TAGGED		
PRV INSTALLED		
COMPRESSED AIR INLET INSTALLED		
PRESSURE RELIEF VALVE INSTALLED		

## Static Verification

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_

DATE: DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

EXPANSION TANK	STATUS	COMMENTS
PRESSURE GAUGE INSTALLED		
INLET/OUTLET PIPE SIZES CORRECT		
DRAIN LINE OPERATION		
GAUGE GLASS OPERATION		
PRESSURE RELIEF VALVE SET		
BACKFLOW PREVENTER OPERATION CHECKED		
EXPANSION TANK LEVEL AND SYSTEM PRESSURE SET		
EXPANSION TANK LEVELS VERIFIED FOR COLD TO HOT WATER TEMPERATURE		
PIPE LAYOUT PERMITS TANK REMOVAL		

GENERAL COMMENTS:	

POSITION/TITLE	SIGNATURE	DATE

**EXPANSION TANK**

**Start-Up**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

**EXPANSION TANK**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

## Static Verification

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_

DATE: DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

GLYCOL MIXING & FILL TANKS	STATUS	COMMENTS
MOUNTING AS PER MANUFACTURES REQUIREMENTS		
ISOLATING VALVES INSTALLED		
DRAIN VALVE AND CAP INSTALLED		
AIR VENTS INSTALLED		
CHILLED WATER PRESSURE GAUGE INSTALLED		
GLYCOL FILL FUNNEL INSTALLED		
MAKEUP WATER CONNECTION C/W BACKFLOW PREVENTER INSTALLED/CERTIFIED		
SYSTEM FILL PRESSURE REDUCING VALVE INSTALLED		
PRESSURE RELIEF VALVE INSTALLED		
INLET/OUTLET PIPE SIZES CORRECT		
PIPE LAYOUT PERMITS TANK REMOVAL		

START-UP	STATUS	COMMENTS
DRAIN LINE OPERATIONAL		
PRESSURE RELIEF VALVE SET		
SYSTEM FILL PRESSURE REDUCING VALVE SET		
TEST RESULTS VERIFIED		

GENERAL COMMENTS:	

POSITION/TITLE	SIGNATURE	DATE

**GLYCOL MIXING FILL TANKS**

**Start-Up**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE



**GLYCOL MIXING FILL TANKS**

**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
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**GENERAL COMMENTS:**

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NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

DATE: DD / MM / YYYY

NAMEPLATE			
MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

HYDRONIC COILS	HRC-1	HRC-2	HRC-3	HRC-4		
PIPING CORRECT						
PIPING IDENTIFIED						
PIPING INSULATED						
DRAIN AND CAP INSTALLED						
AIR VENT INSTALLED						
CONTROL VALVE OPERATION						
SHUT OFF VALVE INSTALLED						
ACCESS DOORS INSTALLED						

START-UP	HRC-1	HRC-2	HRC-3	HRC-4		
ENTERING AIR TEMPERATURE AT MAXIMUM AIR FLOW						
EXITING AIR TEMPERATURE AT MAXIMUM AIR FLOW						
SPECIFIED CAPACITY						
CALCULATED CAPACITY						
NOISE ACCEPTABLE						

GENERAL COMMENTS:	

<b>POSITION/TITLE</b>	<b>SIGNATURE</b>	<b>DATE</b>

HYDRONIC COIL

Start-Up

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

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GENERAL COMMENTS:

POSITION/TITLE	SIGNATURE	DATE

**HYDRONIC COIL**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
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**GENERAL COMMENTS:**

POSITION/TITLE	SIGNATURE	DATE

# PUMP

## Static Verification

REVISION #: \_\_\_\_\_

NAME: \_\_\_\_\_  
COMPANY: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: PWGSC  
PROJECT: R.015917.016  
FILE NUMBER: 14097  
DATE: \_\_\_\_\_ DD / MM / YYYY

### NAMEPLATE

MANUFACTURER		EQUIPMENT NO.	
SERVICE		LOCATION	

PUMP	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			
MODEL			
SERIAL NO.			
PUMP CAPACITY (USGPM)			
PUMP HEAD (FT)			
PUMP RPM			
PUMP CURVE NO.			

PUMP	STATUS	COMMENTS
SPECIFICATIONS		
RECOMMENDATIONS		
PUMP IS LEVEL		
MOTOR & PUMP ALIGNED (ALIGNMENT REPORT ATTACHED)		
PUMP BASE GROUTED		
PUMP HAS ADEQUATE SERVICE SPACE		
RECOMMENDED		
PRESSURE GAUGES INSTALLED		
OF FLOW CORRECT		
VALVES & STRAINERS INSTALLED		
BEARINGS LUBRICATED		
NAMEPLATE IS VISIBLE		
VIBRATION ISOLATORS CORRECT		
PIPE ARRANGEMENT & SUPPORT		
CUNO FILTER FULL AND VALVES OPEN		
PIPING IDENTIFICATION INSTALLED		
STRAINERS / PARTICLE FILTERS		
CHEMICAL FEEDER		
COUPLING GUARD		
LIFTING HOOKS FOR MOTOR INSTALLED		
NAMEPLATE HEAD (FT)		
OPERATION TYPE (PARALLEL/SINGLE)		
OPERATION & MAINTENANCE		

MOTOR	SPECIFIED	SHOP DRAWINGS	INSTALLED
MANUFACTURER			

## Static Verification

NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

DATE: DD / MM / YYYY

START-UP	STATUS	COMMENTS
IMPELLER & MOTOR ROTATION CORRECT		
OPERATION FROM ECMS VERIFIED		
OPERATED FOR 12 HOURS CONTINUOUSLY		
WORN PART & SEALS REPLACED IN PUMPS USED FOR CLEANING		
NO LEAKAGE FROM MECHANICAL SEALS.		
NET POSITIVE SUCTION HEAD CHECKED/CALCULATED		
AIR FLOW FOR MOTOR COOLING		

GENERAL COMMENTS:	

POSITION/TITLE	SIGNATURE	DATE

**PUMP**  
**Start-Up**

REVISION #: \_\_\_\_\_

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**PUMP**  
**Functional Performance Testing**

REVISION #: \_\_\_\_\_

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Public Works and  
Government Services  
Canada

Travaux publics et  
Services gouvernementaux  
Canada

BOW HEAT RECOVERY  
CSC REGIONAL PSYCHIATRIC CENTRE  
SASKATOON,  
SASKATCHEWAN

PROJECT NO. R.072342.001

Canada





7 NEW AID HANDLING UNIT 4



